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ENCYCLOPÆDIA BRITANNICA.

MILAN.

Milan (the ancient *Mediolanum*, Italian *Milano*, and German *Mailand*), a city of Austrian Italy, and capital of the Lombardo-Venetian kingdom, is situated on the small river Olona, in N. Lat. 45. 27. 35., and E. Long. 9. 5. 45. It stands nearly in the centre of the extensive fertile plain of Northern Italy, at an almost equal distance from the lower range of the Alps and from the Po, and about midway between the rivers Ticino (*Ticinus*) and Adda (*Addua*), with the former of which it is connected by means of the canal called Naviglio Grande, and with the latter by the canal of the Martesana. (For an account of the foundation and early history of Milan, see Mediolanum.)

During the Gothic wars, Milan having espoused the Greek cause, was besieged and taken by the Goths under Uraia, a nephew of Vitiges, who, according to Procopius, put to the sword 300,000 of its male inhabitants, and reduced the women to slavery. From this great blow it did not recover for centuries. The metropolitan see was the only thing that it preserved of its former power and splendour. Under the Longobard kings it was the residence of one of the dukes appointed by Alboin, but it remained without any importance. Towards the end of the ninth century Archbishop Anspertus partially repaired its ancient walls. As late, however, as the tenth century much of the space inclosed within them was occupied by cultivated fields; the squares were used as meadows; most of the houses were of thatched wood; and, according to the quaint expression of its old historian, Landulphus senior, there was no good form of government, *ob nimiam hominum raritatem*.

In the year 924, however, Pavia having been captured and plundered by the followers of King Berengarius, many of its inhabitants repaired to Milan, which from that time began again to rise rapidly to prosperity. In 945 a diet was held in the city for the first time, by which Lotharius was elected king of Italy; and in 961 the Emperor Otho the Great was crowned as king of Italy in its old church of Santo Ambrogio. At the beginning of the 11th century (1042) a feud between the lower classes and the nobles, with the archbishop at their head, ended in the expulsion of the latter from the town for two years. In 1066 the introduction of the celibacy of the clergy by Gregory VII. (Hildebrand) gave rise to great discords; yet Milan went on increasing in population and importance. It appointed *Consoli* for its government; and in the following century had so far asserted its independence, that the Emperor Frederic Barbarossa determined to reduce it to obedience. He descended into Italy in 1158, and soon obliged the Milanese to acknowledge his authority, on a stipulation from him that they should be allowed to elect their own consuls. Frederic, however, did not keep the terms which had been agreed to, but claimed by his agents the appointment of a *Podestà*, who should govern Milan in his name and under his authority. As those agents were driven out of the town, on the 16th April 1159, he passed a sentence by which the Milanese were condemned to slavery and their property to plunder. In 1161 he surrounded the town, and after a seven months' siege, compelled the inhabitants to surrender, and razed the city to the ground. Frederic was so proud of this achievement, that many of his diplomas were dated "*Post destructionem Mediolani.*"

The fate of Milan awoke the sympathy and excited the indignation of the Lombard towns. Prompted by Pope Alexander III., who was at war with the Emperor, and aided by the agency of the friars, who were the unsuspected means of communication, they resolved to combine together for mutual protection. Deputies from the principal towns secretly assembled in the monastery of Pontida, near Bergamo, on the 7th of April 1167, and laid the foundation of a celebrated confederation known in the history of Italy as the *Lega Lombarda*. By the first article of the league they bound themselves to the restoration of Milan. Accordingly, whilst the Emperor was in the Romagna, the citizens of Cremona, Brescia, Bergamo, Mantua, and Verona marched towards Milan, and on the 27th April 1167, headed by a friar who carried the ensigns, escorted the Milanese home who had been dispersed among the neighbouring villages, and aided them in repairing the houses and raising the walls of their ruined town. On the first news of what

had happened, the Emperor hastened back to Lombardy, but the allied forces were so numerous that he found himself obliged to retire to Germany through Savoy, the only road that remained open to him. At the instigation of the town of Pavia, the Count of Savoy and the Marquis of Monserrat, Frederic again descended into Italy with a large army in 1174; but after a fruitless siege of the new town of Alexandria, he was met by the army of the League near Legnano, and completely defeated on the 29th of May 1176. At length the peace of Constance, June 25, 1183, secured the liberties of the Lombard towns.

The internal constitution of Milan at this time was framed of elements so discordant, that they must soon have led to the gradual centralization of power in a single person. The nobles were divided into two classes: the upper class had a council of 300, called *Credenza de' Consoli*, for out of them the consuls were chosen; the lower had their own council of 100 members, called *La Motta*. The rest of the people in 1198 constituted themselves into a body, and appointed a council of 500, which was called *Credenza di Santo Ambrogio*. As the supreme power resided in the union of these three councils, and their proceedings were not directed by any settled rules, it was so difficult to carry on the machinery of government, that they had recourse at length to a *Podestà*, or dictator, generally a native of another town, whose office was annual, and who had full power over the life and property of all the inhabitants. The first dictator was appointed in 1186.

The Emperor Frederic II., following the steps of his grandfather Frederic I., tried to subdue Milan. In 1237 he defeated the Milanese near Cortenova; and again, in 1239, invaded their territory with a large army, which was completely routed. In 1245 he renewed his attacks, but was unsuccessful.

Milan might now have enjoyed freedom and prosperity, but the civil dissensions between the people and the aristocracy, which had been kept in check by fear of the common enemy, were soon renewed, and led eventually to the complete extinction of their liberties. Out of gratitude to Pagano della Torre, Lord of Valsassina, who, after the defeat of Cortenova, had saved the remains of the army, the people chose him as *Podestà*, to protect them against the nobles; and at his death in 1241 they appointed in his place his nephew Martino della Torre, to whom they gave the title of *Anziano* (elder) *della Credenza di Santo Ambrogio*, with power to impose taxes. Martino formed a registry of all the lands and their owners; and in 1248 for the first time introduced the land-tax into the Milanese territory. Before his death he obtained a decree that his brother Philip should be named *Podestà* for life; but as Philip died after a short time, Napoleone, or Napo della Torre, a son of Pagano, was appointed *Anziano* for life. Under this humble name Napo was the despot of Milan; and in 1273 he obtained the dignity of Imperial Vicar from the Emperor Rudolph of Hapsburg, the founder of the House of Austria. Whilst in the full enjoyment of his power, many nobles whom he had persecuted and driven from Milan, led by an exile, Ottone Visconti, the Archbishop of Milan, surprised him, and made him prisoner at Desio on the 21st January 1277. Ottone was proclaimed lord of Milan, and with him originated the subsequent power of his house. Napo ended his days in an iron cage on the 16th August 1278.

With the exception of nine years, from 1302 to 1311, during which Mosca and Guido della Torre succeeded in restoring their family influence, the Viscontis, without having the name, were actually the sovereigns of Milan from 1277 to 1447, the year of the death of Filippo Maria, the last of that house. Their power was marked by tyranny and great cruelties. Azone and Giovanni were the only members of the house who showed any virtues. Many of them came to a violent end. Galeazzo I. died of an illness contracted whilst in prison; Stefano died of poison; Marco was thrown out of a window; Luchino was poisoned by his own wife; Matteo II. was murdered by his brothers; Barnabo died of poison whilst imprisoned at Trezzo; and Giovanni Maria was murdered at the age of twenty-four. Giovan Galeazzo, called Count of Virtù, from a fief in France which his wife Isabella brought as dower, having obtained in 1395 the creation of his estates into a dukedom by the Emperor Wenzel, was the first of the family who bore the title of duke. Filippo Maria having died without legitimate offspring, the Milanese tried to restore the republican form of government; but after three years they were compelled by famine to surrender to Francesco Sforza, who had married Bianca Maria, a natural daughter of Filippo. Sforza entered Milan on the 26th February 1450, and was proclaimed duke. He transmitted his power to his descendants, who held it till 1535, the year in which the last of them, Francesco II., died without issue. At the extinction of this line, Milan and its duchy were a subject of contention between King Francis I. and the Emperor Charles V. In 1455 the Emperor agreed to give his daughter Maria in marriage to the Duke of Orleans, second son of Francis, with the duchy of Milan as her dower; but the untimely death of this prince having left the succession again open, Charles V., on the 5th July 1546, gave the duchy to his son Philip, afterwards Philip II. of Spain.

The history of Milan and its duchy, after it became a Spanish province, has already been sketched in this work under ITALY, and more especially under LOMBARDO-VENETIAN KINGDOM. An account of the events of which Milan was the scene in 1847–50 will be given under the head SARDINIA.

Milan was desolated several times by the plague, but never so severely as in 1630, when it lost 140,000 of its inhabitants. A powerful and heart-rending description of that fearful visitation may be found in Manzoni's well-known novel, *The Promessi Sposi*.

The modern town is nearly of a circular figure; it is walled and protected by a citadel built by Francesco Sforza, enlarged by Philip II., and much strengthened by the Austrians since 1849. The whole compass of the wall is nearly 7¼ English miles; and just outside of it runs a road called *Strada de Circonvallazione*. The town has an area of 8,182,389 square metres, one-half of which is occupied by 5114 houses; one-fourth by 348 streets, lanes, &c., and 64 squares; and one-fourth by gardens. Its average height above the sea is 450 feet. The longest part, from the Porta Romana to the Porta Sempione, is about 3600 yards; and the broadest part, from the Porta Ticinese to the Porta Orientale, is 3200 yards. The wall is furnished with ten gates, some of which are the most striking objects of the city. The most remarkable of these is the Porta Ticinese, which resembles the entrance to a Roman temple. It is built of granite, and consists of colossal columns of the Ionic order, with an appropriate entablature; and in connection with it is the fine bridge over the Naviglio Grande. The *Arco della Pace*, begun by Eugene Beauharnais in 1807, from a design of the Marquis Cagnola, was called originally *Arco del Sempione*, and was intended to celebrate Napoleon's victories in Germany and Italy. At the fall of Napoleon in 1814 it had scarcely risen to the impost of the smaller arches. In 1816 the works were resumed by the Austrians, who gave it its present name to commemorate the return of the peace, and changed the destination of the sculptures that ornament it. It was finally completed and inaugurated in 1838, at the time of the coronation of the Emperor Ferdinand II. The columns, of 6 feet in circumference and 40 feet in height, formed out of a single block of marble, are its most distinguishing ornaments. The arch resting on them, of a breadth nearly equal to that of Constantine, is

ornamented with a car of bronze, to which six horses are harnessed, and in which the goddess of victory is seated. The whole building is of white marble, with the figures and bas-reliefs of bronze. The total cost was L.142,840.

There are in Milan few piazzas or squares, and none either large, fine, or even regular. The Piazza del Duomo is long, but narrow and disfigured by the booth-like shops and buildings that surround it. The Piazza de' Mercanti, though small, is remarkable as containing some remains of ancient Milan, and has in its centre a portico where the traders assemble. The Piazza Fontana has a fine fountain, with two excellent figures in marble. The Piazza d'Armi, formerly the Foro Bonaparte, is the best promenade in Milan. It is planted with trees, and is about 600 yards long and 540 broad. The streets of Milan are generally narrow and crooked, and rather gloomy from the height of the buildings. The Corso, or High Street, is an exception. It runs through the whole city, is nearly 2¼ miles in length, is of great breadth, and on both sides has magnificent and lofty houses. The streets are kept clean, and the pavement, which is composed of small pieces of marble or of granite, is far better than is usually seen in towns on the Continent.

Amongst the public buildings the *Duomo* or cathedral is the most remarkable. Next to St Peter's at Rome, it is the largest church in Italy. It is 486 feet in length, 288 feet in breadth between the transepts, and 252 in the body; the height of the crown of the vaulting of the nave is 153 feet, and of the highest pinnacle 355 feet. This vast edifice, dedicated to St Charles, was commenced so long ago as the year 1386. Under Napoleon large sums were drawn from the public revenue and applied to this structure; and since the restoration of the Austrian government 12,000 francs, or about L.500, have been paid monthly till the completion of the edifice. It is now almost completed. The outside of the church, which is wholly of white marble, and which in several places had become black from the weather, has been well rubbed, and now appears quite as white as the newer parts. There is no place from which a good view of this cathedral can be obtained. On three sides it is shut in by narrow streets, and only the majestic front, with its five colossal entrances, can be seen from the Piazza del Duomo. The general style of the building is Gothic; but in many of its details it is mixed with incongruous ornaments that detract from its beauty. A vast collection of figures from the hands of the most eminent statuaries, to the number of more than 5000, are placed upon the walls, Gothic turrets, and pinnacles. They are images of various saints, all as large as life. Richly-ornamented galleries, with finely-carved volutes and roses, extend from the one tower to the other. The roof, which is a remarkable work of art, is reached by a winding staircase of two hundred steps, from which the labyrinth of pillars surrounding the spectator has a most singular effect. In the centre of the roof rises the majestic dome, on which is placed a bronze statue of the Virgin Mary. The church has five entrances, leading to a like number of divisions, which are formed by fifty-two octagonal marble pillars 86 feet in height, and bound together at the top by Gothic arches. The altars are numerous and richly ornamented, and along the floor a meridian line was drawn in 1786. The floor is composed of pieces of marble of different colours formed into various ornamental figures. The entrance to this edifice is very imposing, and the panorama from the top is one of the finest in Italy.

The other ecclesiastical edifices are numerous, and most of them of great interest. The Basilica of *St Ambrogio* is the most ancient mediæval structure in Milan. It was founded by St Ambrose in the year 387, and dedicated to SS. Gervasius and Protasius, and afterwards rebuilt in its present form by Archbishop Anspertus in the ninth century. Though repaired in 1631, its original features were preserved unaltered. It is a kind of museum for the history of the arts; and the gold and silver facing of the high altar is one of the most remarkable monuments of goldsmith's art in the ninth century. The church of *St Eustorgio*, near the Porta Ticinese, rebuilt in the thirteenth century, is the most interesting repository of family monuments in Milan, though many of them were greatly defaced by the French at the end of the last century. *St Lorenzo*, rebuilt in the sixteenth century upon the plan of St Vitale at Ravenna, contains several fine pictures. *Sta. Maria presso San Celso*, or *La Madonna*, is a magnificent building, and one of the richest churches in Milan. *St Fedele* unites simplicity with great extent. *St Carlo Borromeo* was built in 1838 by contribution raised amongst the inhabitants after the first invasion of the cholera.

The celebrated fresco-painting of the "Last Supper," by Leonardo da Vinci, remains in what was formerly the refectory of the Dominican convent annexed to the church of *Sta. Maria delle Grazie*. It has been ruined by neglect and repainting; while the saline efflorescence which has extended itself over the wall on which it is painted has destroyed the glow of the colours, and in many places the paint has peeled off, whilst in others it is covered with mould.

Several of the civic buildings are deserving of notice. The royal palace, though the residence of the viceroy, has by no means an imposing exterior. It contains the magnificent throne apartment and the fresco-paintings of Appiani. The palace of the archbishop is a fine piece of architecture, with an admirable collection of paintings. The *Broletto*, or town-hall, is an extensive building with two courts and colonnades, erected by Filippo Maria Visconti for the Count of Carmagnola. Besides these edifices, the palaces of the families Litta, Melzi, Borromeo, Trivulzi, Vismara, Pozzi, and numerous others, are of great extent as well as of various kinds of architecture, and contain many valuable paintings.

The institutions devoted to science, literature, and the fine arts are the most distinguishing objects on which the Milanese can pride themselves. The Ambrosian Library, founded by Cardinal Borromeo, contains about 100,000 printed books, great part of which are arranged in a lofty hall, and about 18,000 MSS. bound into 5500 vols. Many of the MSS. were brought from the suppressed monastery of Bobbio, and are celebrated for the *palimpsests* discovered among them by Angelo Mai. In connection with the library are apartments containing collections of pictures and of statuary, both of great merit. The Brera, formerly the college of the Jesuits, and, still earlier, of a brotherhood called *Umiliati*, is devoted to science, and is connected with the university of Pavia. The interior square of the building is surrounded with colonnades—on the ground floor composed of Doric, and on the upper floor with Ionic pillars, forming open halls. The tower of this edifice is employed as an astronomical observatory, and the garden is made use of for the purposes of botany. The ground floor is adapted for lecture-rooms, and the upper floor contains a library of more than 125,000 volumes and numerous valuable manuscripts. Adjoining it is the picture gallery, containing many excellent productions, especially some most valuable fresco-paintings, which have been preserved and removed from the churches and monasteries in and around the city. On the upper storey are apartments containing numerous casts of ancient and modern sculpture in plaster of Paris, and also a collection of coins and medals. Besides these public institutions, there are many collections of old and valuable works in the libraries Fagnani, Melzi, Reina, Litta, Archinto, Trivulzi, &c.

In this large city, where the destitute, the aged, and the infirm are very numerous, the institutions for their relief are upon a commensurate scale, and possess property to the

amount of nearly L.7,000,000. The Ospedale Maggiore, begun by Francesco Sforza in 1456, is a prodigious range of building, with a beautiful front of 450 feet in length, entered by magnificent portals. The usual number of patients contained in it is about 1600, but it can contain as many as 2000. The annual average number of patients admitted is 20,000; of deaths, 2700. With this is connected the Foundling Hospital, in which nearly 1000 children are maintained within the walls, and about 2000 are sent to board in the villages around the city. There is also a large lying-in hospital; a lunatic asylum, in which are kept generally 420 insane persons; the lazaretto, containing many small houses without the gates, as a precaution against the plague; the Trivulzi, which contains 600 poor of both sexes, above seventy years of age, who are maintained by property bequeathed to it by the noble family of that name; an orphan-house, which supports 350 young persons; and several smaller institutions. Besides these, the monks and the nuns of the order of mercy have each their benevolent establishments.

The places of amusement are both numerous and extensive. The opera-house, *La Scala*, built in 1776 on the site of an ancient church of that name, is, next to St Carlo at Naples, the largest theatre in Europe. It contains 240 boxes in six tiers, one above the other, and has seats for 800 persons in the pit, besides standing room in the centre and both sides of it, so that it is calculated to contain nearly 5000 spectators. There is also the imperial theatre of the Canobbiana, which can hold 2500 spectators; and three or four small private theatres.

The city, including the suburbs, contained in 1854 168,596 inhabitants (exclusive of the Austrian garrison), of whom 84,039 were men and 84,557 were women. They formed 37,300 families, and were classified as follows:—

Married.	Unmarried.	Do. under 18.	Widowers.	Celibacy by vow.	Total.
58,161	60,504	32,158	16,112	1661	168,596

There were among them 16,640, or 1 in 10, proprietors; 6934 employés, in actual service or pensioned off; 59,392 tradesmen, merchants, and artists; 4078 who followed liberal professions; and 10,560, or 1 in 15, were supported in the charitable institutions. 31,674 inhabitants above seven years of age, and 2893 under seven, frequented public, private, or charitable schools; giving 1 student for 5 inhabitants. The average mortality was 1 in 35. One-third of the population died under 19; one-fifth from 19 to 25; one-fifth from 26 to 40; one-eighth from 40 to 60; one-tenth from 61 to 89; only 5 died above 90 years of age.

Milan has often been called the Paris of the south. It has an appearance of wealth and industry not generally met with in Italian towns. Its chief wholesale trade consists in silk, either raw or spun, and in cheese; for the particulars of which see LOMBARDY. As Milan is a kind of metropolis to the north of Italy, and resorted to in the winter by the rich, the tradesmen are at that time of the year in full occupation; but at other seasons they find little employment, except what arises from the foreign visitors. A railway connects Milan and Venice, with the exception of a temporary break of some 15 miles between Treviglio and Bergamo; while the Turin railroad extends as far as Novara, 27 miles west of Milan. (* * *)

MILAZZO, or MELAZZO (the ancient *Mylæ*), a fortified seaport-town of Sicily, intendency of Messina, on a narrow rocky promontory on the northern coast of the island, 15 miles W. of Messina. It consists of an upper and a lower town, both irregularly built, and containing no public buildings of note. It is principally distinguished for its fortifications, its citadel, and other military works, being so strong by nature and art as to be reckoned almost impregnable. The harbour is good, and a large export trade is carried on in wine, silk, tunny, fruit, corn, and oil. The inhabitants are chiefly employed in the tunny fishery and as sailors. Pop. 8000.

MILBORNE PORT, a decayed market-town and borough of England, county of Somerset, on the Ivel, 28 miles E. by S. of Taunton. It sent two members to Parliament in the reign of Edward I.; and from Charles I. till disfranchised by the Reform Act. An ancient guildhall stands in the High Street, and the parish church is a large cruciform edifice, surmounted by a massive square tower. Leather-dressing and glove-making are the principal trades carried on. Pop. of parish (1851) 1746.

MILDENHALL, a market-town of England, county of Suffolk, on the Lark, 70 miles N.N.E. from London. The town is irregularly laid out, but the houses are generally well built. The parish church is a large and handsome edifice, with a richly carved roof and a lofty tower. The inhabitants are chiefly engaged in agriculture, and by means of the Lark, which is here navigable, there is some trade. Pop. of parish (1851) 4374.

MILETUS, a Greek city of Ionia, in Asia Minor, was situated on the northern side of the peninsula of Mt. Grion, at the entrance of the Gulf of Latmus, nearly opposite the mouth of the Mæander, from which it was 80 stadia, or 10 miles distant. At the time of the Ionian emigration to Asia Minor, Miletus was a town peopled by Carians, in whose territory it stood. It is said to have belonged originally to the Leleges, and to have been afterwards occupied by a band of Cretans, under Sarpedon the brother of Minos. When the Ionians arrived in Asia, Neleus and a company of his followers seized Miletus, put to death all the men, and took the women for their wives. Miletus thus became one of the twelve cities of the Ionian league, and was the farthest S. of their number. The town possessed four separate harbours, large and commodious, one of which was capable of containing a large fleet; and Miletus was remarkable for naval and commercial activity, and for the number of its colonies in the most distant parts of the then known world. These are said to have been in number between seventy and eighty; and the most important of them were—Abydus, Lampsacus, Parium, Proconnesus, Cyzicus, Heraclea, Sinope, Amisus, Phasis, Panticapæum, on the Cimmerian Bosphorus; Obbia, at the mouth of the Borysthenes; Istria, at the mouth of the Danube; and Naucratis, in Egypt. And though their attention was chiefly turned towards the E. and N., their ships also navigated the Mediterranean, and even passed the Pillars of Hercules. Of the internal history of Miletus in early times but little is known. According to Herodotus, it seems to have been much distracted by factions, which rose to such a height, that after a contest which had lasted for two generations, the intervention of the Persians was necessary to allay the discord. The Milesians were frequently engaged in wars with other states, both in Greece and in Asia. They assisted Eretria against Chalcis, in the contest for the sovereignty of Eubœa; and they engaged in a war between Chios and Erythræ, on the side of the former. But their most important war was that against the Lydians, from 623 to 612 B.C., when Miletus was governed by Thrasybulus, a friend of Periander of Corinth, and during the reigns of Sadyattes and Alyattes, two successive kings of Lydia. A peace was at last concluded, which left Miletus independent; although in the reign of Crœsus, the successor of Alyattes, the Milesians seem to have consented to pay tribute to Lydia; a concession which they transferred to Cyrus when he conquered that country. Miletus was afterwards governed in succession by Histiæus and Aristagoras, who contributed greatly to excite the Ionians to cast off the Persian yoke. In this revolt, which began in 500 B.C., Miletus took part; but it was taken by the Persians in 494 B.C., and its inhabitants transported to the banks of the Tigris. The town was given to the

Carians; and although it recovered its liberty after the battle of Mycale in 479 B.C., it never regained its former greatness and prosperity. The fall of Miletus gave so much concern to the Greeks, that when the poet Phrynichus made it the subject of a tragedy, the Athenians were affected to tears, forbade the piece to be represented, and imposed a heavy fine on the author. Miletus is celebrated as the birth-place of Thales, Anaximander, and Anaximenes, the principal philosophers of the Ionic school; and of Cadmus and Hecatæus, two of the earliest chroniclers of Greece.

MILFORD, a seaport and market-town of Wales, county of Pembroke, on the N. side of Milford Haven, 12 miles W.N.W. of Pembroke. The town is pleasantly situated, and well and regularly built of stone; the principal streets, three in number, run along the shore from E. to W., and other shorter ones cross them at right angles. The parish church, which is remarkable for its high tower and painted windows, is situated at the E. end of the town. The town has also a market-house and custom-house. In the neighbourhood of Milford are to be seen the remains of an old religious establishment, known by the name of Pill Priory. The town of Milford is of very recent origin, having been founded in 1790; but it rose very rapidly to be a large and prosperous town. It had a royal dockyard for building men-of-war, and an arsenal; and it was a station in the mail route to Ireland. But these sources of its prosperity did not long continue; the dockyard was transferred to the other side of the Haven, and soon after, the starting-place of the packets was also removed to the S. The town, however, still shows some activity in ship-building; and the excellent roadstead contributes much to the prosperity and importance of the town. The shipping has been largely increased by the South Wales railway, which connects this port with the principal towns in the kingdom. Milford has a considerable trade, chiefly in timber. The oysters got on this coast are excellent, and they are dredged to a considerable extent. Pop. (1851) 2837.

MILFORD HAVEN, an arm of the sea in the county of Pembroke, Wales, has its entrance towards the S., but soon turns, and stretches E. for 12 miles, from Dale near its mouth to Pembroke Ferry, with a breadth varying from 1 to 3 miles. It is one of the best harbours in Europe, being sufficiently large to accommodate the whole British navy in good anchorage, and in a sheltered position. On account, however, of its distance from the Channel, and the inconvenience of its position, it is not of so much importance, either as a harbour for men-of-war or as a commercial port, as it would otherwise be. It has numerous smaller creeks running into the land, and the scenery is in some places very beautiful; the shores being lined with gently sloping hills. There is a lighthouse at the entrance called St Anne's light, near the village of Dale. In the reign of Henry IV. a French fleet anchored in Milford Haven, with a body of 1200 men, to assist Owen Glendwr; and here also Henry VII. landed, shortly before the battle of of Bosworth Field.

MILHAU, (the ancient *Æmilianum*), a town of France, department of Aveyron, and capital of a cognominal arrondissement, is situated on the right bank of the river Tarn, 30 miles S.E. of Rodez. It is generally well built, though its streets, with the exception of the principal one, are narrow. It has tribunals of primary instance and commerce, a communal college, society of agriculture, &c.; and was one of the strongholds of the Protestants during the French religious wars. The chief manufactures are silk-twist, woollen cloth, leather, and leather gloves. It carries on a considerable trade in cheese, cattle, wool, timber, wine, fruits, &c. Pop. (1851) 9869.

MILITARY FRONTIER (*Militärgrenze*), a tract of country in the Austrian dominions, extending along the borders of Turkey from the Adriatic to Transylvania, is bounded on the N. by Croatia, Sclavonia, Hungary, and Transylvania, and S. by Bosnia, Servia, and Wallachia, having a length of nearly 1000 miles, and an area of about 16,000 square miles. This district derives its name from the military government by which it is ruled, and it serves to defend the Austrian empire against the sudden inroads of the Turks. The inhabitants are at once peasants and soldiers, and they compose a force of 45,000 men, constantly under arms in the time of peace. In 1815 there was . body of 62,000. They hold their land on condition o military service, and while at home receive no further remuneration; but when they are led to other parts they are entitled to the usual pay of the Austrian army. They are divided into 17 regiments of infantry and 1 of hussars, besides a battalion of boatmen, called *Tschaikisten*, who cruise on the large rivers of the district in boats armed with guns. Each regiment consists of two battalions that serve in turn, and the colonel of the regiment exercises civil as well as military authority. The supreme government is in the hands of the Aulic council of war (*Hofkriegsrath*) at Vienna. Under this there are four general commandos, which have their seats at Agram, Temesvar, Peterwardein, and Hermannstadt. Every male between the ages of 18 and 60 is liable to military service, and is occupied with such duties for about eight months in the year. During the remainder of their time they are employed in agriculture and pastural occupations; but, owing to the little time which they can spare from military duty, the agriculture of the district is in a very backward state. They live together in families, which possess land in common; and all the members are obliged to perform their share in the cultivation of the soil. The produce is divided equally among all the labourers; but the heads of the family receive a double share. Many of the families contain as many as eighty members. The people are for the most part of Sclavonian origin; but there are also Croatians, Servians, Wallachians, and other tribes. They are intelligent and clever, patriotic, and strongly attached to the imperial family. The first establishment of this military government was in the sixteenth century, in the reign of Ferdinand I., who settled military colonists in a part of Croatia. The system was afterwards extended and perfected, especially by Prince Eugene of Savoy towards the end of the seventeenth, and by Field Marshal Lascy in the eighteenth century. The present system of government was established in 1807. The whole country is divided into four parts,—the Croatian, Sclavonian, Hungarian, and Transylvanian Military Frontier. Pop. (1851) 1,009,109.

MILITARY or MARTIAL LAW, is that branch of the laws of war which respects military discipline, or the government and control of persons employed in the operations or for the purposes of war. Military law is not exclusive of the common law; for a man by becoming a soldier does not cease to be a citizen or a member of the British commonwealth. He is a citizen still, capable of performing the duties of a subject, and answerable in the ordinary course of law for his conduct in that capacity. Martial law is therefore a system of rule superadded to the common law, for regulating the citizen in his additional character of soldier; a temporary character assumed for a special end, and to be laid aside when that end has been attained, and when the disturbance which gave occasion to it has subsided. For, as the law knows nothing of a mere soldier, or one bred up to no other profession than that of arms, so a perpetual standing army is against the principles of the constitution, and if without consent of parliament, is clearly against law.

Throughout all Europe, in the feudal times, property was commonly held upon condition of military service; and the possessors of land were, by virtue of their right, at once its

cultivators in peace and its defenders in war. But the fetters of land under the feudal system were incompatible with a state of commerce, and the arbitrary power of lords over their vassals was adverse to civil liberty; its strictness declined; the services of tenants were commuted for money, and with money were purchased the services of mercenaries, who were ready to make war a trade. The disorders incident to the disbanding of these troops, the changes which had taken place in the mode of warfare, and the necessity of attending to the balance of power in Europe, all concurred to suggest the idea of a disciplined standing army, which was formed first in France, and then in the other states of Europe. The military despotism, however, which ensued on the continent was in this country happily prevented by the spirit of a free people; and at the Revolution it was asserted and declared, that the raising or keeping up a standing army within the kingdom, in time of peace, without consent of parliament, is contrary to law. The expediency of a standing army is admitted, and at the same time the liberties of the people are maintained. A standing army therefore exists, but primarily for the benefit, because only with the consent, of the people.

In early times the king's justiciar was *caput legis et militiæ;* at the head not only of the law, but also of the military force of the kingdom. But in England, on the division of the *aula regis*, the constable and marischal presided over a court of chivalry for the determination of matters of honour and arms. From time to time, however, other tribunals were subsequently instituted for the administration of martial law; and at length, after the Revolution, when, in addition to the militia and other local troops of the kingdom, a regular standing army was judged necessary for the safety of the realm, for the defence of the possessions of the crown, and for the preservation of the balance of power in Europe, acts were passed for the maintenance of military order and discipline. Scotland differed from England in this respect, that there was here no distribution of the powers of the lord justiciar, such as took place in England, nor was there ever any court of chivalry. In other respects the two countries were, in as far as concerns martial law, very much alike.

The first of the military acts passed after the Revolution was occasioned by a mutiny in a body of English and Scotch troops (amongst whom were the regiment of dragoons now called the Scotch Greys, and the Royal Scotch regiment of foot), on being ordered to Holland to replace some of the troops of that country which King William had brought over with him. The circumstance was communicated to parliament, and on the 3d April 1689 an act was passed for punishing mutiny, desertion, &c., which has been renewed annually by parliament down to the present day. It authorized the king to grant commissions to certain officers to hold courts-martial for the trial of crimes committed by officers and soldiers; and this act, which has been renewed from time to time, has since the Union been extended to Scotland.

An act of the same nature was passed in the parliament of England, 13 Cha. II. stat. i. c. 9, authorizing the lord high admiral to grant commission to inferior vice-admirals, &c., to assemble courts-martial for the trial of offences committed at sea by officers, marines, or others in the king's naval service. But this statute was in many points altered by subsequent enactments, till at last all the laws relating to courts-martial for the sea service were reduced into one act, applying equally to the whole United Kingdom, namely, 22 Geo. II. c. 33, explained and amended by 19 Geo. III. c. 17.

The more recent statutes for the government of the forces, naval and military, are 1 Will. IV. c. 14, 15; 2 and 3 Will. IV. c. 23, 28; 3 and 4 Will. IV. c. 5, 6; 4 and 5 Will. IV. c. 4, 5, &c. During the reign of Victoria they have been as follows:—2 and 3 Vict. c. 5; 3 and 4 Vict. c. 6 and 37; 4 and 5 Vict. c. 2; 5 and 6 Vict. c. 12; 6 and 7 Vict. c. 3; 7 and 8 Vict. c. 9; 8 and 9 Vict. c. 8; 9 and 10 Vict. c. 11; 10 and 11 Vict. c. 12; 11 and 12 Vict. c. 11; 12 and 13 Vict. c. 10; 13 and 14 Vict. c. 5; 14 and 15 Vict. c. 6; 15 and 16 Vict. c. 7; 16 and 17 Vict. c. 9; 17 and 18 Vict. c. 4; 19 and 20 Vict. c. 10; 20 Vict. c. 13; which brings down the statutes respecting military law to March 21, 1857. The judgments of courts-martial, like those of other courts, are liable to be taken cognisance of in the superior courts of common law, and the members punished for illegal proceedings, and for all wilful and corrupt abuse of authority against the known, obvious, and common principles of justice. (See Grose's *Military Antiquities;* Tytler on *Courts-Martial;* Adye on *Courts-Martial;* M'Arthur on *Courts-Martial;* and Napier's *Remarks on Military Law.*

MILITIA, from the Latin *miles*, a soldier, in its original signification, means warfare, the qualification of soldiership, or the military body. In this last signification it became incorporated with the English language. It is now used to distinguish, from the regular forces, the body of citizens who may be annually called out for a limited time, and embodied on occasions of emergency. As the system out of which the present militia has arisen existed previously to the establishment of a mercenery army, and frequently constituted the sole military organization of its time, a historical sketch of the institution will involve to a certain extent a general view of the military state of Britain during the earlier periods of our history.

Any account of the military system of the Saxons, especially when we approach the era of the Norman Conquest, becomes involved in the great question as to the extent to which feudal practices had been adopted in England previous to that event. It has, however, been distinctly ascertained, that land, amongst the Anglo-Saxons, became not only the reward of military services performed, but the stipulated wages of their continuation. Thus there came to be a connection between the performance of services to a chief and the holding of land under him; the soldier or thane possessing the land on the condition of performing military duties, but not, as by the mature usages of the feudal system, rendering the service as an incident of the tenure of the land. The grants so made were generally for a contingent period, and were revocable from a vassal unfit to perform his military engagements; and we find amongst them a species of transaction so complicated as grants to churchmen, on the condition of their making provision for the performance of the military duties they were personally disqualified from undertaking. (Sir Francis Palgrave's *Rise and Progress of the English Commonwealth; Proofs and Illustrations,* ccxx.) The oath of the vassal was personal and conditional, and had no reference to the land as a bond of union. (Allen *On the Rise and Growth of the Royal Prerogative,* Ap. xxii.) It was the duty of the superior to protect his follower, and when he ceased to do so, the vassal was relieved from obedience; but desertion was viewed as a crime of great magnitude. Those freemen who had undertaken to perform military service in return for lands were entitled, like the clients of the Romans, to select their own "Hlafords" or patrons; but this class of followers seems to have gradually decreased towards the era of the Conquest, when it would appear from Domesday-book that all land was, or was presumed to be, held of a superior. It was perhaps for the furtherance of such a principle, without the invasion of existing free rights in property, that an exception sometimes appears in favour of the tenant:—*Et poterat ire cum ea* (terra) *ad quem vellet Dominum;* intimating that he might hold his land of whatsoever lord he chose.

Whatever right the patron may have had to the exclu-

sive military services of his dependent, it undoubtedly yielded to the claim of the state to the assistance of every freeman in cases of invasion or rebellion. It is probable that when the national force, denominated the *Fyrd*, was brought into existence, the right of patronage gave the superior no further power than that of leading his dependents when they joined the general host. The approach to any decision on this point is impeded by many difficulties, arising from the incongruities in the practice of different periods and of different parts of the country, and the absence of any contemporary treatise explanatory of the general rules and the reason of the apparent exceptions. It is thus that on some occasions the right of the Hlaford to command his followers is spoken of without any reference to the paramount claims of the public, whilst elsewhere we find the community arrayed by command of the sovereign, without reference to the circumstance that two distinct classes are to appear in the field, in the respective position of patrons and vassals. "From the earliest period," says Sir Francis Palgrave, "to which our documents can reach, we find the Fyrd appearing as a general armament of the people, comprehending every rank, though under different obligations and penalties. If the *Sithcund-man*, being a landholder, remained at home, he forfeited all his land; sixty shillings was his fine; whilst thirty shillings was the *Fyrd-wite* of the churl, and to the last it continued a levy of all the population of the country." (*Proofs and Illustrations*, ut supra, cccxviii.) Sir William Blackstone and others include the national militia amongst the improvements attributed to the inventive genius of the great Alfred. The Fyrd, however, is of earlier origin. In the laws attributed to Edward the Confessor, the authenticity of which is justly doubted, though they are certainly the work of some one well acquainted with the Anglo-Saxon constitution, there are regulations for the organization and discipline of the Fyrd, probably embodying those improvements of Alfred which procured him the credit of having planned the system. These regulations adapt the arms to be provided by each freeman to a scale of wealth; forbid their being sold or pledged under penalties; provide for their descending to heirs; and appoint annual exhibitions, which, in order to baffle attempts to display the same weapons in different districts, were to take place simultaneously all over the country. (*Leges Edwardi*, apud Wilkins, sect. 35.) The command was given to district leaders called "Heretochs," who, it is stated, were like the *vice-comites* or sheriffs, elected by their respective districts in full folkmote. Sir William Blackstone observes, that the power thus vested in the people proved dangerous to the community, by erecting a rival to the royal prerogative; and he refers to this source of influence the treachery of Eric Streone, and the usurpation of Harold. Whatever the theory of the Anglo-Saxon constitution may have admitted, however, it does not appear, from the history of the period, that the voice of the people regularly influenced the command of the natural force; and undoubtedly, in the instances cited, the power unduly used had been otherwise obtained.

The Norman Conquest did not produce so much effect by altering the system so established, as by bringing the new engine of feudalism to act in concert with it. The king was then the commander of two separate forces. His feudal army was furnished by the tenants of his knights' fees, for each of which he could demand the service of one knight or of two esquires for forty days. These were his personal followers during their period of service, and were liable to be employed either at home or abroad. But the absolute demand on his services was inconvenient to the vassal, and the limitation of the period was often no less so to the king. Hence those who were partial to the occupation of war frequently remained with the army beyond their assigned period for a stipulated remuneration, whilst others got their services commuted into a money-payment, which afterwards merged into the oppressive exaction of scutage. Whilst this new species of force came into operation, the Fyrd of the Saxons still remained in existence. It afterwards was the source whence arose two distinct institutions; the *posse comitatus*, liable to be called out by the sheriff to keep the king's peace; and the militia force of the present day.

In the celebrated "assize of arms" of 1181, we find the Fyrd of the Anglo-Saxons in its original purity. All freemen are appointed to have arms in their possession, according to a scale of ranks, which consists, first, of the holders of a knight's fee; secondly, of the possessors of chattels or rents to the extent of sixteen merks; thirdly, of the holders of similar property to the value of ten merks; and, lastly, of all other burgesses and freemen (Wilkins, 296). The Fyrd, with its periodical exhibitions of arms, was recognised as late as the year 1285, when, by the statute of Winchester (13 Ed. I., st. ii., c. 6), the scale of arms assigned to the respective ranks was revised. The part of the act which enforces the keeping of arms was adjusted to the progress of the art of war in 1558 (4th and 5th Ph. and M. c. 2), and finally abolished in 1604 (1st Jac. I., c. 25, sect. 46).

Meanwhile practices commenced which gave rise to much subsequent dispute respecting the question, how far the right of the monarch to demand the military assistance of his subjects in such wars as he chose to prosecute was restricted. Many apparent anomalies in the constitution of this early period may be explained by reflecting that the Anglo-Saxon people continued to cherish certain privileges and customs which the Norman monarchs were often unable openly to abolish, whilst they were frequently powerful enough to infringe them. The annual array was an institution with which they naturally tampered, finding it their interest to amalgamate it with their feudal prerogatives. On the other hand, there were no definite limits to the prerogative, which insinuated itself wherever it was not practically checked. Accordingly we find parliament avoiding for some time any distinct recognition of the prerogative of the crown, or the privileges of the subject, and acting on the defensive against the former. Thus, by statute 1st Ed. III., c. 5, "The king wills, that no man from henceforth shall be charged to arm himself, otherwise than he was wont in the times of his progenitors kings of England; and that no man be compelled to go out of his shire but where necessity requireth, and sudden coming of strange enemies into the realm; and that it shall be done as hath been used in times past for the defence of the realm." The seventh chapter of the same statute gives redress on complaints that commissioners appointed to raise soldiers had been chargeable to the shires; and by the instructions to the sheriffs in the 10th Ed. III., stat. ii., money so exacted is directed to be returned. More decided attempts to amalgamate the assize of arms with the feudal force appear to have been opposed in 1351, when by 25th Ed. III., stat. v., c. 8, it was enacted that "no man shall be constrained to find men of arms, hobelers nor archers, other than those who shall hold by such services, if it be not by common assent and grant made in parliament."

At an early period, the crown gradually enlarged its military authority by issuing commissions of array. These writs, which were at first probably mere authorities to individuals to use the royal name and influence in collecting troops, came from practice to be viewed as emanating from the prerogative. In that anxiety to avoid collision with the crown which distinguishes many of the old acts of parliament, they are frequently alluded to without being either sanctioned or condemned. A singular instance of apparently intentional ambiguity occurs in 1st Ed. III., stat. ii., c. 15, which was avowedly passed for the relief of indivi-

duals who, at the suggestion of "false and evil counsellors," had been prevailed on by "duress" to come under burdensome obligations to perform military duties. The contracts are cancelled with a sort of oracular qualification, evidently inserted as the nominal price of a real concession: "Considering that such writings were made to the king's dishonour, sithens that every man is bound to do to the king as his liege lord all that pertaineth to him, without any manner of writing." In the fifth year of Henry IV. a statute was passed limiting the form and authority of commissions of array. It involves the anticipation of foreign invasion, empowers the commissioners in such circumstances to array and train all men-at-arms, to cause all able-bodied men to arm themselves according to their substance, to amerce those unable to bear arms in a similarly adjusted ratio, and to require the services of persons so armed on the sea-shore, or elsewhere, at the moment of danger. It is singular that this statute, which forms the only legislative authority to which Charles I. finally appealed in the celebrated struggle for the command of the militia, has never been conceived of sufficient importance to be printed in any collection of the statutes, and seems to have been accidentally discovered in manuscript by some of the crown officers (Rush. *Hist. Col.*, part iii., vol. i. 661–9). It was indeed, like the last cited statute, an act of grace, having been passed for the protection of the persons nominated as commissioners, who, according to the preamble, were liable to many penalties and forfeitures in the performance of their assigned duties. It is worthy of note, as bearing on the extent of the authority intended to be conferred by this act, that during the previous year (by 4th Hen. IV., c. 13) the enactments above referred to, checking the encroachments of the royal authority, were all jealously confirmed; the holders of lands in Wales and of military fiefs, and persons who had bound themselves by contract to perform military services, being specially excepted. During the Tudor dynasty, the declaratory limitations attempted by the old statutes were undoubtedly little respected by the crown, and forced levies were made on many occasions, when the necessities contemplated by the acts could be brought forward as a nominal justification, without being minutely questioned. A statute of the year 1558 (4th and 5th Phil. and M. c. 3) appears at first sight to give full sanction to the right of impressment; but an observation of the circumstances in which the act was to be enforced, and reference to a previous act which it professed to amend, show that it was intended for the discipline of those who had become soldiers, and to prevent their desertion. During the Long Parliament, by an act granting the temporary power of impressing as many men as the king and both houses of parliament might appoint (16th Car. I., c. 28), the limitations were again confirmed; and it was declared, that by the law of the realm the subject ought not to be impressed or compelled to go beyond his county, &c., in the same terms as the statute of the first of Edward III.

Such was the state of matters when, in the celebrated dispute between Charles I. and the parliament regarding the right to command the militia, it was maintained on the one hand that the preservation of the peace of the country, and its protection from foreign invaders, were the unalienable privileges of the crown, and involved the right to command all armies, and to demand on all occasions the military service of the lieges; and, on the other, that such privileges existed in no individual without the consent of both houses of parliament; whilst it was urged, first in the form of an ordinance, and next in that of a bill, that the king should consent to the militia being placed in the hands of commissioners named by parliament. Although the statutes above referred to show that in moments of danger the king was so far the guardian of the peace, that he was entitled to put himself at the head of the persons bound to keep themselves in readiness for such occasions, and the practice had been undoubtedly still more favourable to the prerogative, neither an act of the legislature, nor any uninterrupted train of precedents, had given the monarch the unlimited military command which he arrogated. At an unfortunate time for the adjustment of such a question, it had to be settled between the conflicting branches of the legislature; and Whitelocke at least approached the truth when he said, he apprehended "that the power of the militia is neither in the king only, nor in the parliament; and if the law hath placed it anywhere, it is both in the king and parliament, when they join together;" though the state of matters equivocally illustrated his remark in continuation, that "it is a wise institution of our law not to settle this power anywhere, but rather to leave it *in dubio*, or *in nubibus*, that the people might be kept in ignorance thereof, as a thing not fit to be known nor to be pried into." Arguments founded on precedent and the nature of the constitution were at that juncture, however, merely like the diplomatic manœuvres preceding an international war. Each party was calculating its strength for the approaching conflict; and if their respective rights were so earnestly insisted on by either side, with any other view than that of colouring the real grounds of the rupture, it was that of securing the wavering by a show of adherence to constitutional principles. In a short time each party mustered its own forces in its own way.

In the parliament which was summoned after the Restoration, effectual means were taken by two statutes (13th Car. II., c. 6, and 13th and 14th Car. II., c. 3), which probably would not have been passed by the convention parliament, to put an end to any doubts as to the prerogative on this point. It was declared, that "the sole supreme government, command, and disposition of the militia, and of all forces by sea and land, and of all forts and places of strength, is, and by the laws of England ever was, the undoubted right of his majesty and his royal predecessors;" and lieutenants and their deputies were empowered to charge their counties to provide horse and foot soldiers, according to a fixed scale of property. The system thus constructed was slightly amended in the years 1699, 1714, and 1743.

In 1756, when the large standing force, which the position of Britain rendered it expedient to keep up, was made more unpopular by the introduction of the Hanoverian mercenaries, a bill to reconstruct the militia passed through the House of Commons under the auspices of Mr Charles Townshend and his friends, but was rejected in the House of Lords by 59 to 23. With some difficulty the measure was carried in 1757; but, though approved of by a large party, its practical enforcement frequently produced discontent and local disturbance. In 1762 the system was improved, and several acts were afterwards passed amending particular departments. In 1802 the militia laws of England and Scotland were consolidated by 42d Geo. III., c. 90 and 91; and these statutes, with that of 49th Geo. III., c. 120, applicable to Ireland, and the later acts of 15th and 16th Vict., c. 50; 17th and 18th Vict., c. 13, 105 and 106; and 18th and 19th Vict., c. 1, 57, 100, and 106—contain the law applicable to the militia of the United Kingdom. Before giving such a brief selection from the many minute regulations prescribed by these statutes, as a work of general reference is expected to contain, we may be permitted to glance at the origin of the militias of Scotland and Ireland.

In Scotland there seems never to have been, except in burghs, a national force for the defence of the citizens, like the Fyrd of the Saxons. The earliest acts of parliament, however, enforce practice in the bow, of which the efficiency had been so dearly learned in the English wars; whilst periodical "wapenshawings" are directed to be held, in which each individual should be armed upon a scale

vaguely proportioned to his property. (Acts, 1424, c. 18 and 44; 1425, c. 60; 1457, c. 64; 1491, c. 31; and 1540, c. 85-91.) In time of war or rebellion proclamations were issued, charging all sheriffs and magistrates of burghs, to direct the attendants of the respective wapenshawings to join the king's host (1482, c. 90); and the criminal records contain many prosecutions for "abiding from" the various "raids," which are generally settled by composition with the lord treasurer. During the civil wars of the seventeenth century, the army which had been brought into existence by the enthusiasm of the Covenanters was supported by levies and assessments apportioned by district committees of war appointed by parliament, whose duties and powers were modelled on those of the commissioners of array in England. In 1662 (1st Car. II. 3, 27), the parliament made offer of 20,000 foot and 2000 horse to be at his majesty's sole disposal, and to be marched to any part of Scotland, England, or Ireland. This body constituted a regular standing army, the organization of which underwent some alterations in the years 1669, 1672, 1693, and 1695. From this last period no legislative improvements were made in the militia of Scotland until the year 1797, when the system established in England was partially extended to that part of the empire, though not without considerable local disturbance.

In Ireland the predatory army of *galloglasses*, which, even in times of comparative tranquillity, it was found necessary to keep constantly armed for the preservation or the enlargement of the pale, was supported to a small extent by supplies from England; but it chiefly depended on exactions from the Anglo-Irish, made by a dexterous application of the many fines and petty tributes originally exigible by the native chiefs. To these the English added the formidable exactions of coign and livery, which embracing free quarters, and all that is generally taken under the sanction of that licence, were the frequent subject of bitter complaint, though not much heeded by a government which expected that the conquest would at least support itself. (See *Irish State Papers*, published by authority of government, ii. 477, &c.) In 1715, on occasion of the rebellion in Scotland, an act was passed by the Irish parliament (2d Geo. I., c. 9) for raising a militia to consist of Protestants. Roman Catholics were subject to double rates; and all serviceable horses belonging to them might be seized and made use of, provided that within ten days the sum of L.5 (deducting the expense of seizure and keeping) was tendered to the owner of each as full payment. After several partial alterations, the militia laws were consolidated by the Irish parliament in 1793 (33d Geo. III., c. 22), and 1795 (35th Geo. III., c. 8), and accommodated to those of England in 1809.

By the present constitution of the militia in the United Kingdom the sovereign appoints lords-lieutenant in Britain, and governors in Ireland, to each county or province, with power to call out and train the militia annually, and to appoint deputy-lieutenants or deputy-governors, and other officers, subject to the royal approval. The higher officers in the militia, unless they enjoy an exemption on account of their rank in the army, require to be qualified by the possession of property. The amount varied greatly in the different departments of the United Kingdom, and being of the character of real or landed estate, was farther complicated by the different kinds of feudal tenure. From time to time there were partial legislative innovations on the purely territorial character of the qualification, and by an act passed in 1855, a uniform qualification throughout the empire, which might be in landed estate or any other property, was adopted. The qualification thus fixed is a yearly rent or value of,—for a colonel, L.600; for a lieutenant-colonel, L.400; for a major, L.300; and for a captain, L.200.

The business of balloting for and calling out the militia, commences with the annual general meeting of the lieutenancy of each county, when the next subdivision meeting is appointed, to which chief constables, or other officers, are required to direct constables or schoolmasters to return lists of all males between the ages of eighteen and thirty-five in their respective parishes. Within fourteen days after requisition, the constable or schoolmaster leaves a schedule in each dwelling-house, to be filled up within fourteen days, with the names and designations of persons within the ages, and their claims of exemption, if there be any, under a penalty of L.5. Within a month after serving the notices, the constables or schoolmasters make up, and affix to the church doors, lists mentioning exemptions and incapacities, and notifying the times and places for the discussion of appeals. These are decided by two or more deputies at the subdivision meetings, and their decisions are final. The clerks of general meetings then transmit lists to the privy council, distinguishing those liable to serve from those exempt. The men to be enrolled are chosen by ballot from each parish; all who are not above four feet and five inches in height, or are not approved of on examination by a surgeon, being discharged, and others balloted for in their room. Those who do not personally appear, or send an approved substitute to take the oath, are liable in a penalty of L.10. There are arrangements by which, with the consent of the inhabitants, volunteers, remunerated by parish assessments, may be substituted for balloted men.

The persons exempted are,—peers; commissioned officers of the other forces, whether on full or half-pay; non-commissioned officers and private men in the other forces; persons serving, or who have served for four years, as commissioned officers in the militia; persons serving in the yeomanry or volunteers; persons serving, or who have served at any time within a year past in the local militia; resident members of the several universities; clergymen of the establishments, and registered dissenting clergymen; parish schoolmasters; articled clerks; apprentices; seafaring men; persons employed in the royal docks, the Tower, Woolwich Warren, the gun-wharfs of Portsmouth, and the stores under the direction of the Board of Ordnance; persons free of the company of watermen of the Thames; any poor man with more than one child born in wedlock, in England; any man with more than two lawful children, and not possessing property to the value of L.50, in Scotland; and in Ireland, any poor man not worth L.10, or who does not pay L.5 a year of rent, and has more than three lawful children under the age of fourteen.

The mutiny act and the articles of war apply to the militia, when called out, with the ordinary constitutional limitation, that no punishment can extend to life or limb. There are separate provisions for recovering deserters, &c. Until lately the conditions on which the militia could be called into service were, in Britain, invasion, or imminent danger of invasion, or actual rebellion or insurrection; in Ireland, actual invasion, rebellion, or insurrection. An act of 1854 so far altered this constitutional principle as to authorize the sovereign to call out the militia "whenever a state of war exists between her majesty and any foreign power." The old principle, that the militia cannot be compelled to serve out of the kingdom is still adhered to; and it has been thought necessary to pass special laws to enable them to volunteer for foreign service. In 1813 (54 Geo. III., c. 1) provision was made for accepting the service of militiamen and officers, to be formed into provisional regiments, and to co-operate with the regular forces. At previous periods, considerable numbers of militiamen had been drafted into the line, the losses of the militia regiments being made up by temporary acts, which slightly increased their original quotas. In 1855 a special act was passed "to enable Her Majesty to accept the services of the militia out of the United Kingdom, for the vigorous prosecution of the war."

By 48 Geo. III., c. 111 and 150, the celebrated local militia was, in 1808, appointed in England and Scotland, being limited in each county to "six times the original quota, or proportion of the original quota of militia." In 1812 two new acts were passed (52 Geo. III., c. 38 and 68), which apportioned the numbers of men to the respective shires in England and Scotland, but contained regulating provisions which tended to make the local militia and volunteers together amount to six times the number of the original militia contingents. When these forces were added to the 200,000 men allowed to be trained by Mr Windham's act (46 Geo. III., c. 90), the citizen army at the disposal of government in Great Britain amounted, independently of the militia, &c., of Ireland, and of temporary augmentations, to very nearly 500,000 men. In 1811 the effective strength of the regular militia was 77,424 private men, whilst that of the local militia was 213,609. In 1819 the disembodied militia of Britain and Ireland, calculated from the estimates of the year, amounted in round numbers to 71,200; and in 1829 it amounted to 70,082 private men and drummers.

The balloting, enrolling, and exercising of the militia has of late taken place only at occasional periods, an act being generally passed during each session suspending their annual recurrence. The militia were called out during the late war with Russia; and by a parliamentary return, the numbers in the three kingdoms on the 14th March were,—England, 44,198; Scotland, 4461; and Ireland, 13,095; making a total of 61,754. Within a month the numbers had decreased to 51,183, but during that period 19,450 had volunteered from the militia into the line. At the close of the session of 1857, the great Indian mutinies rendered it necessary again to take measures for calling out the militia. (J. H. B.)

MILIZIA, Francesco, an eminent Italian architect, was born in 1725. He gives the following account of himself in his autobiography:—"My native place is Oria, a small town in Terra d'Otranto, in the kingdom of Naples. I am the only son of one of the noblest and richest families in that small community. At nine years I was taken to Padua, where one of my uncles on my father's side had established himself in the practice of medicine. There I studied rhetoric with very indifferent success until at the end of seven years I ran away from Padua, in consequence of having been scolded by my uncle, and wandered until I found myself at Bobbio, near Placentia. Thence I sent news of myself to my parents, and went to Rome, where my father met me, took me to Naples, and left me there to study. I learned a little logic and metaphysics under the celebrated Abbé Genovesi, and studied physical science and geometry under Father Orlando, a Celestian monk. From Naples I also ran away, having a strong desire to see the world, more especially France; but having arrived at Leghorn, I was forced to go back from want of money. I returned to Oria; and after having spent several years in idleness, I shut myself up in a country-house, and studied science. Finally, when I was twenty-five years old, I married a noble lady from Gallipoli, of amiable disposition; and having fixed my abode in her native town, I paid some attention to books, but more to amusements. Having obtained from my father a larger provision, I went with my wife to visit Rome, and after a year and a half returned to Gallipoli, whence, in 1761, in my thirty-sixth year, I went back again to Rome. There I continued to study, and took some pleasure in architecture, although I knew nothing of drawing. Enamoured with this art, which I still regard as the noblest and most useful, I wrote the *Vite degli Architetti più celebri*, which was well received by the public, although my criticism was too severe, and my style but little cultivated."

This extract from Milizia's autobiography does not extend farther than the year 1775. About this time he was appointed superintendent-architect of the royal Farnesian palaces, which the king of Naples possesses in the Papal States, but resigned the office in 1786. He lived in the closest intimacy with all the artistic and literary celebrities at Rome, especially with Raphael Mengs, whose views he adopted with such enthusiasm, and diffused with so much pertinacity, as frequently to be unjust to other artists who did not share in his opinions. His critical partiality and bluntness of manner also gained him many personal enemies. He died at Rome, March 1798, of pulmonic disease.

The first work of importance published by Milizia was the *Vite de' più celebri Architetti d'ogni Nazione e d'ogni tempo Antichi e Moderni, preceduti da un saggio sopra l'Architettura* (Rome, 1768), which, in the last edition, he more modestly entitled, *Memorie degli Architetti Antichi e Moderni*; Parma, 1781. He denounces faults in severe and strong language, while he praises good qualities with a few sober words. This work was translated into English by Edward Cressy, London, 1826. His next work (*Del Teatro*, Rome, 1772) is a curious sign of the times. The frivolity, and even immorality of the drama at Rome, suggested to Milizia the thought of denouncing the abuses of the stage. He accordingly wrote a book, in which he insisted on the reform of the theatre. A storm was raised against him by the Roman public, headed by the priesthood, who compelled the master of the sacred palace to withdraw all the copies of the obnoxious book. More just criticism, however, subsequently placed the work in its proper light. The best of Milizia's works is the *Principi di Architettura Civile*, published in 1785. He treats, first, of "Beauty;" secondly, of "Fitness;" thirdly, of "Solidity." This work roused many antagonists. His language, his principles, and his judgments were all violently attacked by the older artists, while the young followed him enthusiastically. His next work (*Arte di Vedere*, Venezia, 1781) raised against him even a fiercer storm, by the free manner in which he examines the greatest works of the greatest men. In his *Roma delle belle Arti del Disegno*, Bassano, 1781, the principal monuments and buildings of Rome were so severely handled, that the book was proscribed and the author persecuted. This caused him to leave his work unfinished, and to turn his attention to totally different labours. To the last part of his life belong the *Dizionario delle Arti del Disegno*, Bassano, 1787, which is worth very little; the *Introduzione alla Storia ed alla Geografia fisica della Spagna*, Parma, 1783; the *Storia dell' Astronomia*; the *Elementi delle Matematiche Pure*; and, finally, his work on the *Economia Politica*, which was published after his death, Rome, 1798. (E. F.)

MILK, a well-known fluid, constituting the sole food of mammals during a certain period after birth, is an opaque, white, emulsive liquid, with a bland, sweetish taste, and a faint peculiar odour. When examined by the microscope it is found to consist of myriads of remarkably minute globular particles suspended in a serous liquid. These particles are termed *butter*, and are readily separated from the surrounding liquor, on being allowed to stand, owing to their relative specific lightness. On rising to the surface they carry with them a portion of caseine, one of the main constituents of milk, retain some of the serum or whey in which they float, and thus form *cream*. The upper stratum of cream is richer in butter, while the lower abounds more in the albuminous substance, caseine. The milk from which the cream has been separated is termed *skimmed milk*, and that from which the butter has been extracted is termed *butter-milk*. The butter or fatty matter is obtained from the milk by the process of agitation called *churning*, and the curd or cheese, or caseine, as the technical phrase is, is separated from the milk by the infusion of *rennet*, a liquid obtained by macerating the stomach of a sucking animal (as of the calf) preserved by means of salt. The whey of milk from which the curd and butter have been completely separated, yields on evaporation a colourless, sweet sub-

stance, known by the name of *sugar of milk*, as well as one or more nitrogenous composition. The relative proportion of the constituents of milk vary considerably in all animals with the quality of the food, the age of the animal, and the period after parturition. Among the most elaborate experiments on the composition of several kinds of milk are those of MM. O. Henri and Chevallier, published in the *Journal de Pharmacie*, vol. xxv., and which are as follows:—

	Milk of the				
	Cow.	Ass.	Woman.	Goat.	Ewe.
Caseine	4·48	1·82	1·52	4·02	4·50
Butter..........	3·13	0·11	3·55	3·32	4·20
Sugar of milk..	4·77	6·08	6·50	5·28	5·00
Various salts...	0·60	0·34	0·45	0·58	0·68
Water	87·02	91·65	87·98	86·80	85·62
Total..........	100·00	100·00	100·00	100·00	100·00
Solid substances	12·98	8·35	12·02	13·20	14·38

Of the various saline constituents which enter into the composition of milk, Schwartz gives the following as the composition of the ashes of 100 parts of cow's milk. (See Gmelin, *Handbuch der Theoret. Chemie*, vol. ii.)

Soda (in milk combined with lactic acid)	0·0115
Chloride of potassium, ...	0·1350
Phosphate of soda............	0·0225
Phosphate of lime............	0·1805
Phosphate of magnesia............	0·0170
Phosphate of iron............	0·0032
	0·3697

The quality of the milk is also affected by the state of health of the female supplying it. Tubercular disease of the lungs of an animal has been found to increase the quantity of phosphate of lime in the milk. Labillardière states (*Dict. Mat. Méd.* iv.) that the milk of a cow affected by a species of tubercular phthisis contained seven times more phosphate of lime than usual; and Dupuy, according to Pereira, has also noticed the large quantity of calcareous matter in the milk of cows, in whose lungs the same substance was found in abundance. The morbid changes produced in the quality of the milk by the disease called *cocote*, so prevalent among the cows of Paris some years ago, attracted considerable attention among scientific men. The principal morbid changes recognised in the milk were a want of homogeneousness, imperfect liquidity, a tendency to become viscid on the addition of ammonia, and on microscopic examination the presence of certain globules not found in healthy milk. And not only is this subject of great importance in reference to the frequency of disease in cows, and the consequent morbific character of their milk; it also requires very special attention in connection with the milk of the human subject. The deleterious effect to a child of being suckled by a female labouring under tuberculous disease must be too obvious to require exemplification. According to Dr Jon. Pereira (*Treatise on Food and Diet*), it is possible by adding certain ingredients to the food to modify the *colour*, *odour*, *taste*, and *medicinal effect* of the milk of a female; and the influence which medicines taken by the parent exert over the child is known to every nurse. As the natural food of the young mammal of every species is the milk of its mother, we may accordingly regard milk not only as containing all the elements necessary for the nutrition and growth of the body during a certain period, but also as a kind of model food for the species to which the animal belongs. Milk appears to partake of the nature of both animal and vegetable food. The large proportion of caseine and butter which it contains represent the fibrin and fat of beef, while the equally large proportion of sugar represents the starch of wheaten bread. The curd of milk goes to form the albumen and fibrin of the blood. The butter serves to form fat, and with the sugar contributes, by yielding carbon and hydrogen to be burnt in the lungs, to support the animal heat of the body. The salts develop the osseous system; the iron is required by the blood and the hair, while its chloride salt goes to form the hydrochloric acid of the gastric juice.

Milk, as an article of food, is of great use and value, as well for the adult as for the child, and for healthy persons as well as for invalids. The chief objection often to its employment is the difficulty of digestion of its fatty matter. Whey, as an excellent diluent and nutritive, is often used in febrile and inflammatory complaints. It owes its slightly nutritive qualities to the sugar of milk which it contains. It gently promotes the action of the secreting organs, and thus proves useful in congestion of the liver. According to Pereira there are various establishments in Switzerland and Germany for the cure of chronic disorders by the use of pure or aromatized whey (*Molkencuren; Cures de Petit-Lait*). The whey is obtained from the milk of the cow, the goat, or the ass; and is used as a drink, as a lavement, or as a bath, associated often with the employment of mineral waters. Butter-milk also forms a very agreeable cooling beverage in febrile and inflammatory diseases; and its nutritive qualities are owing to the caseine, the sugar, and the salts of milk which it possesses.

With respect to the distinctive properties of the different milks in most frequent use, valuable information will be obtained by referring to the table already given. While *ewe's* milk contains the largest proportion of nutritive matter, it is on that account less easy of digestion, and not suited for dyspeptics. The same holds of *goat's* milk, which ranks next in nutritive power. *Ass's* milk is the least nutritive, but the most easy of digestion. With the exception of woman's milk it is the richest in sugar. It is considered a most valuable aliment in consumptive cases, in chronic diseases of the digestive organs, and in convalescence from acute maladies. This seems to depend on the small quantity of butter and the large quantity of sugar of milk which it contains. *Cow's* milk holds a middle place in nutritive and digestible properties between goat's and ass's milk. According to Donné (*Comptes Rendus*, 1841), it is the only milk which is either very feebly alkaline, often neutral, or sometimes slightly acid. The milk of the ass and the woman are always obviously alkaline. The milk of women from fifteen to twenty years of age is said to contain more solid constituents than that of women between thirty and forty. Women with dark hair also are said to give a richer milk than women with light hair. (See Pereira's *Treatise on Food and Diet*, also Johnston's *Chemistry of Common Life*). For further information respecting the milk of cows see Dairy.

MILL, James, was born on the 6th of April 1773, in the parish of Logie Pert, near Montrose, where his father united the occupations of shoemaker and small farmer. After receiving his elementary education at the parochial school of Logie Pert, and at the grammar-school of Montrose, he was sent by Sir John Stuart, Bart. of Fettercairn, to the University of Edinburgh, to study for the church. After completing his theological course, he received license as a preacher, but as accident rather than choice had led him into the profession, he never contracted any particular liking for it, and was not promoted to a charge. The study which chiefly delighted him, and exercised his thoughts during the period of his academical course, was that of metaphysical and ethical philosophy. The class of moral philosophy was then taught by Mr Dugald Stewart, to whose noble eloquence and animated exhortations to mental study Mill always listened with profound attention and enthusiastic admiration. In a letter to a friend in 1821, Mill, speaking of Stewart, from whose system of speculation he was then widely separated, remarked, "The

taste for the studies which have formed my favourite pursuits, and which will be so to the end of my life, I owe to him."

After having officiated for a considerable time as a private tutor, Mill removed to London in 1800, where he became editor of the *Literary Journal*, which did not, however, long survive. From the period of his arrival in the metropolis till the year 1819, when he received a valuable appointment in the India House, he supported himself and his increasing family entirely by his pen. Much of his time was employed in writing for periodical publications. For several years he was an occasional contributor to the *Edinburgh*, *British*, *Eclectic*, and *Monthly Reviews*. He early made the acquaintance of Jeremy Bentham, and actively co-operated with the supporters of the *Philanthropist* in those exertions to which the Lancasterian and Infant Schools owed their origin; and at a later period he was one of the founders of the London University.

His principal work, the *History of British India*, had been commenced as far back as the year 1806, but the greatness of the work itself, and the variety and weight of his other avocations, prevented its completion for upwards of ten years. It was at last published in five volumes, 8vo, in the winter of 1817–18. It was the smallest merit of this book, that it was the only single work calculated to convey to the general reader any intelligible notion whatever of India, or Indian affairs as a whole, and which rendered it, therefore, indispensable to all Englishmen who would possess even the most general knowledge of one great department of their country's interest. But it achieved far more. It gave a new turn to the thoughts of all the most eminent leading men engaged in the administration of Indian affairs; and the measures of government in that country for many years bore testimony to the high merit of this valuable history.

Although he had very freely censured the conduct of the East India Company, yet the powers of mind and knowledge of the subject which he displayed induced the Court of Directors, in the spring of 1819, when they were desirous of strengthening their home establishment, to introduce him into it (though personally unknown to most of them, and having little or no interest), and to intrust to him the chief conduct of their correspondence with India, in the revenue branch of administration. He was subsequently made head of the department of correspondence with India in the India House, or, in other words, chief minister for Indian affairs to the East India Company; and he lived to see almost all the great principles which he had advocated, not merely recognised, but practically employed in the government of India.

Mill's official duties might well have furnished him with an excuse for relinquishing his pen as an author. But his mind was not of a cast to stop short in the career of inquiry, or to allow the calls of business to suppress the fruits of his reflections. He became a contributor to the *Supplement* to the former editions of the present work about three years before his appointment to the India House; and his contributions were continued nearly till the completion of that publication in the year 1824. His most striking articles were those on *Colonies*, *Education*, *Government*, *Jurisprudence*, *Law of Nations*, *Liberty of the Press*, and *Prison Discipline*. These essays were also widely disseminated by separate republications of them, at a very cheap rate, and proved not the least effective of his writings in stirring the thoughts of his contemporaries.

In 1821–22 he published his *Elements of Political Economy*, a treatise in which the science, as remodelled by Ricardo, was for the first time, and without any pretensions to originality, brought into a systematic form, and arranged in strict scientific order.

Mill's originality and acuteness as a metaphysician were abundantly displayed in his *Analysis of the Phenomena of the Human Mind*, published in 1829. He belongs to the sensational school of philosophy, and there is perhaps no English writer since Locke who has employed so much energy and acuteness in analyzing our mental phenomena upon purely sensational principles. As a sensationalist he stands midway between Locke and the French ideologists. The latter held that all mental phenomena were but different forms of sensation; while the former, although maintaining that the material of our knowledge was derivable from sensation, nevertheless asserted the existence of certain powers of reflection by which this primitive material is moulded. While differing essentially from both, Mill resembled Locke in tracing our mental phenomena to two primitive elements, viz., *sensations* and *ideas*; but under the latter term he included much less than did the English philosopher under the word reflection. By *sensations* he understands "that which exists when the object of sense is present;" and by *ideas*, "that which exists after the object of the sense has ceased to be present." (*Analysis*, &c., vol. i., p. 41.) These two classes of "feelings," as forming the whole material of our thoughts and emotions, are the basis of all our mental operations. But these phenomena do not recur arbitrarily; on the contrary, they are under the regulation of a law called the association of ideas, which marshals them in synchronous or successive order, giving rise to "complex notions" and "trains of thought." Again, in order to be able to communicate our sensations and ideas to others, we require to assign to them certain "names." These elementary processes, then, of "sensation, ideation, association, and naming," form the groundwork of Mill's analysis. The rest of his work is occupied in showing how, out of these elements, all the complex phenomena of the mind can be formed. The subtle ingenuity of the writer is here strikingly brought out, but no amount of dexterity can make a false system true. Accordingly, the reader, while continually constrained to admire the manly independence of thought, and clear forcible style of the author, is nevertheless compelled to dissent from the most important results of his system. To take a single specimen of the shifts to which Mill is frequently and unconsciously driven. Memory and judgment are not of course with him original faculties; they are generated according to the fourfold process already indicated. But how is it possible to derive judgment and memory from such processes, seeing that these very powers are involved in the formation of those sensations and ideas which lie at the basis of the whole system? Mill's definition of an idea necessarily involves the recognition and distinction of a present and a past object; but it is the judgment which distinguishes, and it is the memory which renders a past possible. Here, then, at the very threshold of the system, the faculties which he afterwards tries so ingeniously to account for are found in full operation. Such specimens of analysis are not peculiar to Mill, however; they belong to the entire sensational school; and it was the radical vice of the system, rather than an intellectual defect in the analyst, which led this philosopher astray.

Mill's last work was a fragment published anonymously in 1835, containing a criticism of a very severe kind upon the *Dissertation on the History of Ethical Philosophy*, contributed by Sir James Mackintosh to the present publication. Most even of those who agree in the general opinions expressed by Mr Mill have admitted that the degree of bitterness which he manifested towards this eminent and singularly candid writer was in a great measure uncalled for.

Mr Mill wrote several of the principal articles in the early numbers of the *Westminster Review*, among which may be specially mentioned the one on the *Formation*

of Opinions, and, after an interval of some years, the celebrated article on the *Ballot*. After the union of the *Westminster* with the *London Review*, he wrote, among other racy and characteristic articles, one entitled *Aristocracy*, which was the last of his literary labours.

For some winters previously to his death he had an obstinate cough, which, by ending in pulmonary consumption, carried him off on the 23d of June 1836. His remains were buried in Kensington church, he having lived at Kensington during the last five years of his life.

The high reputation of Mill is honourably sustained in the person of his son, the present John Stuart Mill, author of the *System of Logic, Ratiocinative and Inductive*, who is one of the profoundest thinkers of the age.

MILL, *John*, was the son of Thomas Mill of Bampton, and was born about the year 1645, at Shapp, in Westmoreland. He studied at Queen's College, Oxford, which he entered as servitor in 1661; and took his degree of M.A. in 1669. Mill was soon after made a fellow of his college; and having subsequently entered the church, he obtained great reputation as a preacher. In 1681 he became rector of Blechingdon in Oxfordshire; and during the same year he was made Doctor of Divinity and chaplain to Charles II. The work by which Mill is best known is his edition of the Greek Testament, a performance of great labour and erudition, on which he spent the last thirty years of his life. He had the benefit of the counsel and encouragement, in this work, of Dr Fell, Bishop of Oxford, at whose expense the publication of it was begun; but this divine having died, Mill not only continued the work at his own cost, but repaid to the executors the sum furnished by the bishop. In 1685 he became principal of St Edmund's Hall in Oxford; and in 1704 he was appointed by Queen Anne a prebend of Canterbury. Mill died in 1707, just a fortnight after the publication of his Greek Testament. This edition, which is the best proof of the industry, learning, and scholarship of its author, is based on those of Robert Stephens, 1550, and of Bishop Fell, 1675; and contains a collection of more than 30,000 various readings, from MSS., versions, quotations from the fathers, &c. The number of these variations excited the alarm of many, and especially of Dr Whitby, who, imagining that they would destroy the validity of the text, wrote a work in order to reduce their number and importance. The same subject was taken up by Antony Collins, for a different purpose, in his *Discourse on Free-Thinking*, in which he contends that "these numerous variations destroy the authority of the New Testament." But this book was answered by Whiston and Bentley with great ability and success; showing that the variety of readings is no objection to the authority of the Scriptures, being only a necessary result of the number and variety of the MSS. Their arguments are briefly summed up in the irony of Swift; that the multitude of readings renders the Bible quite useless; and of course the works of Livy, Horace, and other ancient authors, are all likewise worthless, for a similar reason.

MILLEDGEVILLE, a town in the United States of North America, capital of the state of Georgia, is situated on the W. bank of the Oconee River, 80 miles W.S.W. of Augusta. It stands in a beautiful and fertile cotton country, and contains a number of handsome residences. The river supplies excellent water power; and was once navigated below by small steamers, but these are now superseded by railroads. A branch railroad, 17 miles long, extends S. to Gordon on the central railroad, and another extends in the opposite direction to Eatonton. Pop. (1850) 3500.

MILLENNIUM, a period of a thousand years, generally used with reference to the thousand years during which, according to the statement of the Apostle John in the 4th verse of the 20th chapter of the Apocalypse, Christ is to reign with his saints upon earth.

As almost all nations are possessed of some traditionary information respecting the existence of a happy and a holy age at the commencement of the world's history, so among most of them do we find traces, more or less distinct, of an expectation that a period of still greater excellence will immediately precede its close. In several of the oriental religious systems this expectation occupies a prominent place;[1] nor will the classical reader need to be reminded of the well-known Eclogue of Virgil, in which he describes the glories of "the last age," and the return of the Saturnian reign, in strains which so strikingly accord with those of the Jewish Scriptures, that this poem seems to have been commonly regarded by the early church as prophetic of the birth and reign of Christ.[2] A still more remarkable, because more explicit, allusion to a millennium occurs in the writings of Plato, in the statement which he repeatedly makes, that a period of a thousand years (χιλιετης πορεια, χιλιοστον ἐτος, περιοδος χιλιετης) must intervene between death and our "arrival at the inheritance and possession of the second life."[3]

Among the Jews this expectation assumed a more definite form, and was expressed in less hesitating language. Their prophets distinctly revealed to them the certainty of a period of future felicity under the reign of the Messiah;[4] and they had, from a comparatively early age, the tradition, that that period would extend through a thousand years. This tradition seems to have had its rise in the notion, that as the work of creation was divided among six ordinary days, so the world would have to pass through six divine days of toil and suffering (each of which days they imagined to be a millennium, from a misinterpretation of Ps. xc. 4); and that as God rested on the seventh day, so should the seventh millennium be a period of universal rest and quiet under the reign of the Messiah. In the rabbinical writings frequent allusions to this opinion are to be found, the most important of which have been collected by Wetstein in his notes on Apoc. xx. Of these allusions the following may be taken as a specimen: "There is a tradition in the house of Elias, that the righteous whom the holy blessed God shall raise from the dead, shall not return again to the dust, but for the space of a *thousand years*, in which the holy blessed God shall renew the world, they shall have wings like the wings of eagles, and shall fly above the waters."[5]

From the Jews this notion of a personal reign of the Messiah with his saints on earth, was adopted by several in the early church, by whom the passage in the Apocalypse above referred to was confidently quoted in support of the opinion. By some of these the blessings anticipated during the millennium were regarded as entirely of a temporal and sensual kind, while others looked forward to that period as a season of spiritual enjoyment and religious harmony. In neither of these forms, however, does the opinion ever seem to have become general in the church. Indeed, we are expressly informed by Origen, that it was confined to those "of the simpler sort," and to such as "refusing the labour of intelligence, followed the superficial mode of literal interpretation."[6] Great obscurity, however, attends the history of this dogma in the early church, as the documents we possess are too few, and too partial in their information, to justify our expressing any definite opinion on

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1 See Plutarch *De Isid. et Osir.*, c. 47; Hyde *De Relig. Vet. Pers.*, p. 832.

2 See Augustine, *Inchoat. Expos. in Ep. ad Romanos*; Lactantius, *Instit.* vii. 24; Eusebius, *Constantini Orat. ad Sanctorum Cæt.*, c. 19.

3 *Timæus*, p. 1054, E.; see also *Phæd.*, p. 1223, D.; and *De Rep.*, lib. x., p. 761, E.

4 See, among other passages, Is. ii. 1–4, ix. xi. xxv.; Zech. xiv.

5 Sanhedrin, fol. 92, quoted in Dr Ad. Clarke's *Comment. in loc.*

6 *Proleg. in Cant. Cant.* 69, B.; *De Princip.* ii. 11, sect. 2.

the subject. From the testimony of Eusebius, we learn that the first who taught it in the church was Papias, a bishop of Phrygia, in the earlier part of the second century, who professed to have received a traditional revelation on the subject from the apostles. Influenced by a regard to the piety and antiquity of the man (την ἀρχαιοτητα τἀνδρος προβεβλημενοι), several ecclesiastics, and among the rest Irenæus and Justin Martyr, adopted his opinion. Adherents were also found in the Latin church, especially from among the Montanist party. It is justly remarked, however, by Professor Neander, that the defensive attitude which the advocates of the doctrine perpetually assume in regard to it, affords a strong presumption that it was not the doctrine of the church in general.[1]

In the third century it was vehemently assailed by Origen, and as eagerly defended by Nepos, a bishop of the district of Arsinoe, in Egypt. The latter, however, was but a feeble antagonist for so redoubtable a controversialist as Origen, whom his scholars delighted to style the Adamantine; and consequently his interference served only to quicken the downfall of the cause he had espoused. The assault of Origen was followed by that of Dionysius, bishop of Alexandria, and one of Origen's most able scholars, which seems, in the Eastern church at least, completely to have driven the opinion into obscurity.[2] From this time forward we find few traces of it in ecclesiastical history, until we arrive at the tenth century, when it was revived, though in a very altered form, and used for the purpose of terrifying the ignorant populace into larger concessions to the ambition and avarice of the papal power. They were taught that the millennium, during which Satan was to be bound, was to be calculated from the birth of Christ, and consequently was then rapidly drawing to a close; that at its termination Satan would be again set free, and the reign of Antichrist would commence; and that, after a short season of triumph to the enemies of the church, the last judgment would take place, and the world be consumed by the final conflagration. So powerful was the effect produced by the teaching of this doctrine, that multitudes, as the eventful year that was to close the last century of the millennium approached, forsook their homes, "and hastened to the shores of Palestine, with the pious persuasion that Mount Zion would be the throne of Christ when he should descend to judge the world; and these, in order to secure a more partial sentence from the God of mercy and charity, usually made over their property, before they departed, to some adjacent church or monastery."[3] The much-dreaded year, however, having passed away without any of the expected convulsions, the minds of the people recovered their equilibrium. Those who had fled returned to their homes, and resumed their wonted occupations; and the only lasting effect of this stupendous panic was the augmentation of the temporal prosperity of the church."[4]

Since the Reformation, the opinion of the early millennarians has been revived in the church; and the doctrine of a personal reign of Christ on earth with his saints has been maintained by many excellent persons, as one of the truths clearly revealed in the Scriptures. The tenets of those who avow this opinion are chiefly the following:— That Jerusalem is to be rebuilt, the temple restored, and sacrifice again offered on the altar; that this city is to form the residence of Christ, who is to reign there in glory with all his saints for a thousand years; that for this purpose there shall be a resurrection of all the pious dead, that none of the Saviour's followers may be absent during his triumph; that at the close of the thousand years they shall all return to heaven, and the world be left to Satan and his followers for a season; and that then the general resurrection and last judgment shall take place, and the history of the world be brought to a close. In support of these tenets, they appeal to numerous passages in the prophetical writings of the Old Testament, to some sayings of Christ himself recorded in the Evangelists, to one or two detached passages in the writings of the apostles, and principally to the declarations of St John in the Apocalypse. The passages in the Prophecies on which most stress is laid by them are those in which the latter-day glory seems to be described in connection with the return of the Lord of Hosts unto Zion, the establishment of his sanctuary with men for ever, and the coming of the nations to Jerusalem to receive instruction, and offer their homage to Him.[1] The declarations of our Lord referred to are those in which he speaks of the destruction of Jerusalem in connection with his second advent;[2] from which it is inferred that Jerusalem shall remain in its present state, and that seasons of tribulation and sorrow shall befall the church, until Christ come to restore the one to its former glory, and to exalt the other over all its enemies.[3] The passages quoted from the apostles are chiefly two: the one the address of St Peter to the Jews,—"Repent and be converted, that your sins may be blotted out, when the times of refreshing shall come from the presence of the Lord; when he shall send Jesus Christ, which before was preached unto you;"[4] which is held to prove that Christ shall come again, and that this event shall be attended with times of refreshing to the Jews; the other the declaration of St Paul to the Thessalonians,[5] that "the dead in Christ shall rise first;" from which it is inferred that there will be a resurrection of the just antecedent to the general resurrection. The main prop of the doctrine, however, is the passage in the twentieth chapter of the Apocalypse, already referred to, and which is as follows: "And I saw thrones, and they sat on them, and judgment was given unto them; and I saw the souls of them that were beheaded for the witness of Jesus, and for the word of God, and which had not worshipped the beast, neither his image, neither had received his mark upon their foreheads or in their hands; and they lived and reigned with Christ a thousand years. But the rest of the dead lived not again till the thousand years were finished. This is the first resurrection" (verses 4, 5). Here it is contended that we have a distinct testimony in favour of a millennial reign of Christ and his people, and of a resurrection of those who had been faithful to him, as well as of those who had suffered for his sake, antecedent to that of the rest of the dead, and hence called "the first resurrection."

By those who oppose this system, it is generally admitted that the expectation of a long season of uninterrupted triumph to the cause of Christ, is one which is fully authorized by the declarations of Scripture. It is denied, however, that these declarations, when properly interpreted, support the notion of a personal reign, and a twofold resurrection. With regard to the passages from the Old Testament prophecies, it is maintained, that many of those adduced by Millennarians, as favouring their system, have been already fulfilled in the temporal history of the Jewish nation; and that in others which seem to have a still future reference, Jerusalem is used as typically representative of

[1] *Church History*, vol. ii., pp. 429–433; see also Waddington's *Church History*, ch. iii.; Whitby's *Treatise on the Millennium*, appended to his Commentary, &c.

[2] Euseb. *Hist. Eccl.*, vii. 24, 25.

[3] Waddington's *Church History*, chap. xv.

[4] Ibid.

[1] See Begg's *Connected View of some of the Scriptural Evidence of the Redeemer's Speedy Personal Return*, &c., pp. 85–118.

[2] Matt. xxiv.; Mark xiii.; Luke xxi.

[3] Begg's *Letters on our Saviour's Predictions*, &c., *passim*.

[4] Acts iii. 19, 20.

[5] 1 Thess. iv. 16.

the Christian church in its triumphant state; the temple is spoken of in reference to the ministrations of the gospel; and the coming of the people to Jerusalem is set forth as indicative of the universal prevalence of the Christian faith. The inference deduced by Millennarians from the words of our Lord above referred to, is regarded by their opponents as at best very obscure and far-fetched; while, on the other hand, it is contended, that the obvious comparison which our Lord draws between the destruction of Jerusalem and his second coming, as well as the circumstances of appalling and unexpected suddenness with which his appearance will be made, seem much better to accord with the notion that the coming spoken of is his coming to judgment, than with the opinion that it is an advent for which his church shall be longing, and the world prepared. In the statement of St Peter to the Jews, it is admitted that there are some expressions which would seem at first sight to favour the Millennarian scheme; but it is argued that every such inference is precluded by the words which follow, and in which the apostle declares, that the heavens must retain Christ "until the restitution (or accomplishment) of all things, which God hath spoken by the mouth of all his holy prophets since the world began." As, therefore, by the showing of Millennarians themselves, the glories of the millennium form part of the "all things" that are revealed in inspired prophecy, and which must be fulfilled *before* Christ shall re-appear on earth, it is plainly impossible that he can come to our world in person at the *commencement* of that period; and consequently the times of refreshing spoken of by St Peter must be interpreted of other blessings than those which would flow from the personal reign of Christ at Jerusalem. As to the statement of St Paul, that "the dead in Christ shall rise first," it is affirmed that a single glance at the context is sufficient to convince us that the apostle is not establishing a difference between the righteous and the wicked as to the time of their respective resurrections, but is simply showing that those believers who are alive at the season of Christ's second advent shall not enjoy any advantage over those who are dead, for the latter shall be raised first, *i. e.*, previous to the common ascent of the whole to meet the Lord in the air. In reference to the passage from the Apocalypse, it is contended, 1*st*, That the expression "*first* resurrection" no more necessitates a twofold *corporeal* resurrection, than the phrases "first and second death," so frequently employed by the same writer, necessitate the supposition of a twofold corporeal dissolution; but that in both cases we have an instance of the same intermingling of the spiritual with the material, as in our Lord's declaration, "Let the dead bury their dead," where, as is generally admitted, the first adjective is used in a spiritual or metaphorical, the second in a literal and corporeal sense; 2*dly*, That the phrase, "the rest of the dead," refers to the "remnant" spoken of in the 21st verse of the 19th chapter (the words in the original are the same in both verses, οἱ λοιποὶ), by whose resurrection is intended the temporary restoration of the reign of evil after the millennium; 3*dly*, That it is not a legitimate interpretation to regard the expression, "I saw the *souls of* them that were beheaded," &c., as intimating their *corporeal* resuscitation; for though we may properly enough speak of a *soul* when we mean a *person*, yet it would outrage all propriety of language for any one to say that he saw the souls *of* certain individuals, when he meant that he saw these individuals themselves; 4*thly*, That by the return to the earth of the souls of the martyrs and confessors, nothing more is intimated than the universal prevalence of that holy and determined spirit by which they were distinguished; in the same way as the ancient prophecy, that Elias should return to the earth before the appearance of the Messiah, is allowed to have received its accomplishment when John the Baptist came "in the *spirit* and *power* of Elias;" 5*thly*, That it is as contrary to sound principles of interpretation to expound a book professedly symbolical literally, as it would be to expound a professed narrative symbolically; 6*thly*, That it is imperative on those who insist on the literal interpretation of this passage to be consistent, and interpret literally the whole book, in which case we should have literal vials, and trumpets, and millstones, and chains, and burning lakes, &c.; an extent of literality for which few will be hardy enough to contend; and, *lastly*, That by interpreting the whole passage symbolically, and understanding by it a prediction of a season of joyful triumph to the church, during which the whole world shall be under the religion of Christ, and the zeal and piety of its holiest members in its purest days shall be universally diffused, no violence is done to any part of it, while a meaning is elicited in entire accordance with the general tenor of Scripture.

It is further objected by those who are opposed to Millennarianism, in the *first* place, that the hypothesis is in itself exceedingly improbable; for since Scripture assures us that the departed saints are already with Christ in heaven, in the enjoyment of unspeakable felicity, it is hardly conceivable that they would leave such a state to dwell for a thousand years on earth, in a state which at best must be one of imperfect enjoyment, and then return to heaven to permit their enemies for a season to reign in their stead; 2*dly*, That the Millennarian notion of a resurrection of the righteous antecedent to that of the wicked, is directly opposed to the testimony of Scripture, which represents the two as simultaneous; see, *e.g.* John, v. 28–29, &c.; 3*dly*, That the idea of a long interval elapsing between the advent of Christ and the last judgment, is inconsistent with those passages which represent the one as immediately consequent upon the other; such as 2 Thess. i. 7–10; 2 Tim. iv. 1, &c.; 4*thly*, That, on the Millennarian hypothesis, there can be no judgment of the righteous whatever, for they having been once admitted to *reign* with Christ, can never after that be placed for trial at his bar—a hypothesis clearly at variance with innumerable passages of Scripture; such, *e.g.* as Rom. xiv. 10–12, Matt. xxv. 31–46, &c.; 5*thly*, That to represent the millennium as a state of immortality on earth is to confound it with the New Jerusalem, though the two are distinctly revealed as separate states, the one previous and the other subsequent to the final judgment; and, *lastly*, That the theory of Millennarianism is in two points at least self-contradictory; for it not only represents Christ as reigning until the *last* enemy has been destroyed, and yet supposes the existence of a whole host of enemies, who, at the close of that reign, are to be gathered together; but also represents them as contending with the saints, until they are consumed by fire from God (Rev. xx. 7–10), though, according to another part of their hypothesis, the saints shall before this have returned with Christ to heaven. For these reasons, among others of less weight, this hypothesis of a personal reign of Christ on earth has been rejected by the majority of divines, and the period of the millennium regarded as a season of great spiritual blessedness, consequent on the complete triumph of Christianity throughout the earth. (W. L. A.)

MILLER, HUGH, a popular miscellaneous writer and geologist, was born in Cromarty on the 10th of October 1802. He may be said emphatically to have sprung from the bosom of the people, and to have inherited, along with his higher intellectual qualities, the virtues, habits, and feelings of the old middle-class country population of Scotland. His father was a seaman, owner of a small coasting vessel that plied along the shores of the Moray Firth, and who unfortunately perished at sea when his son was only about five years of age. But Hugh had kindly, sagacious relatives, who attended to his education, and would have struggled hard to send him to college had he not himself

resolved on being a stone mason. He was proud to appear as a working man; proud of his rough coat and leather apron; and resolved to force his way upwards by solitary study, self-denial, and perseverance. As a boy he was somewhat intractable—lonely, observant, fond of books, and delighting in rambles by the sea-side, exploring the rocks, caves, and woods of his native shore. He wrought fifteen years as a mason; and his early labours in a quarry gave him his first lessons in geology. Those studies in the open air he has beautifully described—"Sweet are the uses of adversity;" and along with his love of natural science he had the feeling and fancy of a poet. His first publication was ***Poems Written in the Leisure Hours of a Journeyman Mason***, which appeared in 1829; and the same year he wrote a series of ***Letters on the Herring Fishing***. These were recognised as remarkable productions. Their author had evidently read and studied the best English authors, and possessed extraordinary powers of description and illustration. His prose style was succinct, clear, and elegant—formed on the model of our best essayists, Cowley, Addison, and Goldsmith. His verses were less essentially poetical than his prose; and it was soon obvious to himself, as to others, that poetry was not to be his peculiar vocation. For two or three years after his advent as an author Mr Miller continued to labour as a mason; but a branch of the Commercial Bank of Scotland being opened in his native town, he was appointed accountant of the new establishment. About the same time he published *Scenes and Legends of the North of Scotland, or the Traditional History of Cromarty*,—the result of many years' oral collections among the old inhabitants of the town and neighbourhood, and of a wide and curious range of reading and reflection. His next appearance was as a polemical controversialist. The Scottish Church question as to the rights of patronage then agitated the country, and Miller wrote two able pamphlets,—a ***Letter to Lord Brougham***, and ***Whiggism of the Old School***, supporting the principles and opinions afterwards embodied in vigorous action in the Free Church. These popular little treatises led to Mr Miller's appointment as editor of ***The Witness***, a twice-a-week newspaper established in Edinburgh in 1840, of which he afterwards became the principal proprietor. He was now fairly launched into the world of politics and literature—a stout Presbyterian, determined to give no quarter to the opponents of spiritual independence or to the supporters of the Established Church, which he conceived to be degraded, dismantled, and obsolete. There was much bitterness and personality in this contest, but Miller gradually emerged from it, and sought distinction in a wider field. In the sixteen years of his Edinburgh life he wrote those works which now constitute his fame:—***The Old Red Sandstone, or New Walks in an Old Field; First Impressions of England and its People; Footprints of the Creator, or the Asterolepis of Stromness;*** and ***My Schools and Schoolmasters, or the Story of my Education*** (the last a delightful and instructive autobiography). No geologist had ever before evinced the same art or talent in popularizing the truths of his science—in investing it with poetical beauty and interest, and at the same time extending its facts and principles by close and accurate research. In the formation known as the Old Red Sandstone he is entitled to the honours of a discoverer, having shown that it is not, as was supposed, barren of fossils, but in reality rich in organic remains. In the Palæontological history of plants and animals, and in tracing the fossil floras of Scotland, Mr Miller also did good service to science; while he laboured with untiring zeal and Christian devotedness to disprove the development hypothesis and to harmonize the phenomena of geology with the text of Scripture. His latest efforts were directed to the illustration of the first chapter of Genesis, to prove that the days of creation were not natural but prophetic days—unmeasured eras of time. Passages of great eloquence and of rich and solemn imagination abound in these semi-theological disquisitions. The fossil remains seem, in his glowing pages, to live and flourish, to fly, swim, or gambol, or to shoot up in vegetative profusion and splendour, as in the primal dawn of creation. Such power belongs only to high genius—the power to reanimate and vivify the past, and to clothe the scattered hints and discoveries of science with living beauty and radiance. What Burns did for the old songs of Scotland, Miller did for the facts of geology. His friends, however, saw with regret that the indefatigable and inspired student was overtaxing his brain and hand. For some years before his death he suffered from ill-health and hypochondria. Always averse to general society (for he never conquered his natural shyness and awkwardness of address), his love of solitude became a disease. He had not attained by practice to facility in composition; and latterly he complained that with double labour he could only do half work; extraordinary visions or delusions overmastered at times his clear intellect; his egotism (always his greatest weakness) magnified everything affecting his fame or his writings, and he surrounded himself with weapons of defence, sword, dagger, and pistols, to guard his person and geological museum. Manifestations of this kind had been long conspicuous; yet when he took up his pen and elaborated his original conceptions and fine descriptions, no trace of mental disease was apparent. His last work, ***The Testimony of the Rocks***, is one of the ablest and most argumentative of his compositions. He had laboured night and day at this final "testimony," and corrected its last page the day preceding his death. The excessive application, and perhaps a feeling of triumphant exultation at the successful completion of his task, overturned his already shattered intellect, and he died by his own hand on the night of the 23d or morning of the 24th of December 1856. This melancholy termination to the life of so noble a worker produced a sensation of grief and astonishment over the whole kingdom. His indomitable energy and masculine intellect, his enthusiasm and nationality, his fine English style and brilliant imagination, the purity of his life and his devotion to Christian duty and principle—all these were well-known traits of his character and writings that hallowed and endeared his name. Scotland had lost one of her worthiest sons, and geology one of its most eloquent expounders and illustrators. (R. C—S.)

MILLER, *Johann Martin*, was born in 1750, at Ulm, where his father was a preacher and professor. He studied for the church at Göttingen; where he became one of the *Hainbund*, or society of poets, which included among its members Boie, Bürger, Hötly, and others. In 1783 Miller was appointed preacher in the cathedral of Ulm; and in 1810 he was made dean of Ulm. He wrote poetry, chiefly lyrical and elegiac; and many of his pieces have become extremely popular. He also wrote several novels and romances, in the sentimental style, of which the principal is *Siegwart*, a work which excited great interest, and met with much success. His novels and romances are now forgotten, and little read; but his poems have lost none of their popularity. He died in 1814.

MILLET. Under this name the fruits of several plants belonging to the order *Graminaceæ* are known in commerce. All of them are used as food, either for domestic animals or man. That to which the term is most generally applied is the "common millet," *Panicum miliaceum*, Linn., originally a native of India, but now naturalized even as far north as England. It is thought that this and some of its allied species constituted one of the earliest of the grain products used in making bread, and that its generic name is derived from *panis*, bread, and not, as has been frequently assumed, from its panicled inflorescence. It is mentioned by Pliny as being one of the ordinary cereals of his time. He says, "Campania is particularly prolific in millet, and a

fine white porridge is made from it; it makes a bread, too, of remarkable sweetness. The nations of Sarmatia live principally on this porridge, and even the raw meal." "The Ethiopians know of no other grain but millet and barley."

This species of millet is still sold in London shops called Italian warehouses, for the purpose of being used as a substitute for rice or semolina in making puddings, the demand being confined to professional cooks and others who cater for the luxurious. Its principal use, however, is in feeding cage-birds. Occasionally a crop of this very beautiful grain is seen in Kent, but its culture is almost discontinued, and the little which is used in this country is imported from Italy or France.

Another species, *Panicum italicum*, is also said to have been used by the ancients; but there is much confusion respecting the millet plants mentioned by Pliny; we believe he usually meant the species of *Sorghum*, and not those of *Panicum*, as he spoke of "white, black, red, and even purple" millet, and his translators have generally assumed that he meant *P. miliaceum* or *P. italicum*. His descriptions, however, apply strictly only to the species and varieties of durra or Turkish millet, the commonest of which, *Sorghum vulgare*, is now becoming an article of considerable importance in the commerce of this country. It is imported in large quantities, particularly into Liverpool, under the names of "great millet," "durra," "darra," and "Turkish millet;" and there is no doubt that although ostensibly imported as food for cattle and poultry, it is chiefly ground into flour, with wheat, and used for human food. It is this grain, we believe, of which Pliny says, "there is no grain known that weighs heavier than millet, and which swells more in baking." *Sorghum vulgare*, Persoon, is a native of India, but is extensively cultivated throughout Asia, Africa, Southern Europe, and the West Indies. In the last locality it is called negro corn, and is largely consumed by the coloured population when made into bread. It is similarly used in other countries, though not so exclusively; the bread made from it is very white and agreeable. The two-coloured millet, *Sorghum bicolor*, W., is often mixed with it, but the grains are inferior in size, and being marked with a large black spot, the colour when ground is not so good. The imports of these grains have hitherto been very irregular, and owing to the various names under which they have been offered, the quantity cannot be correctly ascertained. In 1856, however, it exceeded 600 quarters.

Pliny says, "A kind of millet has been introduced from India into Italy within the last ten years, of a swarthy colour, large grain, and a stalk like that of a reed. This stalk springs up to the height of 7 feet, and has tufts of a remarkable size, known by the name of 'phobe.' This is the most prolific of all the cereals; for from a single grain no less than 3 sextarii are produced; it requires, however, to be sown in a humid soil." Strangely enough, during the year 1856, this grain, the black millet, *Sorghum nigrum*, of Römer and Schultz, was introduced as a new cereal into the Liverpool corn market, under the name of "sorgho," an evident corruption of its generic name; it came from Italy, and was very strongly recommended for cattle feeding; for which purpose, no doubt, it would succeed admirably. The red millet, *Sorghum rubens*, W., is also occasionally brought from Africa and used for poultry feeding. One of the great millets, *Sorghum saccharatum*, has lately been proposed as a substitute for the sugar-cane, but with very little prospect of success; its hard twiggy panicle has, however, been for a considerable time extensively employed in the United States (where it is called broom-corn) in making those brushes called whisks, and for carpet brooms. Several other species of millet are used in various parts of the world, but they are of comparatively little importance. (T. C. A.)

MILLIN DE GRAND-MAISON, AUBIN-LOUIS, an eminent antiquary, was born at Paris in 1759. He was originally intended for the church, but he afterwards left this sphere, and devoted himself to literary pursuits. In 1785 he published a collection of translations from foreign languages; and becoming acquainted with Willemet the botanist, and having his attention thus directed to natural science, he published in 1790 a work on the Rise and Progress of Natural History in France. On the outbreak of the French revolution, Millin was favourably disposed to the first movements of the friends of liberty; but the excesses and atrocities of the Reign of Terror seriously disconcerted him; and he did not hesitate to express the utmost horror and indignation at these actions. He was in consequence imprisoned, and did not regain his liberty till the fall of Robespierre, in 1794. In the same year he succeeded Barthélemy as keeper of the cabinet of medals, and about the same time he edited, at first along with other distinguished men, and afterwards alone, the *Magasin Encyclopédique*. He also lectured on the history of antiquities; but finding that his labours were injuring his health, he travelled to the south of France, examining the antiquities to be found there. On a second journey thither, which he carried afterwards into Italy, the effects of his exertions were such as to cause his death in 1818. He was a voluminous writer, and his principal works are as follows:—*Dictionnaire des Beaux Arts*, 1806; *Histoire Métallique de la Révolution Française* 1806; *Voyage dans le Midi de la France*, 1807-11; *Voyage en Savoie, en Piémont, à Nice, et dans l'Etat de Gênes*, 1816; *Voyage dans le Milanais, à Plaisance, Parme, Modène, Mantoue, et Crémone*, 1817; and *Histoire Métallique de Napoleon*, 1819-20.

MILLINGEN, JAMES, an antiquary of considerable eminence, was born in London in 1774, and educated at Westminster School, where he became a good classical scholar, and displayed a great taste for antiquities. He wished at one time to enter the army, but was prevented by the state of his health; and when about to go to one of the English universities, his future course was entirely changed by his father's repairing with his family to France, under the influence of the bright hopes inspired by the French revolution. Millingen resided in Paris for some time, where he was imprisoned as a British subject by order of the Convention. When released he became partner in a banking establishment, and continued his study of numismatics. Millingen having undertaken a journey to Italy, died at Florence in 1845. His principal works are:—*Recueil de Medailles Grecques Inédites*, Rome, 1812; *Peintures Antiques Inédites de vases Grecques*, Rome, 1813; *Ancient Unedited Monuments of Grecian Art*, London, 1823; and *Ancient Coins of Greek Cities and Kings*, London, 1831.

MILLOT, CLAUDE-FRANCOIS-XAVIER, a distinguished historian, was born in 1726 at Ornans, a small town of Franche-Comté, and was descended from an old family connected with the profession of the law. When his studies were completed he was admitted among the Jesuits; and after having taught classics in several towns, he was appointed professor of rhetoric in the college of Lyons, one of the most celebrated institutions of the society in France. In a discourse, crowned by the Academy of Dijon, he ventured to pronounce a eulogium on Montesquieu, an act of boldness which offended his superiors, and led to his leaving the society. He next tried the pulpit, but not meeting with much success in that profession, he turned his attention to literature, and began by composing abridgments of the history of France and England, which met with great success. Having about this time received the appointment of professor of history at Parma from the Marquess of Felino, Millot soon found himself highly unpopular in his Italian residence, from his stanch adherence

to the minister his patron, then an object of popular hatred in that state. On the retirement of the Marquess of Felino, the Abbé Millot returned to France, where his courageous conduct procured him many friends. The court of Versailles, in the name of that of Parma, granted him a pension of 4000 francs; and in 1778 he was appointed preceptor to the Duc d'Enghien. He died on the 21st of March 1785, the same day on which, nine years afterwards, his august pupil was shot in the fosse of Vincennes. The Abbé Millot had been received into the French Academy in 1777, in the room of Gresset. He was also a member of the Academies of Lyons, Nancy, and Châlons-sur-Marne. D'Alembert used to cite him as the man in whom he had found the fewest prejudices and the least pretensions. The following are his principal works, viz.:—*Deux Discours*, Lyons, 1750, in 8vo; *Essai sur l'Homme*, translated from Pope with notes, and a discourse on English philosophy, Lyons, 1761; *Harangues choisies des Historiens Latins*, Lyons, 1764, in two volumes, 12mo; *Elémens de l'Histoire de la France*, Paris, 1769, in 3 vols.; *Eléments de l'Histoire d'Angleterre*, Paris, 1769, 3 vols.; *Eléments d'Histoire Générale Ancienne et Moderne*, Paris, 1783, 9 vols., a work which has been translated into the German, Danish, Dutch, English, Swedish, Italian, Spanish, and Portuguese languages; *Histoire Littéraire des Troubadours*, Paris, 1774, 3 vols.; *Mémoires Politiques et Militaires pour servir à l'Histoire de Louis XIV. et de Louis XV.*, Paris, 1777, in 6 vols. 12mo; and *Extraits de l'Histoire Ancienne, de l'Histoire Romaine, et de l'Histoire de France*, Paris, 1796.

MILNE, JOSHUA, the author of the famous Treatise on Annuities which goes by his name, was born in 1776, and pursued the calling of an actuary. His *Treatise on Annuities*, which was published in 1815, is still regarded as one of the standard works on the subject. At his death, in 1851, he left behind him a large library containing a complete and valuable collection of works on the statistics of vitality, and on the science of botany.

MILNER, JOSEPH, a divine and historian, was born in 1744, near Leeds in Yorkshire. He received his elementary education at the Leeds grammar school; but having the misfortune early to lose his father, he was deprived of the means of prosecuting his studies at a university. Milner, however, from his diligence and talent, obtained the employment of chapel-clerk of Catherine Hall, Cambridge, which enabled him to study at that university. After graduating in 1766, he entered the church, and divided his time between teaching and lecturing in Hull. He was made vicar of North Ferriby; and although he met with much neglect and opposition on account of his evangelical views, which subjected him to the charge of Methodism, yet his preaching was exceedingly popular. He was appointed vicar of Hull in 1797, but only enjoyed the preferment a few weeks, when he was removed by death. His principal works are the *History of the Church of Christ*, which was completed by his brother, and two volumes of posthumous *Sermons*.

MILNER, *Isaac*, a learned divine, brother of the preceding, was born at Leeds in 1751. He was educated at the grammar school of his native town, and subsequently at Queen's College, Cambridge, which he entered in 1770 He attained to the honour of a senior wrangler in 1774, and gained a fellowship the following year. In 1785 he was appointed Jacksonian professor of experimental philosophy, received the degree of D.D. in 1788, became dean of Carlisle in 1791, and in 1798 was made Lucasian professor of mathematics. Milner was an intimate friend of Wilberforce, and in 1787 he accompanied him and Pitt to the continent. He died in 1820, after writing a continuation of his brother's *Church History*, besides *Animadversions on Dr Harvies' History of the Church of Christ*.

MILNER, *John*, a Roman Catholic divine, was born at London in 1752, and educated at the college of Douai. After being ordained in 1777, he came to Winchester, where he presided over a Roman Catholic congregation. He was much attached to the study of ecclesiastical antiquities, on which he published several works, and displayed so much skill and learning as to be admitted, in 1790, into the Royal Society of Antiquaries. Milner also engaged in several religious controversies among the Roman Catholic clergy; and published several works on such subjects. He was appointed, in 1803, vicar apostolic of the midland district, and bishop of Castabala. He died in 1826. Milner's principal publications are:—*A Dissertation on the Modern Style of Altering Cathedrals; History, Civil and Ecclesiastical, and Survey of the Antiquities of Winchester; Treatise on the Ecclesiastical Architecture of England during the Middle Ages.*

MILNTHORPE or MILLTHORPE, a market-town of England, county of Westmoreland, near the east bank of the estuary of the Kent, and on the Preston and Carlisle railway, 7 miles S.S.W. of Kendal. It has manufactures of sacking and twine, and some trade by means of small coasting vessels, which come up, by means of the tide, opposite the town. Market-day, Friday. Pop. (1851) 1534.

MILO, T. ANNIUS PAPIANUS, son of C. Papius Celsus, was born at Lanuvium. Little is known of his life till the year 57 B.C., when he became tribune of the people, and attached himself to the party of Pompey. The object of this party, at that time, was to procure the restoration of Cicero from exile; and this measure did not fail to bring down upon Milo the hostility of Clodius, who had formerly, as tribune, been the chief supporter of the law which exiled Cicero. Both Clodius and Milo surrounded themselves with bands of armed gladiators, and frequent and bloody were the conflicts between these two factious demagogues. These riots were not allayed by the return of Cicero; for that orator and Pompey were the objects of repeated attacks from Clodius and his partizans, while Milo and his followers stood up in their defence. Both thus rendered themselves liable to prosecution for assault, and each was ready to accuse the other; but Clodius succeeded in protecting himself by obtaining the office of curule ædile for 56 B.C., and Milo was secured from danger by the influence of Pompey. In the year 53 B.C., when Milo became a candidate for the consulship, and Clodius for the prætorship, their former animosities were renewed with increasing violence; and Milo, on being attacked by Clodius in the senate on account of the debts with which he was loaded, was defended by Cicero in a speech of which some fragments have been preserved. In the beginning of the next year, as Milo with his usual escort of armed gladiators was journeying from Rome to Lanuvium, he was met near Bovillæ by Clodius, attended by a similar body-guard. After the two leaders had passed each other in quietness, a dispute arose between some of their followers, and in the fray which ensued, Clodius, whose party was inferior in strength, was dragged from a house in which he had taken refuge, and slain by the followers of Milo. For this act Milo was brought to trial by the nephews of the deceased; and, though defended by Cicero, the turbulence of the crowds who collected to witness the trial, and the soldiers with whom Pompey had caused the forum to be lined, so intimidated the orator that he was unable to deliver the speech he had prepared for the occasion. Milo was accordingly condemned and sentenced to exile, in terms of the law passed by Pompey with special reference to this case. He then retired to Marseilles; and when Cicero sent him an improved copy of the speech he should have delivered in his favour, Milo replied that it was well he had not spoken thus, "For if so," said he, "I should not now be enjoying the excellent fish of Marseilles." He remained at Mar-

seilles till 48 B.C., when he returned to Italy at the invitation of M. Cælius, who, having been expelled from the senate, was raising a rebellion in the south of Italy. Milo joined him; but their enterprise was not successful, and Milo was slain before a small fort near Thurii.

MILO (the ancient *Melos*), an island of the Grecian Archipelago, one of the larger Cyclades, in Lat. 36. 45. N., Long. 24. 26. E. It is about 13 miles in length from E. to W., and where broadest is about 7 miles across. Area 65 square miles. Its N. coast is deeply indented by a spacious bay stretching S.E. for about 6 miles, and forming one of the best and safest harbours in the Levant. Milo is evidently of volcanic origin, and the surface is for the most part rugged and mountainous. The valleys and low grounds are of great fertility, and produce abundance of corn, wine, oil, and fruit. It has hot mineral springs, and mines of sulphur, vitriol, and alum. The highest summit is Mount St Elias, 2538 feet high. Milo, the chief town, is situated near the bottom of the bay, and is now chiefly in ruins. It is unhealthy by reason of salt marshes in the vicinity. Here the beautiful antique statue of Venus, now in the French collection, was discovered during the present century. The population of the island is said not to exceed 4000.

MILON, a famous wrestler of antiquity, the son of Diotimus, was born at Crotona. He is chiefly remarkable for his bodily strength, by means of which he obtained the crown for wrestling six times at Olympia, and as many times at the Pythian games. He flourished towards the end of the sixth century B.C.; and in 511 B.C. headed his countrymen in a successful battle against the Sybarites. Many stories are related of his strength, of which the most remarkable are, his supporting a falling house till its inhabitants escaped, and his carrying a heifer on his shoulders round the Olympic race-course. After he had become weakened by age, he is said to have seen one day in a forest a tree half split by wedges, and as he endeavoured to tear it asunder with his hands, the wedges fell out, and he being caught by the hands in the tree was devoured by wild beasts.

MILTIADES, a great Athenian general and statesman, was the second son of Cimon, and flourished in the fifth century B.C. He makes his first appearance in history at the death of his brother Stesagoras, who had succeeded to the tyranny founded over the Thracian tribe of the Doloncians by his uncle the elder Miltiades. Repairing to the Chersonese with a small handful of Athenian troops, Miltiades by a clever stratagem decoyed the Doloncian magnates into his power, and thus mounted the vacant throne without opposition. With the same promptitude he fortified his newly-attained position by enlisting a body-guard of mercenaries, and espousing Hegesipyla, the daughter of a Thracian prince, Olorus. He was reigning with great popularity when he was summoned in 513 B.C. to attend Darius Hystaspis in his expedition against the Scythians. The duty allotted to him and the other Greek commanders was to guard the bridge of boats across the Danube, while the rest of the army penetrated into the interior of the enemy's country. But as Miltiades considered the Persian monarch to be the natural foe of Greece, he advised his fellow-soldiers to destroy the bridge, and leave Darius and his host to perish in the wastes of Scythia. After a debate, however, his advice was set aside. Some time afterwards Miltiades was forced to retreat from his kingdom before an irresistible horde of Scythians, and not until the enemy had retired was he able to return. About this period also the islands of Lemnos and Imbros were wrested by him from the hands of Persia and subjected to the power of the Athenians. It is probable that this deed, and his well-known devotion to the Greek cause, drew upon himself the resentment of Darius. At any rate, Miltiades was compelled, by the approach of a Phœnician fleet, to abandon his dominions and betake himself to Athens. No sooner had he set foot on his native soil, than he was arraigned by the Athenian democracy for supporting the cause of tyranny by his occupation of the Doloncian throne. His eloquent appeal, however, to his services in behalf of the Athenians confounded his accusers and secured his acquital. Miltiades now rose to the highest honours and offices of the state. But not until the approach of the Persian armament under Datis and Artaphernes, in 490 B.C., did his genius and heroism rise to their full development. Then it was that he incited his fellow-citizens to proclaim their defiance of the invaders by casting into a pit the insolent Persian legates who had come to Athens to demand earth and water. Appointed one of the ten generals who led the little Athenian army forth into the plain of Marathon, he urged his fellow-commanders to meet the immense host of the enemy on a fair field of battle. His eloquence prevailed; and when it was his own turn to assume the supreme command he prepared for the fight. After selecting a position where his forces could not be surrounded by the overwhelming numbers of the enemy, he drew up his line, placing heavy phalanxes on the wings, and the light troops in the centre. His army was then ordered to move forward. As it advanced the two wings fell into double-quick march, and bore down with resistless force upon the right and left of the enemy. The Athenian centre then gave way, and suffered part of the Persian army to pass into the space between the two wings. At that instant the solid Greek phalanxes, which were by that time unopposed, wheeled round with vehement celerity and crushed the remnant of the foe between their two lines. No sooner had this victory been gained, than Miltiades posted towards Athens with a part of his army, and arrived in time to save the city from being attacked and pillaged by the Persian fugitives. He was now treated with the highest esteem by his fellow-citizens. In the public picture that was painted to commemorate the battle of Marathon, he was represented standing foremost of the ten commanders and animating his soldiers for the charge. It was not the habit, however, of the Athenians to honour a great man when his services in their behalf did not succeed. Accordingly, the unsuccessful expedition of Miltiades against the island of Paros changed his enthusiastic admirers into his deadly enemies. He was publicly impeached for having misled his country into a disastrous war, and the mob began to clamour loudly for his life. A wound which he had received in his late campaign, and which had turned into a gangrene, prevented him from confronting his accusers with his ready eloquence, and obliged him to entrust his cause to his brother Tisagoras. He was found guilty, and sentenced to pay a fine of fifty talents. As he was unable to meet the sentence, his maimed and shattered body was cast into prison. There grief and disease terminated the career of Miltiades in 489 B.C., the year after he had won the battle of Marathon. But the vengeance of his enemies was not yet exhausted. His lifeless body was denied a resting-place, until his son Cimon gave himself into custody as surety for the fine which had been imposed. The best authority for the biography of Miltiades is Herodotus. (See ATTICA.)

MILTON, or MILTON-ROYAL, a market-town of England, county of Kent, on an inlet of the channel between the Isle of Sheppy and the mainland, 11 miles N.E. of Maidstone, and 39 E. by S. from London. The town stands on the declivity of a hill, and is old and irregularly built, but it contains many good houses and cottages of recent erection. The inhabitants are principally engaged in the oyster fishery,—the "Milton natives" being in great demand in the London market. Some trade in corn and other agricultural produce is also carried on. Market-day, Saturday. Pop. of parish (1851) 2407.

MILTON.

Milton. JOHN MILTON was born at his father's house in Bread Street, in the city of London, on the 9th of December 1608. Nothing of the material fabric of the street in which he was born now remains, the great fire of 1666 having destroyed that with so much of the rest of old London. But the present Bread Street, which is one of the streets striking off from the great thoroughfare of Cheapside towards the river, occupies the exact site of the old Bread Street; and the spot in which Milton was born may be yet identified as being that occupied by the third or fourth house on the left, going from Cheapside. Here, as one of a line of very respectable shops, and dwelling-houses over them, inhabited chiefly by merchants, and all, as was then the custom, distinguished by signs over the doors and not by numbers as at present, there stood, prior to the great fire, a house and shop known as the Black-Spread Eagle. Milton's father, whose name was also John, had occupied this house since 1603, and carried on in it the business of a scrivener or a copying-lawyer. The story is, that he had betaken himself to that profession some fifteen or twenty years before, on being disinherited by *his* father, a substantial yeoman in Oxfordshire, for having abandoned the Catholic faith. He had prospered well, and had become possessed of considerable property, including the house in Bread Street; and the sign of the Spread Eagle affixed to the house was no other than the armorial device of his family. Before removing to this house, and when verging on forty years of age, he had married a lady considerably younger than himself, whose name, according to one account, was Sarah Bradshaw, but according to another, Sarah Caston. Five children were the issue of the marriage, of whom only three attained to mature years,—a daughter, Anne, a year or two older than the poet; the poet himself; and a son named Christopher, exactly seven years younger than the poet.

In Milton's case there is less trace of the effect of that rude, though powerful kind of education which is afforded to all children by the mere miscellany of external circumstance amid which they live, than of the effect of the more express education of orderly domestic training. Here, to use a common phrase, he had every advantage. Peace, piety, and comfort reigned in the home in Bread Street. Like most of the substantial London citizens of the time, the scrivener was of Puritan leanings in the matter of religion, and his household was regulated on Puritan principles. But he was also a man of liberal culture and taste. He was especially skilled in music; and specimens of his skill in this art may be seen in various musical publications of the day. It was from him that Milton derived his musical ear and his first tuition in music as an art and a science. This excellent man discerned the genius of his son from the first, and found the chief pleasure and pride of his life in fostering it and watching its growth. Of Milton's mother we hear less. She was, according to Milton himself, "a most amiable woman, particularly noted for her charities in the neighbourhood;" and Aubrey adds that she had such weak eyes, that before she was thirty years old she had to wear spectacles.

It was in his father's house that Milton received his earliest literary education. His first teacher was Thomas Young, a Scotchman, who, after having been educated at one of the Scottish universities, had migrated into England. His connection with the Milton family may have begun as early as 1618, when his pupil was ten years of age; and it must have closed by 1623, when Young went abroad as chaplain to the British merchants at Hamburg, from which exile he returned in 1628 to be settled as vicar of Stowmarket in Suffolk. While still under Young's care Milton was sent to St Paul's School—a public grammar school of as high celebrity as any in London, and convenient as being situated within a minute's walk of Bread Street. The head master of the school was Alexander Gill, a Lincolnshire man, whose reputation as a teacher was then great; and the usher, or under-master, was his son, the Rev. Alexander Gill, junior, who had recently left Oxford with a considerable name as a scholar. With him Milton contracted an acquaintance, which was continued afterwards; and he also formed a friendship with a fellow-pupil at the school, named Charles Diodati, the son of an Italian physician settled in London. Diodati left school for Oxford in 1621; but Milton remained at school three or four years longer. At school, according to Aubrey, "he studied very hard and sat up very late, commonly till twelve or one o'clock, and his father ordered the maid to sit up for him; and in these years he composed many verses which might well become a riper age." Of these early poetical exercises, the only remaining specimens are his English Paraphrases of Psalms cxiv. and cxxxvi., which bear to have been done in his sixteenth year. Milton himself, however, confirms Aubrey's account of his excessive studiousness from his earliest boyhood; and he says, that when he was sent to the university he was already "instructed in various tongues," and had "no mean apprehension of the sweetness of philosophy." Milton.

Cambridge has the honour of counting Milton among her many eminent sons. He was entered as a lesser pensioner at Christ's College, Cambridge, on the 12th February 1624–5, when he was sixteen years and two months old; and he continued his studies in the college for the full academic period of seven years. Concerning his college life there has been much difficulty among his biographers. Johnson was the first to hint the belief that while at college he sustained some punishment at the hands of the college authorities, if not the indignity of corporal chastisement. The original authority, however, for such a statement is Aubrey, whose memoir of Milton, accessible in print since 1813, Johnson had probably seen in MS. at Oxford. Aubrey says, that Milton having received "some unkindness" from his first tutor at college, left him for another; and over the words "some unkindness" there are inserted in the MS. the words "*whipt him.*" On this, taken in connection with Milton's first Latin elegy, in which, writing to his friend Diodati, he seems to refer to some difference with the college authorities which was occasioning his temporary absence from college, the whole controversy has been raised. From the investigation we have been able to bestow on the subject, the facts seem to be these:—That about the second or third year of his residence at college Milton did have some difference with his first tutor, Mr William Chappell, then one of the most distinguished tutors in the university, and afterwards Bishop of Cork and Ross; that this difference did involve some interference on the part of the master of the college, Dr Bainbridge, in consequence of which Milton left college for a time; but that eventually the difference was adjusted by his being transferred from Chappell's tutorship to that of the Rev. Nathaniel Tovey, afterwards a parish clergyman in Leicestershire. It is certain, at least, that any "rustication" to which Milton was subjected did not involve the loss of a single term of his academic course. He took both his degrees exactly at the proper time—his B.A. degree in January 1628–9, and his M.A. degree in July 1632. Apart,

however, from the controversy as to his rustication, it is certain, from Milton's own statements, that at first, owing to a certain haughtiness of manner, and also to a certain obstinacy in pursuing his own course of study, he was unpopular within the walls of the college. His college fellows, he tells us, used to nickname him "The Lady," in allusion partly to the delicacy of his personal appearance, and partly to his moral fastidiousness. He informs us distinctly, however, that this unpopularity was but temporary, and that long before he left college he had won the respect not only of the college, but of the whole university. He speaks in one place of "that more than ordinary favour and respect which he found *above any of his equals* at the hands of those courteous and learned men" who were the authorities of his college, and who, he says, when he left them in 1632, "signified in many ways how much better it would content them that he would stay." In short, Milton left the university with the highest possible reputation. "By his indefatigable study," says Anthony Wood, "he profited exceedingly, and was esteemed to be a sober and virtuous person, yet not to be ignorant of his own parts." These last words are worth noting. From the very first there is discernible in Milton a vein of noble self-respect, and even self-assertion; a conviction of superior power when measured with others; a conscious dedication of his life to noble ends; and a resolution to preserve unstained the purity of his moral being, as essential to the capacity of truly great work in the world, or truly great endeavour of whatever kind.

On going to the university Milton had been destined for the church. For this purpose he had gone through the usual course of study in rhetoric, logic, and the scholastic philosophy and theology—studies, however, which even then he regarded in the main as barren and unprofitable, and on which, as on the whole system of university training, he afterwards looked back with vehement contempt. There is evidence that during the seven years which he spent in Christ's College he led a life of singular intellectual independence, performing his academic tasks duly, but occupying himself with much else of his own choosing. The following is a list of his remaining writings during this period (1625–1632):—

I. Latin.—(1.) In *prose*, the first four of his *Familiar Epistles*, written in 1625 and 1628, and addressed to Thomas Young and Alexander Gill the younger; and seven college themes or orations on various subjects written between 1626 and 1632, and first published by him, along with his *Familiar Epistles*, in 1674, under the title of *Prolusiones quædam Oratoriæ*. (2.) In *verse*, thirteen pieces, chiefly on incidents of his university life; to wit, the seven pieces in the elegiac metre which form his *Elegiarum Liber*, and the first six pieces of his so-called *Sylvarum Liber*.

II. English.—Thirteen poems, longer or shorter, as follows:—*On the Death of a fair Infant dying of a cough*, 1626—the infant being the poet's niece, the daughter of his sister Anne, who in 1624 or 1625 had married Edward Phillips from Shrewsbury, who held a situation in the Crown Office, London; part of a *Vacation Exercise at College*, 1628; The *Hymn on the Nativity*, 1629; *On the Passion*, 1630; *On Time*, 1630; *On the Circumcision*, 1630; *At a Solemn Musick*, 1630; *On May Morning*, 1630; *On Shakspeare*, 1630; *On the University-Carrier* (Hobson), "who sickened in the time of his vacancy (January 1630-1), being forbid to go to London by reason of the plague;" *another on the same; An Epitaph on the Marchioness of Winchester*, 1631; Sonnet on his twenty-third birthday 1631.

No one can read these juvenile compositions now without discerning in them ample promise of what Milton became. The English poems are best known; and in one or two of them—as in that on the Fair Infant and that on Christ's Nativity—there is evidence of true poetic genius and of the most exquisite skill in words and verse. But it is in the less read Latin compositions, perhaps, that the leading traits in the *character* of the young poet are best exhibited. There, while we admire the strong understanding and a command of the Latin tongue in comparison with which the usual classical Latinity of modern scholars is forced and feeble, and while also, even in the cumbrous element of the Latin, we discern the graceful winging of the poetic muse, we see at the same time, better than we can see in the English poems, the habitually grave and austere tone of Milton's mind from his earliest youth,—its tendency, on the one hand, to scorn, and a kind of ferocity of disgust and reprobation; and on the other, to high ideal views and contemplations such as enter only the spirits of the sublime. Nowhere else in the range of juvenile writing known to us is there such distinct evidence of what Horace has called the "*os magna soniturum*,"—the mouth formed for great utterances. The very heaviness of such attempts as there are at the facetious and the humorous proves that it was not in these that Milton was fitted to excel. "*Festivitates et sales*," he says himself in one of the pieces, "*in quibus perexiguam agnosco facultatem meam*." In other words, the basis of his character was a moral austerity inconsistent with mere frolic or frivolity, though not inconsistent with the free exercise, on the one hand, of a powerful and inquisitive intellect, or, on the other, of a phantasy delighting in the minutest forms of the musical and the graceful.

It is to be remembered that, though Milton had the compositions above mentioned in manuscript before leaving Cambridge, none of them was published prior to that time except the Epitaph on Shakspeare. It appeared anonymously among the laudatory verses prefixed to the second folio *Shakspeare* in 1632; and it is interesting to know that Milton's first appearance in print was on such an occasion. He was then in his twenty-fourth year. According to his original intention, he would about this time have been passing from college to some country curacy; and one can hardly help speculating as to what might have been the result for the Church of England had he done so. A Milton among the ecclesiastics of the days of Laud would have been a phenomenon of some interest. Long ere leaving college, however, he had abandoned the idea of being a clergyman. The reason was his jealous concern for his intellectual and religious freedom—a state of mind for which the condition of the Church of England under the ascendancy of Laud afforded little chance of satisfaction. Whoever would become a clergyman at that time must, he said, "subscribe slave, and take an oath withal, which, unless he took with a conscience that could not retch, he must strait perjure himself." He describes himself, therefore, as "church-outed by the prelates," and as having no other prospect left to him than that of a life devoted to study and literature. It says much for the liberality and discretion of his father, that in these circumstances, instead of urging him into a profession against his will, he suffered him to take his own way. Till he was thirty-one years of age Milton did not earn a penny for himself.

The five years of Milton's life which followed his leaving college (1632-1637) were spent by him at Horton in Buckinghamshire, about 20 miles from London, whither his father had retired in his old age after giving up business. These five years, according to his own account, were spent in complete literary leisure and the enjoyment of the quiet rural beauty of the neighbourhood; not but that sometimes he "exchanged the country for the town, either for the purpose of buying books or for that of taking lessons in music or mathematics." During this time, he says, he turned over the Greek and Latin writers; doubtless also the Italian, French, and English; and there is proof also that he entertained for a time the notion of studying law along with his younger brother Christopher, who had adopted the law as his profession. Of his literary assiduity during the same period there is ample evidence in a long list of subjects for dramas and other poems, drawn out by him in the course of his miscellaneous reading, and now preserved, with

others of his manuscripts, in the library of Trinity College, Cambridge. Of his actual and surviving writings during this period, however, the following is a list:—

I. Three Latin *Familiar Epistles*,—the first dated 1634, and addressed to Alexander Gill the Younger, and the other two dated September 1637, and addressed to Charles Diodati. Possibly also a scrap or two of Latin verse.

II. The following well-known English poems:—

1. The *Sonnet to the Nightingale*; and possibly one or two other sonnets.

2. The two exquisite companion poems *L'Allegro* and *Il Penseroso*.

3. "*Arcades*; part of an entertainment presented to the Countess Dowager of Derby at Harefield by some noble persons of her family, who appear on the scene in pastoral habit." The Dowager Countess of Derby here alluded to was the same lady who, in her youth forty years before, had, under the name of Amaryllis, been the theme of Spenser's song. After the death of her first husband, Lord Strange, who succeeded his father as Earl of Derby in 1594, she had married the lord keeper, afterwards Lord Chancellor Egerton, by whose death in 1617 she was left a widow for the second time. She lived at Harefield House, near Uxbridge, where she frequently had her younger relatives about her, including the Earl of Bridgewater, her second husband's eldest son, who had married one of her daughters by her first husband. It has been supposed that this venerable lady and her family had discovered the poetic talent of Milton, and had him frequently with them as a favoured guest; but the more probable supposition is, that the young people of her family, having resolved, according to the custom of the time, to get up a masque or musical entertainment in her honour, Milton wrote the words of the *Arcades* to oblige his intimate friend Henry Lawes the musician, who had been charged with the arrangements. The date of the entertainment was 1633 or 1634; and *Arcades* was therefore written when Milton was in his twenty-sixth year.

4. "*Comus*; a masque presented at Ludlow Castle 1634, before John, Earl of Bridgewater, then President of Wales." Pleased with the *Arcades*, the young people of the Bridgewater family had determined on a longer and more elaborate performance of the same kind; and they found an excellent opportunity for it in the autumn of 1634, when the earl went to Ludlow Castle in Shropshire to take up his official residence there as Lord President of Wales. His children,—Lord Brackley, Mr Thomas Egerton, and Lady Alice,—went with him; and there was a congress of the neighbouring nobility and gentry. The masque for such an occasion required to be something beyond ordinary; and while Lawes did his best for the music, it was felt by the family that it would raise the character of the entertainment if Milton would undertake the poetry. He did so; and taking a hint, it is said, from an adventure which had befallen Lady Alice in Haywood Forest, produced the beautiful masque of the Lady lost in the Enchanted Wood, and beguiled by Comus and his crew, till her brothers find her. It was by far the most considerable poem that Milton had yet produced, and the rumour of it must have carried his name into many circles. That it did so, we learn from the fact that Lawes published the poem in 1637, with a dedication to Lord Brackley, in which he says, that "although not openly acknowledged by the author, yet it is a legitimate offspring, so lovely and so much desired, that the often copying of it hath tired my pen to give my several friends satisfaction, and wrought me to a necessity of producing it to the public view."

5. *Lycidas*; a monody on the death of Mr Edward King, a young gentleman of great promise, who had been Milton's college companion at Cambridge. He was drowned in August 1637 in crossing from Chester to Ireland, where his friends resided; and the event seems to have produced a great sensation at Cambridge, where a volume was published in the following year, containing three Greek, nineteen Latin, and thirteen English poems to his memory. Milton's *Lycidas*, which is signed "J. M.," closes the volume. He had most probably written it at Horton and sent it to Cambridge. He was then in his twenty-ninth year.

Such were Milton's productions during the five years of his residence under his father's roof at Horton, or from his twenty-fourth to his twenty-ninth year. They are small in bulk, but how exquisite in quality! The minor poems of Milton are, and ever will be, the admiration of critics; and had Milton died at the same time as the friend whom he celebrates as Lycidas, we should still have had, in virtue of those poems, to pronounce his beautiful name among those of the sons of the English muse.

Considered, however, in relation to our knowledge of Milton as he was all in all through life, there is a peculiarity in these early poems. They are truly Miltonic; but they are Miltonic, not in the sense that they represent the whole of Milton, even as he was when he wrote them, but in the sense that they represent him in those moments when he bent his softer genius to the exercise and relaxation of English verse. The poems belong, on the whole, to the idyllic, or what may be called the sensuous-ideal class; that is to say, they are rather poems of rich and beautiful phantasy, of quiet thoughts and imaginations sweetly linked, than of powerful human interest or greatly agitated feeling. They are in this respect not unlike the poetry of Spenser and Keats. According to Coleridge's remark, however, they prove all the better on this account that Milton was by nature a poet. The tendency to choose themes lying remote from ordinary social interests, and the ability, in treating such themes, to wander on and on in a purely ideal manner, weaving a tissue of sensuous fancies connected by occult relations of beauty rather than by the direct associations of place and time, are, according to Coleridge, the most hopeful signs in a youthful poet. These signs were visible in Milton from the first. With all his moral austerity, all his learning, all the strength of his understanding, and all his sterner inclination to the dogmatic, the indignant, and the polemical, his main delight from the first, when he was free to choose, was in purely literary and especially poetic recreation; as if to show how, by reason of very strength, a soul might come to rest in the sweet and exquisite, and so make true his own maxim,—

"How charming is divine philosophy!—
Not harsh and crabbed as dull fools suppose,
But musical as is Apollo's lute."

His early preferences in literature, he tells us himself, had been for the "smooth elegiac poets," whom, both for their matter and "the pleasing sound of their numerous writing," he found "in imitation most easy, and most agreeable to nature's part" in him. He means here poets of the sensuous or sensuous-ideal order, and refers chiefly to Ovid and other classic and Italian poets, though Spenser may be included. That he was right in saying that, as regards their form, the imitation of these poets was agreeable to nature's part in him, no reader of the minor poems can doubt. One of the most striking things about them, especially when compared with the contemporary English poetry produced under Ben Jonson's critical supremacy during the last years of his laureateship, is the perfection of their literary texture,—the taste and finish of their language and versification. Ben died in 1637, and they were therefore in existence in time for him to have seen them, or some of them; and if he had seen them, he would have found even his own most graceful masques, and much more the productions of the Randolphs and others whom he regarded as his literary children, but slovenly things in comparison. But while the *form* of the poets whom he admired presented no difficulty to Milton, was rivalry with them in *matter* equally agreeable to nature's part in him? On this point there have been varieties in opinion. That all in all Milton was a poet; that he possessed the poetic faculty *par excellence*,—call it imagination, ideality, or what we will,—no one has yet been bold enough to deny; and there are perhaps few who would not agree with Coleridge that the nature of this "poetic imagination"—this "vision and faculty divine"—may be better studied in Milton, by reason of its colossal proportions in him, than in any other English poet. If imagination in the poet is the power of thinking in concrete circumstance, of embodying meanings and states of mind in imaginary scenes, incidents, and objects of beauty, which remain in the memory as "a joy for ever,"—what imagination in the *Penseroso* and the *Allegro*, where the poet has collected and woven together with such musical art the circumstances of nature and life suggestive to the recluse of melancholy on the one hand, and of cheerfulness on the other; in the *Arcades*, where, upon the simple

incident of two or three young people advancing on an English lawn with the homage of a speech and songs to a venerable lady seated under the trees to receive them, the poet has framed so complete and so charming a phantasy for ear and eye; in the *Comus*, where, on the suggestion of a larger incident of the same kind, he has provided for us, and placed irremovably in our literature, that phantasy of the enchanted forest, more British than any in Spenser, and yet wholly air-hung, through which the lost maiden is ever wandering, and the noble pair of brothers are ever searching for her, and the magical crew are ever revelling with evil intent, and the attendant spirit of purity, disguised as a shepherd, is ever walking his watchful round; finally, in the *Lycidas*, where, because a hopeful youth has died, we are back among the streams and dells of Arcadia, and behold a landscape in tears! And yet here occurs a question. Imagination or poetry consists in embodying meanings and feelings in forms, which forms must be sensuous; but can it be that a mind should have this poetic tendency to sensuous embodiment of an ideal kind without having a fondness for what may be called the actual sensuous, or, in other words, a love of natural beauty and an accurate perception of it? As regards Milton, this question has been raised incidentally by Mr Ruskin, who, in a classification he has given of eminent moderns according to the degree in which they seem to him to have possessed a constitutional delight in nature, or the habit of accurately perceiving natural beauty, has placed Milton, along with such men as Bacon and Johnson, among those in whom this quality was moderate or defective, as distinct from those, such as Shenstone, Keats, and poets generally, in whom it was evidently great. Now there is much importance in this separation of the men of thought and energy on the one hand, who act outwards upon nature, and whose greatness consists in such action, from the men of sensibility on the other, who are tremulous to the sights and sounds of nature, and find their function in recording and reproducing them; nor is Mr Ruskin wrong when he places Milton among the men of thought and dogma, who had strength within themselves, and whose faculty did not lie mainly in the tips of their outer senses. He seems to be unjust to Milton, however, in the negative part of his criticism, which denies to Milton keenness of external perception and sensibility to natural beauty along with his moral and speculative strength. His minor poems have much of their charm in their sensuousness; this is, indeed, the word that would be used to characterize what is most evident in them. By Wordsworth himself,—who recalled our poetry to truth and nature, and who was at war with almost all our poets from Dryden downwards, precisely because, as he said, they had never looked at nature for themselves, but had spoken of her by rote,—the accuracy of Milton's images from nature was never impugned, but was, on the contrary, asserted and exemplified, and held up by way of example; and it would take much argument now to prove that the sensuousness of Milton's poetry was a simulated or merely literary sensuousness, and not the real sensuousness of a man who delighted in the fields, and the flowers, and the clouds, and whose mind teemed with recollections of them. We do not find in Milton, indeed, that universal retentiveness of objects and facts of all kinds, from the oddities of street life, up through the beauties of sylvan scenery, to the splendours of celestial space, which we find in Shakspeare, and to which, so far as facts of the lower or more uncouth order are admitted along with those of the higher, a certain humorous lightness of disposition, such as Milton did not possess, seems to be essential. It may be also that, in Milton as in other men, there had been developed a kind of secondary love of nature, as already transfused and attenuated into literature, and seen through the mist of beautiful speech. All in all, however, as it was certainly the bent of his genius to express itself in sensuous imaginations, so there seems to have been no film separating him from the world of actual existence whence the materials for these imaginations are usually drawn; but, on the contrary, such a habitual intimacy of his senses with whatever in nature or life was beautiful or impressive, that whenever his phantasy began to work, his memory was ready with authentic forms, sounds, colours, or whatever else was necessary for any poetic combination. His woods, his flowers, his atmosphere, are the woods, the flowers, and the atmosphere of genuine English nature.

Underneath the grace and the flowers, however, there are in these minor poems of Milton all the signs of his manly strength. We have called them sensuous-ideal in their general character, and have spoken of them as being, even in virtue of their singular excellence in this kind, essentially Miltonic; but they are Miltonic also in a higher and more complete sense, as indicating the massiveness of Milton's moral, and the height of his intellectual, nature. The purity of tone in all of them is as perfect as the literary taste; and every now and then, from amid the softness and the luxuriance there breaks forth a passage of luminous speculative meaning or sublime moral maxim. In *Comus* the very theme is the inviolability of virtue by all the powers and wiles of assailing circumstance; and here, as also in the later poem of *Lycidas*, there are outbreaks of the spirit of the future polemic and stern social reformer.

Just before *Lycidas* was written Milton's mother had died (Aug. 3, 1637) at Horton, where she lies buried. From his father, now about seventy-four years of age, the poet not long after obtained leave to make a continental tour, more expressly for the purpose of visiting Italy. He set out with one servant towards the end of the year, taking with him some letters of introduction, and some good advice from Sir Henry Wooton, provost of Eton, who had been King James's ambassador at Venice. He was kindly received at Paris by Lord Scudamore, the English ambassador, who introduced him to Grotius, then ambassador in Paris for Queen Christina of Sweden, and also gave him letters to English merchants in Italy. He went to Genoa by way of Nice, and from Genoa to Leghorn, Pisa, and Florence. At Florence he remained two months, frequenting the society of artists and men of letters. From Florence he went to Siena, and thence to Rome, where he also stayed some time and formed some useful acquaintances. He next visited Naples, where he received much attention from the aged Giovanni Battista Manso, Marquis of Villa, the friend and patron of Tasso. Manso at parting took him to task in a friendly manner for his imprudence in speaking too frankly of religious matters. From Naples it was Milton's intention to proceed to Sicily and Greece; but the news which he received of the imminence of a civil war in his native land determined him to return. "I thought it dishonourable," he says, "that I should be travelling at my ease for amusement when my fellow-countrymen at home were fighting for liberty." Returning northwards, therefore, he reached Rome again, where he was told that the Jesuits had laid a plot against him; but though he remained two months more there, and made no concealment of the strength of his Protestantism, he was not molested. From Rome he went again for two months to Florence; thence to Lucca, and so across the Apennines, through Bologna and Ferrara, to Venice. Thence, after a month's stay, and having shipped for England the books he had bought in Italy, he travelled, by Verona, Milan, and the Pennine Alps, to Geneva, where he became acquainted with the theologian Diodati, the uncle of his friend Charles; and so through France back again to England, from which he had been absent in all a year and three months. While still abroad, Milton had heard of the death of his friend Charles Diodati; and on his return he wrote his Latin poem entitled *Epitaphium Damonis* in honour of his memory.

One result of the Italian tour, which has not perhaps been sufficiently noted, was its effect in stimulating his literary ambition. While in Italy he had shown about, according to the custom, or had recited in literary circles, some of his juvenile compositions in Latin and English, and had also written some additional trifles, among which were his few Italian sonnets, and his three short Latin poems, *Ad Leonoram Romæ canentem;* and the two longer ones, entitled *Mansus* and *Ad Salsillum poetam Romanum ægrotantem.* These specimens of his taste and skill had won him, in return, complimentary letters and copies of verses from the Italian scholars and wits, some of which he thought worth preserving, to be shown afterwards to his less appreciating countrymen. "Gratified," he says, with encomiums of this kind, "which the Italian is not forward to bestow on men of this side the Alps," he had no sooner returned to England than he felt the desire for literary production more strongly than ever. "I began," he says, "thus far to assent both to them and to divers of my friends here at home, and not less to an inward prompting which now grew daily upon me, that by labour and intent study (which I take to be my portion in this life), joined with the strong propensity of nature, I might perhaps leave something so written to aftertimes as they should not willingly let it die." His aspirations had even taken a certain determinate direction as regarded the work on which he was to spend his strength. Knowing that "it would be hard to arrive even at the second rank among the Latins," he had resolved that his literary labours thenceforth should be chiefly in his mother tongue, "not caring once to be named abroad, though perhaps he could attain to that, but content with these British islands as his world." He had resolved, moreover, that his main work should be a poem, and a poem of the higher order, in which "what the greatest and choicest wits of Athens, Rome, or modern Italy, and those Hebrews of old, did for their country," he "in his proportion, with this over and above of being a Christian," might do for his. As to the precise form and subject of such a poem, however, he had not made up his mind—whether it should be epic, after the model of Homer, Virgil, and Tasso, and if epic, what king or knight of British history before the Conquest should be chosen as the hero; or whether it should be a stately drama, in which something of the form of Sophocles and Euripides should be combined with still higher forms, of which the Bible, and especially the Apocalypse, afforded examples; or whether, finally, it should be some grand lyric, such as heathen genius had hardly yet attempted.

Alas! these schemes and ruminations were destined to a speedy and severe interruption. The civil war, prognostications of which had reached him in Italy and hastened his return, was now about to begin in earnest; and for a period of twenty years Britain was to be the scene of a social strife such as had been scarce paralleled in the world before. During these twenty years there was very little literature produced in England that was not polemical in its tenor. There were controversial treatises and pamphlets in abundance; there were also satires and songs for political purposes, and full of political allusions; but of pure history, pure philosophical writing, or pure poetry, there was little. The men of talent from whom literature of such kind was to be expected were either dispersed abroad, or, if they remained in England, were whirled along in the common agitation. In the lives of Shirley, Waller, Hobbes, Davenant, Cleveland, Denham, and Cowley, and even in those of men like Jeremy Taylor and Fuller, the effects of the civil wars of Charles's reign, as bending them somewhat, both in external and in internal respects, out of what might otherwise have been their course, may be traced without difficulty. But in the case of Milton the effect is infinitely more striking. But for the civil wars we should have known but half the man. In his case there was a pre-established harmony of mind with the great national revolution through which he had to pass; there were elements in his moral and intellectual being which actually *waited* for the convulsion; nay, of him alone, in the midst of the Davenants, and Cowleys, and Wallers, can it be said that there was something in his very notions of literature itself which, corresponding as it did by a profound affinity to the new Puritan spirit then beating in the heart of the English people, pointed for that very reason to a literary development which should be no mere continuation of the dregs of Elizabethan wit, but an outburst as original intellectually as the Puritan movement was socially, and requiring partizanship with that movement as its explanation and comment. On the first manifest signs of that movement he consented, as he says, "to lay aside his singing-robes" for a more convenient season, and "to leave a calm and pleasing solitariness, fed with cheerful and confident thoughts," in order to "embark in a troubled sea of noises and hoarse disputes." He imagined that a year or two of such work, to which he felt that he was lending "only his left hand," would be all that would be required of him. But once engaged in the controversies of the time, he was led on and on; and for the space of full twenty years we see him only as a polemical prose writer, giving and taking blows in the cause of the Revolution, and producing nothing at all in verse except an occasional Latin scrap or epigram, and a few English sonnets suggested by passing occurrences. To attempt here a full and connected narrative of this period of his life is evidently impossible; it will be sufficient to present a chronological scheme of the main facts, including a list of his successive publications.

1640-42 (Milton *ætat.* 31-33).—The Long Parliament met November 3, 1640. Milton had by this time changed his mode of life. The household at Horton having been broken up, and his father having gone to reside at Reading with his younger son Christopher, then a barrister-at-law and of royalist politics, Milton had taken lodgings in the house of one Russell, a tailor in St Bride's Churchyard, Fleet Street. Here he took to lodge and board with him his two young nephews, Edward and John Phillips, then about nine or ten years of age, the sons of his sister Anne, now married for the second time to a Mr Agar of the Crown Office. The arrangement seems to have been one of mere kindness at first; but his friends having suggested to him that he might take a few more boys to educate, he removed in 1641 to a larger house in Aldersgate Street, situated in a garden, and out of the bustle of the city. Here he received some additional pupils, the sons of wealthy friends, and occupied his time partly in educating them after a peculiar system of his own, and partly in private studies. It was in these circumstances that he wrote his first pamphlet. Amid the numerous matters occupying the attention of Parliament—the trial of Strafford, &c.—that of church reform was paramount. The root of the evil, it was felt by the Puritans, was in the prelatical constitution of the church; and already there were petitions and bills having for their object nothing less than an abolition of bishops, deans, and chapters, and all Episcopal forms, and a reconstruction of the Church of England after the Presbyterian model. Into this controversy Milton threw himself; and, the press being then free for such opinions, he published in 1641 a treatise or bulky pamphlet in two books, in the form of a letter to a friend, entitled *Of Reformation, touching Church Discipline in England, and the Causes that hitherto have hindered it.* The treatise answers to its name, and is throughout a vehement attack on Prelacy in its forms and essence. It helped to infuriate the controversy which was already waging. A defender of Episcopacy appeared in Hall, Bishop of Norwich. Hall was answered by a counterblast from five Puritan ministers—Stephen Marshall,

Milton. Edward Calamy, Thomas Young (Milton's old tutor), Matthew Newcomen, and William Spurstow—who clubbed the initials of their names together so as to form the word "Smectymnuus;" and Archbishop Usher came to the rescue of Hall, and wrote a confutation of Smectymnuus. Milton feeling that the prelates were likely to have the best of the debate, both in learning and in literary talent, unless he interfered, grappled with Usher and his associates in two additional pamphlets; the one, entitled *Of Prelatical Episcopacy*, addressed mainly to the question of the apostolical origin of Episcopacy; the other, which is much the longer, entitled *The Reason of Church Government urged against Prelacy*. Nor was this all. Bishop Hall having himself written a reply to Smectymnuus, entitled *The Remonstrant's Defence*, Milton produced a fourth tract, written in the form of a dialogue, and entitled *Animadversions upon the Remonstrant's Defence*, &c.; and, finally, these "Animadversions" having drawn forth an anonymous reply, supposed to be by a son of Bishop Hall, in which Milton's character was scurrilously attacked, the controversy was wound up (1642) by Milton's *Apology against a Pamphlet called "A Modest Confutation of the Animadversions upon the Remonstrant against Smectymnuus."*

1643-45 (Milton *ætat.* 34-36).—The civil war had now fairly begun. The king had his head-quarters at Oxford, and his troops and those of the Parliament were fighting for the possession of the country. The Westminster Assembly had met to help the Parliament in discussing the religious question. In the midst of this confusion Milton took a step usually taken in quieter times. "About Whitsuntide" (1643), says his nephew Phillips, "he took a journey into the country, nobody about him certainly knowing the reason, or that it was more than a journey of recreation. After a month's stay from home, he returns a married man who set out a bachelor; his wife being Mary, the eldest daughter of Mr Richard Powell, then a justice of the peace of Forest Hill, near Shotover in Oxfordshire." There had been a previous acquaintance and some money transactions between the two families. What occurred after the marriage is known to every one. Being no Minerva, but a simple and apparently rather stupid country girl, "accustomed to dance with king's officers at home," the young wife found the life she was leading intolerable, and could see nothing in her husband but a man of harsh and morose ways, whom she could not understand, and who was always at his books. She asked leave to return home on a short visit, and, having gone, she flatly refused to come back. Her parents abetted her in the refusal, and seem, among other things, to have alleged their son-in-law's politics as a reason, they being royalists. Milton's conduct on the occasion was most characteristic. Where other men would have remained quiet, or, if so inclined, have consoled themselves in secret, he made his case the matter of public argument. In a subsequent sketch, indeed, of his own life about this time, he speaks as if it was less any private reason than the systematic prosecution of a path of activity which he had marked out for himself that led him to the public discussion in which he now engaged. While other men were fighting for liberty, he says, *he* had resolved to do what he could for the same great cause by expounding the true theory of liberty; and having already written on ecclesiastical liberty, and seen that question brought by events to some sort of settlement, he now saw remaining the equally important questions of private liberty and civil liberty. This is no doubt substantially accurate; and Milton's views on the marriage question were no doubt so properly a part of his general philosophy, that they might have been evolved in the mere course of speculation, without the stimulus of any private interest in the matter. On the whole, however, their connection with his own case is undeniable. It is as if he said,—"I have found myself in circumstances in which a fundamental rule of society as it exists has come in conflict with my comfort in such a manner as to lead me to examine its validity by the higher laws and principles on which it professes to rest; and as I am not a man to do anything underhand, I here publish my views in justification of whatever I may see fit to do." He published in quick succession four tracts on this subject,—*The Doctrine and Discipline of Divorce restored to the good of both Sexes from the Bondage of Canon Law*, &c. (1644, in which year two editions appeared, both addressed "to the Parliament of England, with the Assembly"); *The Judgment of Martin Bucer touching Divorce* (a translated series of extracts, also published in 1644); *Tetrachordon, or Expositions upon the four chief places in Scripture which treat of Marriage or Nullities in Marriage* (published in 1645, and addressed to the Parliament); and *Colasterion; a Reply to a Nameless Answer against the Doctrine and Discipline of Divorce* (1645). The doctrine in all these tracts is, that moral incompatibility is as good a ground for divorce as conjugal infidelity, if not a better—a doctrine leading to numerous applications which he does not state, and which it is needless to say no civilized society has yet seen fit to adopt. One notices in the tracts, too, a singular disposition to treat the question as if it were entirely a man's question; and indeed they are full of those notions of the inferiority of women which Milton held all his life, and which are generally repudiated with indignation by those who now adopt views similar to his as to the theory of the marriage bond. At the time, the pamphlets produced some sensation, and the author was nearly being taken to task for them by Parliament at the instance of the Presbyterian divines in the Assembly. As regards Milton himself, his views were never carried out, the king's waning fortunes having made it convenient for his wife's family to bring about a reconciliation, the effect of which was, that towards the end of 1645 Mrs Milton was again domiciled with her husband. It was not to the house in Aldersgate Street, however, that she returned, but to a larger house which Milton had taken in Barbican, and which was then getting ready. Here, besides her husband and his pupils, she found old Mr Milton the father, who had been obliged during her absence to leave his younger son's house in Reading, in consequence of the surrender of that town to the Parliament, and to take up his quarters with his son John. It remains to add, before quitting Aldersgate Street, that here Milton wrote, besides his divorce pamphlets, his tract *On Education*, addressed to Mr Samuel Hartlib, and his noble *Areopagitica, or Speech for the Liberty of Unlicensed Printing*. Both were published in 1644, and they contain Milton's views on questions of great public interest at the time—the first, his views on the state of the universities, and his plan of a gymnasium which should supersede both them and the grammar schools, and do the work of both better in a much shorter time; and the second, his views on the liberty of the press, in the form of an appeal to Parliament to reconsider an order they had just passed subjecting books to a censorship. When we add, that about the same time Milton prepared for the press the first edition of his poems (published in 1645, in a small volume, by Humphrey Moseley, the Tonson of his day, and containing, besides the pieces in English and Latin already named, some sonnets written in the meantime), it will be seen that there was industry enough in the house in Aldersgate Street during the absence of Mrs Milton.

1646-48 (Milton *ætat.* 37-39).—Mrs Milton's return, indeed, seems rather to have interrupted than to have forwarded his literary activity. One reason of this may have been that she brought her whole family after her. Her father, mother, brothers, and sisters were in Oxford when it surrendered to the parliamentary army in June 1646; and, being thus driven from home, they came up to London

and were kindly received by Milton into his house till matters could be better arranged. As old Mr Milton was still there, and as Milton's first daughter Anne had just been born (July 29, 1646), the house seems to have been inconveniently crowded; at least Phillips hints as much when he says that after their departure it "looked again like a house of the muses." This cannot have taken place prior to the 1st of January 1646–7, when the father-in-law died in Milton's house. Milton's own father died in the March following, at the age of eighty-four or upwards. These deaths, the return of the Powells to Oxfordshire, and probably also a falling-off in the number of Milton's pupils, determined him to give up his house in the Barbican, and to remove (1647) to a smaller one in Holborn, having its back to Lincoln's Inn Fields. He does not seem to have continued to receive pupils long after this time, but to have been content with his scholarly studies and the quiet exercise of his pen. It has been remarked by Mr Keightley, that Milton was fond of the humble literary practice of compilation when there was nothing better for him to do; and accordingly it seems to have been during the years (1646-1648) when he was living in the Barbican and at Holborn, waiting for the farther issue of events, that he prepared for his own use, or for that of his pupils, some of those compilations which he afterwards published. At this time, at all events, he wrote a portion of his *History of England*. In poetry he still did next to nothing.

1648-9 (Milton *ætat.* 40).—On the 30th January 1648-9 Charles was beheaded, and England became a Commonwealth, presided over by a council of state, served in the field by Cromwell and other generals, and assisted in legislation by the Rump Parliament. The Revolution had thus been borne on by its bolder spirits to a stage at which, while the outside world stood aghast, multitudes of those in Britain itself who had followed it so far, including the Scots and the Presbyterians generally, fell off or turned reactionary. At this crisis Milton came forward to justify what the bolder spirits had done, and "to compose the minds of the people," naturally unsettled by the charges, flung upon them on all sides, that they had murdered their sovereign. Within a week or two after the execution of Charles he published a short pamphlet, the full title of which it is worth while to quote:—*The Tenure of Kings and Magistrates; proving that it is lawful, and hath been held so through all ages, for any who have the power to call to account a tyrant or wicked king, and, after due conviction, to depose and put him to death, if the ordinary magistrate have neglected or denied to do it; and that they who of late so much blame deposing* [*i.e.*, the Presbyterians] *are the men that did it themselves.* So seasonable an interposition could not be overlooked by the government of the Commonwealth; and as Milton was personally known to Bradshaw and others of the council of state, they were empowered to consult with him as to his willingness to accept the office of foreign or Latin secretary to the council. He did accept the office, with a salary, as it appears, of about L.290 per annum, and his appointment is dated the 15th of March 1648-9. In order to be near the scene of his duties, he removed from Holborn to lodgings at Charing Cross; he was subsequently in the course of the year accommodated with rooms at Whitehall, but only till an official residence which had been assigned him in Scotland Yard could be got ready. Prior to his acceptance of the foreign secretaryship he had published a pamphlet entitled *Observations on Articles of Peace between the Earl of Ormond and the Irish Rebels*, in which is discussed the policy of the late king in the matter of Irish Popery and Presbyterianism.

1649-53 (Milton *ætat.* 40-44).—Milton's official duties consisted in preparing drafts of such letters in Latin as the council desired from time to time to address to foreign princes, governments, and ambassadors; and a series of forty-six such letters, written by him for the council, and the publication of which was prevented during his lifetime, was edited from his papers after his death. But much more important work was devolved on Milton by the council. The famous *Ikon Basilike* had just appeared, and was circulating in hundreds of copies through the country, representing the late king, on the professed authority of his own private papers, as a saint ever on his knees during his hours of solitude and misfortune, and doing much, therefore, to win popular acquiescence in the use of the term "royal martyr," as already posthumously applied to him. By way of counteractive, Milton wrote and published a long pamphlet entitled Εικονοκλαστης, in which, without questioning the authenticity of the pretended manifesto of royalty, he criticizes it mercilessly. The preparation of this pamphlet must have occupied him during a considerable portion of the year 1649; but it was hardly finished when a still harder piece of work was required of him. Charles II., then a refugee in Holland, had got the great scholar Salmasius, *alias* Claude de Saumaise, of the university of Leyden, to undertake the advocacy of his cause in a treatise such as might be submitted to the learned throughout Europe; and the Continent was now ringing with the fame of the *Defensio Regia pro Carolo Primo ad Carolum Secundum* which Salmasius had published. Fearful of the damage that such a work might do abroad, the English council of state bethought themselves of their secretary as the man to answer it suitably. On the 8th of January 1649-50 it was ordered by the council "that Mr Milton do prepare something in answer to the book of Salmasius, and, when he hath done it, bring it to the council." In execution of this commission, Milton prepared his famous *First Defence for the People of England; or, Pro Populo Anglicano Defensio, contra Claudii anonymi alias Salmasii Defensionem Regiam*, the order for the publication of which appears in the council-minutes under date December 23, 1650. It has been stated that Milton received L.1000 for the performance; but the minutes of council exhibit nothing more than a vote of thanks. The success of the treatise was infinitely beyond what might have been expected. Salmasius found himself assailed in his philosophy, in his Latinity, and in his powers of opprobrious rhetoric, by a man who was more than his match in all; and it is even said that his death, which occurred not long afterwards, was caused by chagrin at his loss of credit. Satisfied with his triumph, Milton rested from literary exertion, except of a private kind, for about two years. It was during this time that he removed from Scotland Yard to a house "in Petty France, Westminster, opening into St James's Park," which house (afterwards occupied by Bentham) he continued to live in till the Restoration. It was about this time also, and apparently in the house in Petty France, that he was visited by the great calamity of his life—his blindness. From a letter on the subject written by him at a later period, it appears that his eyesight had begun to fail as early as 1644, when he was about thirty-five years of age, and that the process of obscuration was so gradual that it was not till about 1650 or 1651 that total blindness was threatened. The preparation of the treatise against Salmasius was believed by himself to have hastened the fatal result. At all events, by the end of the year 1653 Milton was totally blind, and the fact of his blindness was publicly talked of both by his friends and his enemies. The fatal affection was of the kind called *gutta serena;* and Milton himself tells that it left his eyes perfectly clear and without any mark, speck, or external disfigurement whatever. It may have been while the blindness was not yet total, but only nearly so, that he sustained what even for him, in such circumstances, must have been another great loss, and which was certainly a great loss for his children. This was the death of his

wife, the precise date of which has not been discovered, though it was either in 1652 or 1653. She left three children, all daughters,—the eldest, Anne, about seven years of age; the second, Mary, about five; and the third, Deborah, a mere infant in arms. Although she may not have been the fit person to be the wife of Milton, one cannot but imagine the house in Petty France more desolate from her absence; the blind and austere widower left in one part of it to contemplations in which some thoughts of Mary Powell, as she was when he first bore her away from her Oxfordshire home, can hardly have been wanting; and the poor motherless children, known to him only as tiny voices of complaint going about in the darkness near, with none but an alien voice any more to hush or overawe them!

1653–1658 (Milton *ætat.* 44–49).—Notwithstanding his blindness, Milton continued in the active discharge of his duties as Latin secretary during the whole protectorate of Cromwell, which began on the 16th of December 1653, and terminated on Cromwell's death on the 3d of September 1658. Between seventy and eighty Latin letters, written by him in Oliver's name, are included in the collection of his state letters; and besides these he wrote a Latin state paper of some length on the subject of the Protector's differences with the Spanish court. He had, however, an assistant in his office who relieved him of a part of the work; and there is a council order, dated April 17, 1655, reducing his salary to L.150 per annum, with the proviso that the same should be paid to him during his life. It seems, however, that both Milton and his friend Andrew Marvell, who was latterly associated with him in the office, received an actual salary of L.200 a year. That Milton was not only an admirer of Cromwell's genius,—he had already celebrated him in a sonnet as "Cromwell, our chief of men,"—but also an entire believer in the necessity and the advantage of his government, is proved by the tenor of his writings during the Protectorate. These consisted of three pamphlets growing out of the *Defensio pro Populo Anglicano.* As early as 1651, indeed, an anonymous reply to this treatise had appeared; but Milton, who attributed it to Bishop Bramhall, left the confutation of it to his nephew John Phillips, and only revised what Phillips had written. Another work having appeared abroad, however, in 1652, with the title *Regii Sanguinis Clamor ad Cœlum adversus Parricidas Anglicanos,* Milton, who was grossly and calumniously attacked in it, and represented as a blind monster, thought it fit to reply in person. The real author of the work was the Frenchman Peter Dumoulin, afterwards a prebendary of Canterbury; but the reputed author at the time was Alexander More, a Scotchman, settled in France, who had been concerned in seeing it through the press; and against him Milton directed the full force of his vengeance. In the *Defensio Secunda pro Populo Anglicano,* which was not published till 1654, Milton meets the personal accusations of his antagonist, and retaliates with scurrilities quite as coarse and offensive, though doubtless better founded; but he also returns to the main question, in the course of the discussion of which he introduces a splendid panegyric on Cromwell, and brief eulogistic sketches of some of the other heroes of the Commonwealth. Not content with what he had said in his own defence in this pamphlet, he followed it up by another entitled *Authoris pro se Defensio contra Alexandrum Morum, Ecclesiasten* (1655); and More having rejoined, he wound up with *Authoris ad Alexandri Mori Supplementum Responsio,* published in the same year. These pamphlets must necessarily have been written by the method of dictation, and in the first of them there is a passage written with express reference to his blindness. During the remaining three years of the Protectorate, Milton had leisure to fall back upon the compilations which he had on hand. During the same period he married his second wife, Catherine Woodcock, daughter of a Captain Woodcock of Hackney, of whom little or nothing is known. The marriage took place on the 12th November 1656 by civil contract; and on February 1656–57 Milton was again left a widower by the death of his wife in childbirth. He has testified his affection for her in a well-known sonnet.

1658–1660 (Milton *ætat.* 49–51).—The twenty months which followed the death of Cromwell were a time of varying anarchy and uncertainty, in the midst of which events slowly shaped themselves towards one inevitable issue, which men began to think of by themselves long before they dared to speak of it to one another,—the restoration of Charles II. The state of Milton's mind and the course of his life during these perplexing months are to be inferred from what remains of his writings during them. As Latin secretary he wrote eleven letters for Richard Cromwell, and two letters in the name of the Restored Parliament after Richard's abdication. The last letter is dated May 15, 1659, after which we hear no more of Milton officially. But as a citizen he was not idle; and if the resolution and the reasonings of one man could have maintained republicanism in England, and kept the door fast against the return of royalty, whether accompanied by Prelacy or by Presbytery, the work would have been done by Milton. His revived anxiety on the religious question was exhibited in two tracts, both written in 1659, and addressed to Parliament; the one entitled *A Treatise of Civil Power in Ecclesiastical Causes, showing that it is not lawful for any power on earth to compel in matters of religion;* and the other, *Considerations touching the likeliest means to remove Hirelings out of the Church; wherein is also discoursed of Tithes, Church Fees, and Church Revenues, and whether any maintenance of ministers can be settled by law.* As these tracts were intended by their author to stem what he considered a return of the national mind towards intolerance in religion, so his anxiety with respect to what was more properly the political reaction was shown in *A Letter to a Friend concerning the Ruptures of the Commonwealth* (dated October 1659, though not then published), and in a subsequent more public pamphlet entitled *The Ready and Easy Way to establish a Free Commonwealth, and the excellence thereof compared with the inconveniences and dangers of readmitting Kingship into this nation.* The views addressed in this pamphlet to the public at large were even recapitulated by him at the last hour for the private eye of General Monk, in a short letter headed *The Present Means and Brief Delineation of a Free Commonwealth, easy to be put in practice and without delay.* Monk's mind, however, was better made up than Milton's as to the ease or difficulty of the solution in question; and the last act of the despairing republican was to publish *Brief Notes upon a Late Sermon titled "The Fear of God and the King," preached and since published by Matthew Griffith, D.D., and Chaplain to the late King.* *No Blind Guides* was the title as well as the tenor of a short answer to this criticism, written by L'Estrange the essayist; and in May 1660 Charles II. was on the throne. Milton, as almost coming within the doomed category of the regicides, was for some time in danger of being included among those whom the new government exempted from amnesty. His more obnoxious writings were called in by proclamation, and publicly burnt by the hands of the hangman; he was actually in custody after the Act of Indemnity had been passed; and that he escaped finally without punishment is said to have been owing chiefly to the intercession of the poet Davenant.

The period of Milton's life which we have thus hastily traversed, extending from his thirty-second to his fifty-second year, and coinciding, therefore, with what may be

called his middle life or manhood,—was, we would again observe, all but entirely a period of polemical prose-writing. The four-and-twenty separate pamphlets, treatises, &c., which he wrote during these twenty years, make in all, when collected, three or four goodly volumes; while the stray sonnets and other metrical scraps, in which during these years he hinted rather than asserted that he had not parted with his title as a poet, do not amount to more than a few pages. The reader will do well to note this interpolation of a middle period of prose polemics between a poetic youth and an old age dedicated to poetry again, as a significant fact in the life of Milton. It arose, as we have seen, from an imperative necessity of the times, which affected other lives besides his, and the result of which in the aggregate was an apparent break or variation in our literary history co-extensive with the entire period of Puritan ascendancy. But that this fact in the general life of the nation should be illustrated so visibly, and with such mechanical exactness, in the life of Milton, marks him out as pre-eminently, in literary respects, the representative of his age. All the other wits and writers of any note were on the other side, and therefore represent the contemporary mind of England only negatively; in him alone among the writers have we a colossus marching by the law of his own independent constitution in the direction of the movement and in the midst of it, and capable, therefore, of illustrating it positively.

Milton was fitted for the part he performed in connection with the Puritan movement by that very peculiarity of constitution to which we have already referred as distinguishing him from most poets. Poets generally, it is supposed, are and ought to be characterized by an excess of sensibility over principle,—a certain mobility of the whole mind and temper rather than the prevalence in the mind of any one moral mood or gesture. Milton, however, as we have seen, was one of a class of poets, claiming also such poets as Dante and Wordsworth, of whom this cannot be said. Whatever his sensibility, whatever the range and freedom of his imagination, he was a man at the basis of whose nature was a moral austerity compacted of certain definite and deliberate conclusions as to what was right or wrong, allowed or forbidden, everlastingly true and expedient, or everlastingly false and pernicious. Being such, he was necessarily, in relation to the society in which he moved, a man of dogma and asseveration as well as a poet. Possibly this alone might account for the part he took in the social controversies of the time, and for the unusual combination he presents of the reformer with the poet; for generally such a nature, by reason of its dissatisfaction with much that exists, will ally itself to what seems the innovative or progressive tendency; whereas that absence of opinion, except on matters of taste, which is believed to characterize poets and artists as a class, will in itself usually function as an opinion in favour of things as they are. In order to account fully, however, for Milton's thorough identification of himself with the most advanced social tendencies and aspirations of his age, we must think not only of the strength of the moral or dogmatic element in him, but also of the peculiar effects of this dogmatic habit when associated with a most courageous and inquisitive intellect. No man of the time was more resolute in asserting that right of free thought, the recognition of which, as applied to the Bible, he regarded as the essence of Protestantism; no man spurned more angrily all trammels which tradition, authority, and custom would impose on a mind already sufficiently bound, as he thought, by its own idea of allegiance to its Maker. Hence, in his conclusions on social questions, he came uniformly to occupy ground on the farthest verge of the speculation of the time, so far as it still acknowledged the Christian creed and the code of Christian ethics. Nay, on various questions on which men who had passed over to Pyrrhonism were practically conservative, he, the English Christian, was practically revolutionary. In the language not only of Johnson, but of those of our own time to whom his opinions on church and state are still offensive, Milton was one of the rebellious or anarchical order of spirits. In the matter of ecclesiastical polity, for example, he had passed through Church of England Puritanism and Presbyterianism to take up a station somewhere among, if not already beyond, the Independents and other extensive sects of Nonconformists. In some of his writings he appears as a pioneer of the Voluntary Principle. In his opinions on marriage he was heterodox among the heterodox. He had notions of education such as would hardly be propounded now by the most radical of university reformers. He advocated toleration of all Protestant sects, and the freedom of the press, at a time when these ideas were new, in language from which even those who now profess them as a matter of course are accustomed sometimes to abate a little. In state politics he was an ultra-republican, with some modifying reservations. It is, in fact, owing to the peculiar *ensemble* which his creed presents of so many extreme views harmonized in his case unto a kind of unity, but otherwise only found detached and scattered among the sects of his time, that it is reckoned impossible to identify him with any of these sects in particular, or even, as some think, with the Puritans as a party. Both Coleridge and Mr Macaulay have noticed this eclectic character of Milton's intellect as shown in his writings. "From the Parliament and from the court," says Mr Macaulay; "from the conventicle and from the Gothic cloister, from the gloomy and sepulchral rites of the Roundheads and from the Christmas revel of the hospitable cavalier, his nature selected and drew to itself whatever was great and good, while it rejected all the base and pernicious ingredients by which these finer elements were defiled." In the sense in which it is intended this is true. As a man of scholarship and academic culture, as a lover of music and of art generally, and with a fancy accustomed to range in search of beauty through the whole world of fact and of literature, it was not to be supposed that the partizanship of Milton, even when most resolute, would be of a barbarous or meagre kind, confounding principle with forms and minutiæ. Like Cromwell, who was also exempt from the prejudices of his party against art and liberal culture, he fought in the struggle as a general fights, and not as the common soldier. Nevertheless, it is to be remembered that he did fight; and as the true spirit of a cause is better and more profoundly represented in its leaders than in its inferior adherents, so it would be but pedantry to say, that because Milton wore his hair long, or because he has spoken reverently of the richly-stained glass and the pealing organ of a Gothic cathedral, therefore he was not a Puritan. Let us make whatever we can of the fact, he did belong, with his whole heart and soul, to the English Puritan and republican movement of the seventeenth century. He honoured what it honoured; he hated what it hated; he shared its detestation and intolerant dread of Popery. If he was not a Puritan, it was because he was a Puritan and something more; that "something more" being an expression for much that Milton's mind, rolling magnificently within itself, had thought out as properly belonging to Puritanism, and as necessary to be worked into it in order to give it its full development. In this sense, because Milton was an ideologist in the van of the extreme sects, it might perhaps be argued that he did not properly belong to a sect at all. The idealism of Milton's politics,—the spirit of prophetic enthusiasm rather than practical tact with which, in his political speculations, he wraps the facts of his time, and even human nature in general, round his own inwardly evolved theories and his schemes of what might be,—must strike every reader

of his prose writings. In reading them we at once see the difference between a Milton theorizing nobly for Puritanism in his closet, and a Cromwell as the man of action, with enthusiasms as fervid and an ideal as high, grappling in the same interest with events and contingencies. Milton's plans, for example, submitted to Monk for averting the Restoration are interesting now chiefly as very simple-minded proofs of his tenacity as a theorist.

It is not only, however, as illustrating Milton's character, or the higher tendencies of that historical movement with which he was associated, that his polemical prose writings are now of interest. They have an interest other than historical. It is because the bulk of polemical writing is on points of ephemeral importance, and is therefore of ephemeral application, that so little of it endures in proportion to what has been produced, and that ages which may have teemed with such literature appear often as mere blanks in the retrospect of the literary historian. The pamphlets did their work; and when the day for which they were calculated was over, they disappeared with its buzzing insects. Their very efficiency sometimes might be measured by the rapidity with which they were forgotten. But as there are certain controversies which are not ephemeral, so there is polemical writing, the lease of which, to borrow Milton's own figure, may be "for three lives and downwards." To a great extent Milton's prose writing is of this class. Two centuries have elapsed since he lived and wrote, but (and it would have surprised him to learn that it would be so) the war in which he fought is not yet over. In Europe,—nay, in Great Britain itself,—some of the questions which he discussed are not yet settled, or, after having apparently been settled, are again rising ominously into sight. Hence, as Milton did not concern himself with the accidents of these questions, but invariably plunged into their essentials, there is still, with every allowance for the change in the intellectual point of view between his time and this, a permanent interest in most of his argumentations. Apart, however, from the interest which these prose writings thus retain as belonging in the main to one side of a yet unfinished controversy, they have an interest of a more general kind to which none can be indifferent. As Burke's political writings are admired for their elevation of sentiment, and the richness of their intellectual matter, by those who either dissent from their practical tenor or care little about it, so, and even in a more superb degree, there is that in Milton's prose treatises which will keep them immortal. They are as truly Miltonic as his poetry. As Milton's poetry is unique in one section of our literature, so is his prose in the other. It is prose of that old English, or as some might say, old Gothic kind, which was in use among us ere yet men had given their days and nights to Addison, and when it seemed as lawful that thought in prose should come in the form of a brimming flood, or even of a broken cataract, as in that of a trim and limpid rivulet. But even amid the greatest specimens of such prose of the pre-Addisonian period Milton's prose is peculiar. That of Bacon may roll with it a richer detritus of speculative hints and propositions; that of Jeremy Taylor may have a mellower beauty; but no prose in the language is grander than Milton's, or more indicative of moral greatness. Its characteristic in its best passages is a kind of sustained and sometimes cumbrous and operose magniloquence. Milton tells us himself that he wrote slowly; and one can see that as he wrote he was abashed by no weight of thought or sublimity of fancies that could come to him, but would pile thoughts and fancies together till no prose sentence could carry the whole burden in its cadence, and the residue had to be conveyed in a poetic chaunt. Many passages in his treatises might be read apart as prose odes; and even where he is roughest and most controversial, and where his actual reasonings seem, as they often do, poor and inconclusive, it is as if, in order to bury his adversary anyhow, he were tumbling, in sheer rage, a temple into ruins. This is true of his Latin prose writings (of which no fit translation exists) as well as of his English.

Milton survived the Restoration fourteen years (1660–1674), and these fourteen years form the third period of his literary life. To him, if to any man, those days must have seemed dark and evil. One set of men had gone out of office, and been thrust down into the obscurer recesses of the body-politic, there to cherish their principles secretly until such time as they should reappear in the guise of modern Whiggism and modern Dissent. The public direction of affairs had passed into the hands of men of principles directly opposite. Of the state of manners and morals in the court of the witty and licentious Charles II., and of the contrast which it presented to the Puritan government which it had superseded, all have some idea. The superficial change throughout the nation at large, and especially in and about the metropolis, corresponded with this change in the *personnel* of the government. Execration of Puritanism, and a reaction in favour of whatever Puritanism had forbidden or denounced, characterized the popular conduct and every department of the public procedure. Above all, the change was visible in the new literature which began at this time to spring up in consequence of the social calm, such as it was, that had followed an age of conflict and turmoil, and especially in those portions of this new literature which depended on the patronage of the court, or appealed most directly to popular and metropolitan feeling. The literature of the Restoration, as all know, was marked by a certain combination of qualities distinguishing it as a whole from the literature of any preceding, and from that of most subsequent, eras of our national history. It was in the main low in aim, and coarse in tone, exhibiting a robustness in the organs of appetite, accompanied by some keenness in those of perception, rather than a predominance of the imaginative or higher intellectual faculties such as had borne up the Elizabethan literature into universal grace and proportion. Above all, it was pervaded by an anti-Puritan spirit, or spirit of retrospective disgust for the Puritan rule, which showed itself partly in direct satires and denunciations of Puritanism, whether in prose or verse; partly in a predominant tendency towards the comic and jocose in all forms. The reopening of the theatres, and the consequent revival of dramatic writing, gave an increased stimulus to the anti-Puritan spirit, and afforded a special outlet for it. Initiated by Davenant and other survivors of the literary school of the reign of Charles I., among whom were Shirley and Cowley, the drama of the Restoration attained its height in Dryden, who succeeded Davenant as poet-laureate in 1670, precisely because of his dramatic successes during the ten preceding years, and who thus became officially, as he was by right of genius, the chief star of the new literary cluster. Around Dryden, and belonging to the same literary cluster, might be seen, earlier or later, between the years 1660 and 1674, such men as Butler, the author of *Hudibras*, the Duke of Buckingham, the Earls of Dorset and Roscommon, Sir Charles Sedley, Sir George Etherege, William Wycherley, and Thomas Shadwell. These, and such as these, were the so-called "wits of the Restoration;" while the honours of philosophic or other graver prose literature were supported by the veterans Hobbes and Izaak Walton, or by Clarendon, Browne, Barrow, and South. It is worth noting also, that these first fourteen years of the reign of the second Charles, remembered as they chiefly are as a period of spiritual degeneracy in our literature, were the era of the rise among us of mathematical and physical science. The Royal Society dates its existence almost ex-

actly from the Restoration; and Boyle, Barrow, Wallis, Wilkins, Wren, and Hooke, were already busy with their researches, and waiting for the appearance among them of young Mr Newton.

It was rather on the border of this, the well-known world of Pepys and Aubrey, than as actually in it and belonging to it, that Milton spent his declining years. He still, indeed, made London his home; living from 1660 to 1662 in a house in Holborn, near Red Lion Square; then from 1662 to 1665, or thereabouts, in a house in Jewin Street, near his old quarters in Aldersgate Street; then for a short time in lodgings with Millington, a famous book-auctioneer of the day; and finally, from 1665 onwards, in a small house in Artillery Walk, leading into Bunhill Fields. Of course there may have been occasional visits to the country; and one such visit was in the year 1665-6, when, on account of the great plague in London, he took a cottage for some months in the village of St Giles Chalfont, Buckinghamshire. Two years prior to this—in 1662–3, when he was living in Jewin Street—he contracted his third marriage. He was then fifty-four years of age; his wife, who was about twenty-eight years younger, was Elizabeth Minshull, daughter of Mr Ralph Minshull, of a good family in Cheshire. The marriage, which was arranged for him by his friend Dr Paget, was one of convenience—occasioned, it would appear, chiefly by the fact that his daughters, who had grown up without any maternal care, had become a trouble rather than an assistance to him in his housekeeping. At the date of the marriage the eldest of the daughters (who was lame and otherwise deformed) was nearly seventeen years of age, the second nearly fifteen, and the youngest not eleven; and they appear all to have remained with him for some years afterwards in a state of chronic contention with their stepmother. *Her* temper, it is stated, was none of the best; but we have it on her husband's own authority, that "she was very kind and careful of him;" and we have the same authority for the sad fact that his children were "unkind and undutiful." It is on evidence that his brother Christopher had heard him complain that "they were careless of him, being blind, and made nothing of deserting him;" and also that he complained that "they did combine together with the maid to cheat him in her marketings," and that "they made away with some of his books, and would have sold the rest to the dunghill woman." This, so far as it relates to their conduct *before* his third marriage, must apply chiefly to the two eldest daughters, Anne and Mary. The youngest, Deborah, probably as being the youngest, and as having therefore come more within the control of the third wife, has left a more amiable memory of herself. She is said to have been her father's favourite reader and amanuensis so long as she remained with him; she, as well as her sister Mary, having been trained by him to what they thought the irksome work of writing to his dictation, and reading to him in several languages without understanding their meaning. But she too ultimately quarrelled with her stepmother; and about the year 1669 all the three sisters, according to Phillips, were "sent out to learn some curious or ingenious sorts of manufacture that are proper for women to learn, particularly embroidery in gold and silver." Accordingly, during the last four or five years of his life we are to imagine Milton's household in Artillery Walk as consisting but of himself, his wife, and one or two servants; his three daughters no longer living under the same roof. Whether they lived with him or not, however, his circumstances were such as to enable them to depend on him as long as might be necessary. He had now, indeed, no official or stated income as formerly; any casual receipts from his writings can hardly have amounted to much; his first wife's marriage portion of L.1000 had never been paid; and there is proof that the property left him by his father had been impaired by considerable losses or forfeitures at the Restoration. Still, enough remained for his moderate wants as long as he lived, and at his death there was a residue over.

Shut out from the busy world in some measure by the unpopular political recollections which attached to his name, and shut in from it still more by his blindness and by his undisguised scorn of nearly all that, had the privilege of sight remained to him, there would have been for him there to see, Milton found his solace in his own thoughts, in the conversation of a few friends who would drop in to enjoy his society and were proud to lead him out in his daily walks, and also in his books and in continued literary occupation. He did not yet cease from prose writing, but finished or prepared for the press various works which he had begun before the Restoration, and from time to time undertook new ones. The following is a list of his prose writings published during this period, and of such works as, though left ready for the press, were not published till after his death:—

1. *Accedence Commenc't Grammar*; a short skeleton of Latin grammar, possibly prepared many years before, though not published till 1661.

2. *The History of Britain, that part especially now called England, from the first Traditional Beginning, continued to the Norman Conquest; collected out of the antientest and best authors thereof.* This was not published till 1670, though much of it was written before the Restoration.

3. *Artis Logicæ Plenior Institutio, ad Petri Rami Methodum concinnata.* This is a Latin compendium of logic after the method of Ramus, in two books, with a brief Life of Ramus appended. It was published in 1672, but may have been in manuscript many years before.

4. *Of True Religion, Heresie, Schism, Toleration, and what best means may be used against the growth of Popery.* This little tract was published in 1673, and was doubtless written at that time as a contribution to a controversy again rising into interest. It is written in a calm spirit, and with none of the vehemence of his earlier polemical writings, and is interesting as showing his matured views on the subject of religious toleration. He is for the absolute toleration, both as regards doctrine and as regards worship, of all Protestant sects,—the Church of England, Presbyterians, Independents, Anabaptists, Arians, Socinians, &c.; but, as regards worship, he excludes Roman Catholics, partly on the civil ground that they acknowledge a foreign allegiance, partly on the theological ground that they deny the paramount authority of Scripture, which denial, and nothing else, he holds, is heresy. He is not for punishing them "by corporal punishment or fines on their estates," because he supposes this "stands not with the clemency of the gospel more than what appertains to the security of the state;" but he is for suppressing their worship and removing its furniture.

5. *Epistolarum Familiarium Liber Unus; quibus accesserunt Prolusiones quædam Oratoriæ.* These are the "Familiar Epistles" and the "Oratorical Exercises at College," already alluded to. They were printed in 1674, the last year of Milton's life, apparently not on Milton's own motion, but as a speculation of the publisher.

6. *A Brief History of Moscovia and of other less known Countries lying eastward of Russia as far as Cathay; gathered from the writings of several eyewitnesses.* This short sketch was left in manuscript, and was published eight years after Milton's death.

7. *Literæ Senatus Anglicani; necnon Cromwellii, &c., nomine ac jussu conscriptæ.* These are the "Letters of State" already referred to as written by Milton in his official capacity under the Commonwealth. The bookseller who published his "Familiar Letters" intended to publish these in the same volume, but was warned not to do so, and they were not edited till after Milton's death.

8. *Johannis Miltoni Angli de Doctrina Christiana ex Sacris duntaxat Libris petitâ, Disquisitionum Libri Duo.* This is the famous "Treatise on Christian Doctrine," the manuscript of which having been accidentally discovered by Mr Lemon in 1823 in the State Paper Office, was edited and subsequently translated by the Rev. Charles R. Sumner, afterwards Bishop of Winchester. The history of the work is as follows:—In his mature life Milton, dissatisfied with such systems of theology as he had read, and deeming it to be every man's right and duty to draw his theology for himself from the Scriptures alone, had begun to compile a system for his own use, carefully collecting texts, and aiming at doing little more than grouping and elucidating them. He continued this work till he had finished it. Considering it of importance enough to be published, but knowing that it contained some matter which might

be thought heterodox in England, he gave the manuscript, along with a transcript of his "State Letters," to a Mr Daniel Skinner of Trinity College, Cambridge (a relative of his friend Cyriack Skinner), who was going over to Holland, desiring him to arrange for their publication with some Dutch printer. Elzevir, in whose hands they were placed, having declined to have anything to do with them, they were given back to Skinner, who still remained abroad. Meanwhile the existence of the MSS., and the intention to publish them, had become known to the English government; and letters were sent to Skinner from Barrow, the master of Trinity College, warning him of the risk he was running, and ordering him to return to his college under pain of expulsion. This was in 1676, or two years after Milton's death; and Skinner seems to have returned soon after, and to have delivered the MSS. to Sir Joseph Williamson, one of the secretaries of state. By him they were stowed away, with other papers, in the press where Mr Lemon found them a hundred and fifty years afterwards still in the original wrapper.

Besides the above, there are some other things which are supposed, on evidence more or less slight, to have come from Milton's pen in his later life; and it is known that in 1661 he edited from a manuscript of Raleigh's entitled *Aphorisms of State*. (He had previously, in 1658, edited another MS. of Raleigh's entitled *The Cabinet Council*.) In addition to all this, he had collected a considerable quantity of materials towards a dictionary of the Latin language, the papers containing which fell into the hands of Edward Phillips, who is supposed to have used them in compiling the *Cambridge Dictionary* of 1693. How he managed in his blindness to go through so much labour of mere reading and accumulation, is explained partly by what Phillips tells us of his methods. The severe use which he made of his two younger daughters, till at last they would bear it no longer, and detested the very sight of him and his books, has already been mentioned. There were others, however, who, both while his daughters lived with him and after they went away, were but too glad to serve the scholarly and exacting old Lear. "He had daily about him," says Phillips, "one or other to read—some, persons of man's estate, who of their own accord greedily catched at the opportunity of being his readers, that they might as well reap the benefit of what they read to him as oblige him by the benefit of their reading; others, of younger years, who were sent by their parents to the same end." One of his readers, recommended to him by Dr Paget, was a young Quaker named Ellwood.

Milton's later prose writings, however, derive most of their interest from the fact that they belong to the same period as his later poems. It was not to *them*, nor even to the much more splendid polemical writings which had preceded them, that Milton could point as the fulfilment of his early pledge, that if God gave him strength, he would leave behind him some worthy work of Christian genius in which Britain should exult as a national possession, and which posterity would not willingly let die. Often as, amid the turmoil of his middle life, this pledge had recurred to him, how he must have sighed over the work that was then occupying him, and felt it all to be very sickening, and longed for a sabbath at the end of his life when his soul might sail again into the haven of a majestic calm! After all, controversy was but the work of his "left hand," and he longed for the time when his *right* hand should again have its turn, and he could rejoice in the renewed sensations of its superior strength and more natural cunning. His sonnets and other stray pieces of verse written during the civil wars and the Commonwealth, and perhaps also those occasional passages of lyric grandeur in his prose writings where he seems to be spurning prose underfoot, and almost rising for the moment on poetic wings, may be regarded as so many brief efforts whereby he assured himself, while his higher and finer faculty was in abeyance, that he had not lost it. It was not till towards the end of Cromwell's protectorate, however, and when already he had for several years been blind, that he was able to begin an undertaking commensurate with his life-long aspiration. According to Aubrey, it was then (1658), when it appeared as if, under the settled rule of Cromwell, the nation was entering on a long period of peace and leisure, that the *Paradise Lost* was begun. Whether it was then begun in the actual shape in which we now have it, or whether Milton was at this time only turning over the subject in his mind, and ruminating it in that form of a sacred mystery or drama in which we find it first rudely sketched in the Cambridge manuscripts, can hardly be ascertained. Cromwell was not to live long enough to initiate by his great and peaceful rule that new literature, signs of the rise of which were not wanting towards the close of his protectorate. When the new literature did arise, it was in the guise of the literature of the Restoration; and whatever progress Milton may have made in his great poem before the accession of Charles II., the bulk of it was written after that monarch was on the throne.

The facts respecting *Paradise Lost*, and the other later poems of Milton, will be best presented in a table of his later poetical publications supplementary to that of his later prose writings already given:—

1. *Paradise Lost*. This poem was certainly complete by the 27th of April 1667 (Milton *ætat.* 58), on which day it was sold to Samuel Simmons, bookseller, for L.5 down, with a promise of L.5 more when 1300 copies of the first edition should have been sold, another L.5 more when 1300 copies of the second edition should have been sold, and so on for successive editions,—each edition to consist of 1500 copies. According to Ellwood, however, the poem must have been ready more than a year before that time; for he says, that on visiting Milton while he was at Chalfont in Buckinghamshire (1665–6), he gave him the complete manuscript of the poem to read. As originally published, the poem consisted of ten books, and was sold at three shillings per copy. The stipulated 1300 copies must have been sold before the 26th of April 1669, on which day Milton signs a receipt for the second L.5. This was a very good sale in two years; but the remaining copies do not seem to have gone off so fast, as it was not till 1674, or the year of Milton's death, that a second edition was published. In this second edition the ten books were converted into twelve by a division of the seventh and tenth; and there were some other alterations. A third edition was called for in 1678; and in December 1680 Milton's widow parted with all her interest in the work for one sum of L.8, paid to her by Simmons.

2. *Paradise Regained*. When Ellwood returned the manuscript of *Paradise Lost* to Milton, they had some talk, he says, as to the merits of the poem, in the course of which Ellwood ventured pleasantly to say to him, "Thou hast said much here of paradise lost, but what hast thou to say of paradise found?" To this, he says, Milton made no answer, but fell into a muse, and broke off the discourse. When, however, some time after the sickness was over, Ellwood revisited Milton in London, he showed him *Paradise Regained*, saying, "This is owing to you; for you put it into my head by the question you put to me at Chalfont, which before I had not thought of." Assuming this to be literally accurate, we should have to suppose *Paradise Regained* finished in 1667, if not earlier; but it was not published till 1671 (Milton *ætat.* 62), on which occasion it was issued, not by Simmons, but by another bookseller, in the same volume with *Samson Agonistes*.

3. *Samson Agonistes, a Dramatic Poem*, published as above, 1671.

4. A second edition of his minor poems was published in 1673, the year before his death, containing the pieces which had appeared in the edition of 1644, with some additions.

At this point it is that the fact of the interposition of a middle period of prose polemics between the earlier and the later poetry of Milton becomes of importance to the critic of his works. Poetry, as such, is the exercise of imagination; and when a man makes poetry his work, or, after having been engaged on other kinds of work, returns to poetry, it is implied that the whole strength of his mind passes for the time being into the imaginative faculty. But here, as usual, it becomes apparent that our distinctions of faculties are partly devices for our own convenience in conceiving of things. Imagination is not, properly speaking, the imagining part of the mind, but rather the whole mind in the act of imagining; and hence, though some

minds tend more to this act than others, yet the nature and the worth of the imaginations of any particular mind are determined by the total character and contents of that mind. On this principle, also, we see how it is that in one and the same mind there may be poetic development, and how a poet's later muse may differ from his earlier, just as a philosopher's later may differ from his earlier doctrine. Imagination is said to be the faculty of youth; which, however, is true to some extent only in this sense, that men as they advance in life have so many things to do that, even if they set out with a strong imaginative tendency, they indulge it less and less. In the cases of professed poets, however, who preserve and cherish their imaginative tendency, and go through the working world laurelled and privileged to dream, it is not observed that the imagination grows weaker so long as there is growth in the being at all, but, on the contrary, that it gains strength. By the mere necessities of existence, acquisition, and experience, it is a more rich and powerful imagining mind in the later than it was in the earlier stages of the progress. And so also if, after an intermediate period of non-poetical activity, or of activity in the main non-poetical, a mind originally poetical reverts, before decay has set in, and ere the old habit has been forgotten by too much disuse, to its first occupations. In either case there will be differences between the earlier and the later poetry. The themes in all probability will be different, and the style and manner of treatment will be different likewise. So it was with Milton. In his youth his was the imagination of a mind naturally firm and austere, it is true, and already cultured and well equipped with learning, but still sufficiently untorn and unexercised in the contemporary medley of human things to find its delight in fancies of the sweet and sensuous order, in themes of idyllic grace, or of purely ideal beauty. In his old age, or second poetic period, it was different. Imagination was again his darling faculty; but it was now the imagination of the same mind tried and disciplined in a thousand things by what it had meanwhile passed through,—heavily freighted, as it were, with twenty years of griefs, ideas, recollections, and experiences, which had not at first belonged to it. If, then, imagination is the whole mind in the act of imagining, and if, accordingly, the poems which a poet successively puts forth may be regarded as in a profound sense allegories, on a larger or smaller scale, of his entire being at the moments to which they appertain, it was in the nature of things that Milton's later poetry, though bearing certain resemblances to his earlier, should yet differ from it. By universal admission such is the fact. In *Paradise Lost*, *Paradise Regained*, and *Samson Agonistes*, we have the same peculiar Miltonic genius which we discern in *Penseroso*, *Comus*, or *Lycidas*; but it is as if that genius had meanwhile absorbed and incorporated into its fibre all that we know of the intermediate polemic and prose writer. The themes are of larger dimensions and of more direct human and historic interest; the filling up is more various, erudite, and elaborate; the artistic harmony is more complex; and while the whole matter is cast in the mould of the imagination, much of it is of independent and extra-poetical, not to say controversial, value.

Each of the three later poems of Milton has its separate merits as a poem, and also its separate interest in connection with the poet's biography. In the noble Æschylean drama of the blind Samson among the Philistines, one seems to see a scarcely disguised allegory of the poet himself agonizing in the midst of evil times. There is no need to ask how that subject occurred to him. As regards the *Paradise Regained*, though here also we can discover points of contact between the subject and the author, such as might have determined him independently towards the choice of that epic from the first, we yet know that it was composed mainly as a sequel to the *Paradise Lost*. It remains, then, to account for the origin of this greater epic, the crowning glory of Milton's life, and to which it is owing that he is remembered and will be remembered for ever, not only as a noble Englishman who did his duty manfully in a troublous period of his nation's history, nor even only as this, with the addition of having been a notable English poet, but as one of those select few of the children of men who, having wedded their genius to universal themes, stand apart as the great poets of the world, and the authors of the world's masterpieces. Notwithstanding the tradition, through Phillips and Ellwood, of Milton's preference for the *Paradise Regained*, there can be no doubt that it was to the *Paradise Lost* that he himself looked as the fulfilment of his life-long promise.

The most important act of the artist, and that which involves the greatest amount of presumptive evidence respecting him, is his choice of a subject. Milton, we have seen, had wavered long before deciding as to the best theme for his intended masterpiece. Like Wordsworth before he determined on his long philosophical poem, he appears to have ranged through history in search of a subject of sufficient interest and capability; going back through British history, and there resting fondly for a time on the subject of King Arthur, then deviating into general mediæval history, and finally extending his quest still backward and backward through ancient to primeval times. At last in his search he reaches a point beyond which it was impossible to go—the point where human history itself began, and where our planet, with life but newly planted upon it, is seen emerging for its special voyage out of the obscurities of prior and universal existence. The more he thinks of this subject, already familiar to him in its biblical relations, the more sensible he becomes, not only of its intrinsic capabilities, but also of its fitness for himself. The qualities and endowments for which it affords scope,—an imagination delighting in conceptions of the physically vast, as in astronomy, and yet capable of that kind of sensuousness which consists in love of the physically rich, as in landscape and vegetation; great acquired learning, classical and theological; a moral sublimity of nature almost at war with human society as seen around it, and driven, therefore, to communion with objects and intelligences unseen; an intellect withal massive and severely logical to exclude in the process of imagination whatever should be beneath the philosophy of the time, and to shape all into clear form and sequence according to high literary rule;—these are the very qualities and endowments which he is conscious of possessing. On the other hand, those qualities of the want of which he was or might have been conscious,—humour, for example, as in Chaucer and Shakspeare, and the corresponding dramatic faculty of light incident and varied painting of physiognomies and characters to pass and repass in quick succession in a story,—were qualities the exercise of which the theme itself precluded. What room for humour in the grand story of our earth's beginning, or for elaborate portrait-painting in the description of a world tenanted as yet but by the two first beings of our race? In short, by the instinct both of what he could and of what he could not do, Milton's choice was made; and, it having been also at last decided that the form of the poem should be the epic and not the dramatic, and moreover (which was then a great innovation, and was proclaimed by Milton to be such) that the verse employed should be the heroic blank and not rhyme, *Paradise Lost* slowly grew into being. For seven years or thereby, and mostly amid the streets of bustling London, where Charles was amusing himself with his court, and Dryden was seeing his plays acted, and poor Butler was growing morose from ill usage, and Pepys was running about and taking notes, the plan was carried in the blind man's head, till at last, by dictations of twenty or fifty lines at a time, the work was completed.

"Things unattempted yet in prose or rhyme,"

is Milton's description of the matter of his poem. The description is just; and it is part of his title to immortality that he spent his genius on a theme of universal interest, which, seeing that it had been reserved for him to sing it, could certainly now, for that very reason, never be sung a second time even had he sung it worse.

> "Of man's first disobedience, and the fruit
> Of that forbidden tree whose mortal taste
> Brought death into the world and all our woe,"

is his opening more particular definition of the purport of his song. This definition, however, if taken by itself, is totally inadequate; nor, if this were the theme, could it be said to have been unattempted before. The true theme of *Paradise Lost* is the story of the connection of this world, as a whole, with what may be called the larger universe of ante-human existence; and "man's first disobedience" is but the last incident in the story, to which, as to a narrow point, all the prior incidents tend. The true hero of the poem,—the being in whose movements and actions from the beginning to the end the unity of the epic is maintained,—is the archangel Satan. Adopting the scriptural account of this great being, as one in whose life the past and primeval system of things is fatally connected with ours, and adhering also with theological conscientiousness to whatever circumstantials Scripture has supplied towards filling out the story, the poet has passed the whole through the mould of his imagination in such a manner that now it is Milton's story of the origin and first events of the universe, rather than the biblical outline which suggested it to him, that has taken possession of the British mind. As, however, there is no contradiction of the biblical narrative, but only an expansion of it, the majority of readers find in the poem an absolutely unexceptionable rendering of the theme; while, on the other hand, even those who hold aloof from theology in such matters, or would treat the Mosaic account rather as a figure than as a narrative, admit that, as there must be *some* conception of the theme for the mind of man to take hold of, so no more sublime conception of it than Milton's has been provided by a human poet, or could be presented to the Christian world. To both classes of readers the poem properly shapes itself as in the main a Sataniad, or epic of Satan's life from the time of his being an archangel among the hosts of heaven to the time of the execution of that scheme whereby, after the fall of himself and his fellow-rebels, he becomes the lord and minister of evil on our particular earth.

From the very nature of the theme it arises that the extent of physical space which the poem fills is larger than that which any other known poem takes in, or any other conceivable poem could possibly require. The universe of Dante's poem, physically regarded, is but a nutshell to that of Milton's, which stretches in its totality beyond all telescopic bounds, and incloses, as but a drop of central azure, the whole visible region of the stars and galaxies. A diagram of the plan of the poem would illustrate this. It presents to us the first primeval Infinity, not as a universe of stars at all, but as a sphere, if we may so say, of infinite radius, divided into two and only two parts—the higher or upper hemisphere of Heaven, which is a region all of light, formed forth in some inconceivable way into tracts of field and continent, and populated in some inconceivable way by angelic beings, all near to Deity, and doing his missions, but distributed into hosts and hierarchies, and leading lives of freedom; and the lower or nether hemisphere of Chaos, where no such beings habitually are, but which is a great sea or swelter of darkness and confusion, —a limitless, fathomless quagmire of elemental pulp. While we are contemplating this eternal Infinity, divided equatorially, as it were, into a Heaven above and a Chaos below,—lo! the event which breaks in on the grand monotony of ante-human history, and, by means of moral, necessitates physical, changes! Satan and his fellow-angels rebel; there are the wars in Heaven; and when these are over, the rebels, driven headlong into the yawning gap which opens to disgorge them into Chaos, are pursued by the Messiah's wrath, down and still down through its dark abysses, till they reach that space or pit of fire which is now prepared for their reception in nethermost Chaos, under the name of Hell. This third region, so created for the first time, is, as it were, the antarctic zone of the universal sphere, separated from the hemisphere of Heaven by the vast intervening belt of Chaos as it still remains. Stunned and confounded by their fall, the rebel spirits lie long inactive in the fiery lake, till at last, roused by Satan from their stupor, they realize the past and look forward to the future. Amid a Babel of counsel it is Satan that devises a plan. The creation of Hell in the nethermost region of Chaos has not been the only physical change introduced about this time into the universal order. Contemporaneously with the fall of the rebel angels God has executed through his Son the scheme foreordained from everlasting, of the creation at this time of a new race of beings differing from the angels, and of a world fitted to receive them. By the exercise of the creative energy a great mine or hollow has been cut or scooped out of upper Chaos at its junction with Heaven; into this hollow the light has gushed down from above, so that it is now no longer a part of Chaos; and under the influence of the principles of rotation and gravitation planted in it of express purpose, the matter that existed in it chaotically has become coagulated into balls and planets, moving in regular orbits, and separated by clear interspaces. This, in short, is our human or telescopic universe, with its suns, its stars, its moons, its nebulæ; all in apparent diurnal rotation round that little earth of ours, which was to be the centre of the whole experiment. Thereon already walked Adam and Eve, in a paradise of trees and flowers, the fairest and happiest of God's creatures. It was of this new creation, known to him not as yet by eyesight, but only conceived vaguely from recollection of the tradition of it as discussed so long in Heaven, that Satan bethought himself in his fallen estate in Hell. His plan is to abstain from all mere general endeavour against the Almighty, and to gain admission, if possible, into this new creation so as to vitiate and ruin *it*. His scheme having been approved by his co-mates, he himself sets forth to execute it. Leaving the rest of the fallen host to organize their new kingdom and build the palace of Pandemonium, he climbs his arduous way through superincumbent Chaos till the light of the young creation appears above him, and he emerges within its transparent bosses. At first amazed and almost softened by the sight, he at length arouses himself to his task, and having ascertained which of all the shining orbs was the seat of man, he alights on its surface, and, despite the vigilance of angels celestially commissioned to oppose him, completes, in the shape of a serpent, his fiendish errand. When he returns to Hell in triumph, his fellows have already bridged the interval between Hell and Creation so as to make the intercommunication easy; the two regions are thenceforth associated; and though the price to the rebel angels themselves of this voluntary concentration of their energies on one poor world is a farther degeneracy of their form and nature, Humanity is their prey for the appointed season.

There is no need here to dilate on the consistency with which Milton has conducted this magnificent story, or on the power of various invention with which he has filled it up; nor need we refer to such adverse criticisms as have been from time to time ventured against portions of the poem. We refrain also from an inquiry which might more properly belong to us, as to the influence of Milton's blindness, not only in determining him to such a subject, but also

as perhaps positively qualifying him for that kind of imagination and description of which five-sixths of the poem consist—the imagination and description of vast physical space, variously shaded and divided; of luminous orbs in quiet motion through the nocturnal deep; of luminous or else shadowy beings passing or repassing singly or in battalions; of contrasts of light and darkness in all their forms. In the remaining parts of the poem, where the poet condescends on our own earth, and describes the beauty of Paradise, there is certainly no lack of sensuousness, in the more ordinary sense of the term; but it may be questioned whether, with all the richness of those paradisaic descriptions, there is not evidence that the poet was now but living fondly on his recollections of a world of colour and vegetation from which he had been long shut out. At all events, much even of the subsidiary and terrestrial imagery of the poem will be found to consist of light and darkness worked cunningly into visual contrast; and the florid offering on the bier of Lycidas is richer in botanical colour and embroidery than the nuptial bower of Eve.

A question as to Milton's theological belief, which was suggested to some keen critics by certain passages of his *Paradise Lost*, has been answered, in favour of their conjecture, by the discovery of his *Treatise on Christian Doctrine*. In one chapter of that work he expresses views at variance with the orthodox notions of the Trinity. Bishop Sumner gives a summary of these views in theological language. Milton asserts, he says, "that the Son of God existed in the beginning, and was the first of the whole creation;" that "by his delegated power all things were made in heaven and in earth;" that "he was begotten within the limits of time," and "indued with the Divine nature and substance, but distinct from and inferior to the Father." In other words, Milton in his later life was an Arian, and there is a trace of at least incipient Arianism in the *Paradise Lost*.

Milton lived seven years and a half after the publication of his *Paradise Lost*, and three years after the publication of his subsequent volume containing the *Paradise Regained* and *Samson Agonistes*. The personal sketches which we have of him refer mostly to this time of his life.

Of a stature somewhat below the average, Milton had in his youth been singularly handsome, with a complexion of delicate white and red, dark gray eyes, light auburn hair, parted in the middle, and altogether an appearance of slender and even feminine grace, which it required his manly bearing and his confidence as a swordsman to contradict. Even in later life he was usually mistaken for ten years younger than he really was. In his old age, however, his blindness, accompanied by the gout and other infirmities, had abated his activity and vigour. "An aged clergyman of Dorsetshire," says the painter Richardson, "found John Milton in a small chamber hung with rusty green, sitting in an elbow chair, and dressed neatly in black; pale, but not cadaverous; his hands and fingers gouty, and with chalkstones. He used also to sit in a gray coarse cloth coat at the door of his house near Bunhill Fields, in warm sunny weather, to enjoy the fresh air; and so, as well as in his room, received the visits of people of distinguished parts as well as quality." To this we may add some particulars from other sources. "He was an early riser," says Aubrey; "to wit, at four o'clock in the morning, yea, after he lost his sight." In winter his hour of rising was five; and sometimes he would lie in bed after he was awake composing mentally or dictating. He had a man to read to him as soon as he got up, and also after breakfast, and he always began the day with a chapter or two of the Hebrew Bible. The early part of the day was spent by him in reading and writing; "the writing," says Aubrey, "usually as much as the reading." He used to dictate, sitting obliquely in an elbow chair, with his leg thrown over the arm. At one o'clock, after a short walk, he dined, eating well of such dishes as he liked, but drinking little except water. "God have mercy, Betty," he said to his wife one day at dinner about a year before his death, "I see thou wilt perform according to thy promise, in providing me such dishes as I think fit whilst I live, and when I die thou knowest that I have left thee all." After dinner he used to walk again in the garden or out in the neighbourhood, with some one guiding him; or sometimes he would take exercise in a kind of swinging chair which he had contrived; generally, however, in the course of the afternoon, playing for an hour on the organ or the bass-viol, and either singing himself or making his wife sing, who, he said, had a good voice, but no ear. An hour or two towards evening were again given to his books; about six o'clock visitors would drop in, whom he would entertain till eight; he then had olives or something light by way of supper with them; and, after a pipe of tobacco and a glass of water, he went to bed. "Extremely pleasant in his conversation at dinner, supper, &c., but satirical," says Aubrey, who adds, that "he was visited by the learned much more than he did desire." In particular, foreigners of note, when in London, would seek him out; and, indeed, before the publication of *Paradise Lost* he was liable to the visits of admiring foreigners, some of whom, according to Aubrey, regarded him as hardly less a lion than "O. Protector" himself, and would insist (the Great Fire not having yet done its work) on seeing the house and chamber where he was born. "He was much more admired abroad," says Aubrey, "than at home." At home, however, more especially after the publication of his great epic, he did not lack admirers. Which of the "quality" paid him visits we do not know; but among the "people of distinguished parts" was Dryden, whose admiration of him was extreme, and who on going to see him was, it is said, received civilly, though Milton had a low idea of Dryden's poetry. Hobbes was not of his acquaintance, nor had he any liking for Hobbes, but acknowledged him to be a man of great parts. His familiar friends were men of the graver sort, among whom were Andrew Marvell, Dr Paget, and Cyriack Skinner. He attended no church and belonged to no particular communion; nor had he any rites of worship in his family—though what were his reasons for this was not very well known even to his friends. He remained a theoretical republican to the last. His favourite poets among the classics are said to have been Homer, Euripides, and Ovid; and among the English, Spenser, Shakspeare, and Cowley. Aubrey adds that, in speaking or reading, he pronounced the letter *r* very hard; "*litera canina*," as Dryden said to Aubrey, "a certain sign of a satirical wit." From Ellwood we learn that he could not endure the English mode of pronouncing Latin, and that his ear was so quick that he knew at once when his reader had come to a sentence which he did not understand.

The date of Milton's death was November 8, 1674. The cause, according to Aubrey, was "gout struck in;" but his death was calm and easy. He was then close upon being sixty-six years old. He was buried beside his father, in the church of St Giles, Cripplegate. Shortly after his death there was a lawsuit between his widow and his daughters as to the inheritance of his remaining property, which amounted to about L.1500. The widow pleaded a nuncupative, or declaratory will, made by the deceased before witnesses, to the effect that she was to be his sole heir, and that the daughters, having been "very undutiful" to him, were to receive nothing except their interest in their mother's marriage-portion, which, though never paid, was yet in good hands, and recoverable. The decision, however, was so far favourable to the daughters, that each got something out of the property. The subsequent history of the family was as follows:—The widow survived her husband not less than forty-five years, dying, in very old age,

in 1729, at her native place of Nantwich in Cheshire, where she was a member of the Baptist communion. Of the three daughters, the second, Mary, died unmarried; the eldest, Anne, married rather late in life a master-builder, and died in her first childbirth; and the youngest, Deborah, alone left issue. She had gone over to Ireland as companion to a lady before her father's death; there in 1674 she married a Mr Abraham Clarke, a silk-weaver, with whom she returned to London in or about 1687, and settled in Spitalfields, where Addison and others saw her, and asked her questions about her father; and she died in 1727, after having had a large family, of whom only one son and one daughter survived. The son, who was named Caleb, went to the East Indies, and died at Madras in 1719, leaving children, whose issue cannot be traced. The daughter, whose name was Elizabeth, married a Thomas Foster of Spitalfield, who afterwards kept a small chandler's shop in Holloway, and was in very poor circumstances. Some money was collected for her in 1750 by Dr Birch, Johnson, and others; and she died at Islington in 1754, having had seven children, none of whom survived, or at least left descendants. Thus disappeared all the direct posterity of the poet. It remains to be added, that his brother Christopher, having adhered steadily to his royalist politics, was knighted by James II. in 1686, and became one of that king's servile judges, but was set aside at the Revolution, and died at Ipswich in 1692; that the two Phillipses, the poet's nephews, had some reputation as hack-writers in the reigns of James and his successor; and, finally, that their mother, the poet's only sister, had other children by her second marriage, whose descendants are still to be traced. (D. M—N.)

MILWAUKEE, a town and lakeport in the state of Wisconsin, North America, is situated at the mouth of a river of the same name, on the W. shore of Lake Michigan, 90 miles N. of Chicago, and 75 E. of Madison. The town stands partly on the low banks of the river, and partly on the high grounds on the borders of the lake; and is well built of a sort of brick, of very excellent quality, which is manufactured here. Milwaukee has 30 churches, of which 4 belong to the Roman Catholics; 5 public schools; several academies; 3 orphan hospitals; besides other educational and charitable institutions. The chief manufactures of the place are,—iron, bricks, flour, and articles of cooperage, besides wood-working, soap, candles, shingles, and tobacco. In 1855 the total value of the aggregate and miscellaneous manufactures of this rapidly increasing town amounted to more than L.1,000,000 sterling. The harbour of Milwaukee is very good, being formed by the river, which may be ascended by large vessels for 2 miles above its mouth. The commerce is very extensive; in 1854 the value of the imports here amounted to L.2,317,726, while in the following year it rose to L.3,885,381; the value of the exports in 1855 was L.3,610,327. The former consist chiefly of salt, coal, lime, plaster, fruits, &c.; and the latter of wheat, flour, pork, beef, lead, shot, the products of the manufactures, &c. The number of vessels that arrived here in 1855 was 2802, with a total tonnage of 980,700. Milwaukee communicates with the interior by several lines of railway; and it is thus the principal outlet for the productions of the country. The town has risen very rapidly to its present condition, as the place was not settled till 1835. Pop. (1850), 20,061; (1856), about 45,000.

MINA, DON FRANCISCO ESPOZ Y, a Spanish general, was born in 1781, at Idozin, a small village of Navarre. When the insurrection against the French broke out in 1808, Mina took part in the guerilla warfare then carried on, and soon distinguished himself so much by his skill and courage as to collect a large body of men under his standard. He thus rose to be the head of all the troops of Navarre, and urged the war with great vigour, inflicting many heavy blows on the French. He displayed great activity and rapidity in his movements, and gained many successes by falling suddenly and unexpectedly on the French convoys proceeding between Madrid and France; and although the French organized a large army to secure their possession of the country infested by him, he always succeeded in baffling their attempts by dispersing his troops among the ravines and mountain passes, and reuniting them again at a different place a short time after. During all these exploits Mina acted not only as the general directing the movements of his band, but fought himself as actively as any soldier in the ranks. On one occasion he was severely wounded, and on another narrowly escaped with his life, when having been surprised in a house to which he had betaken himself, and not having time to seize his arms, he only saved himself from certain destruction by defending himself with an iron bar. Mina was raised to the rank of colonel in 1811, and to that of brigadier-general in 1813. At the close of the war he was at the head of more than 30,000 men, who had taken 13 fortified places, and captured upwards of 14,000 prisoners. In 1814 Mina was invited to the court of Ferdinand VII.; but he did not conceal his disapproval of the abrogation of the constitution of 1812, and was accordingly sent back to Navarre, where, shortly after, along with the other generals and the greater part of the army, he openly joined the liberal party, and was obliged to save himself from the fate of his companions by taking refuge in France. (For a full account of the events of this period, and of Mina's share in them, see SPAIN.) The Spanish ambassador in France demanded the delivery of the fugitive; but Louis XVIII. not only refused to do so, but insisted on the recall of the ambassador, and gave Mina a pension. On the restoration of Napoleon he refused to enter his service, and retired to Switzerland; but returned to France on the fall of the emperor. In 1820 Mina returned to the theatre of his old exploits; and the remembrance of his former achievements soon put him at the head of a large army. When the constitution was again accepted by the king, Mina was appointed captain-general of Navarre; and in 1821 he held the same office in Galicia; but was soon after deprived of his command, when he retired to Siguenza. He was recalled, however, in 1822, and took the command of the constitutional army in Catalonia, with which he obtained great successes over the enemy. The invasion of a French army, however, compelled Mina, after resisting as long as possible, to give up the contest, and to retire to England. After the revolution of 1830 he repaired to Paris, where he and Valdes planned an invasion of Spain. The latter, more impatient than Mina, entered Spain in 1830; and as his expedition was not successful, Mina crossed the frontier in order to save his companions, though with faint hopes of the success of his enterprise. After displaying great courage and passing through the greatest dangers, he reached with difficulty the French frontier. In 1834, on the breaking out of the civil war, Mina was recalled to take the command of the army of the queen. But he was now opposed to his old followers the peasants of the north, who embraced the side of the Carlists, and turned against Mina those very tactics which he had taught them, and by which he had gained along with them so many successes. His health, too, was injured by the incessant activity, sufferings, and dangers of his laborious life; and he was obliged to resign his command in 1835, without having gained any great success. He died the following year at Barcelona.

MINAS GERAES, a mountainous province of Brazil, situated between Lat. 14. 30. and 23. S., and Long. 40. and 51. W., is bounded N. by the province of Bahia, W. by

Goyaz, S. by Sao Paulo, and E. by Rio de Janeiro and Espirito Santo. It is about 600 miles in length from N. to S., by 350 in average breadth, and has an estimated area of about 216,000 square miles. This is the most elevated province of Brazil, as well as the richest in minerals, and the most populous. It occupies an elevated table-land traversed by detached mountain ranges, separated from each other by sloping and pastoral but not very deep valleys. The most elevated summits are Itacolumi, 5750, and Itambi, 5900 feet above the level of sea. Owing to its elevation, the climate of Minas Geraes is temperate when compared with that of other countries under the torrid zone. It is abundantly watered by numerous small streams, which fall into larger currents. The principal of the latter is the Sao Francisco, which flows northward through almost the entire province, and after passing through Bahia and forming the boundary between that province and Pernambuco, and between Sergipe del Rei and Alagoas, falls into the Atlantic Ocean. The Rio Grande and the Rio Parnahiba flow southward to form the Rio Paranà; and the Rio Doce and the Jequitinhonha flow eastward into the Atlantic. The soil is in general very fertile, yielding in abundance, and with little labour, the grains and fruits of Europe, besides the aromatic plants and other vegetable productions characteristic of such regions, as cotton, tobacco, sugar, maize, manioc, coffee, indigo, ipecacuanha, jalap, liquorice, &c. The forests abound in valuable timber; and vast herds of swine and cattle are reared. The great wealth of the province, however, is in its mineral resources. Among the metals and minerals found here are gold, silver, copper, platina, iron, lead, mercury, antimony, bismuth, limestone, millstone, alum, and sulphur. The manufactures are still very imperfectly developed; but there are some extensive ironworks in the neighbourhood of the capital, Ouro Preto. Pop. (1852) 1,300,000.

MINCHINHAMPTON, a market-town of England, county of Gloucester, and 12 miles S. by E. from the town of that name. It is pleasantly situated on a gentle declivity of the Cotswold Hills, but is irregularly built. The parish church is a large cruciform edifice surmounted by an octagonal tower. There are several dissenting places of worship, and national and other schools. The inhabitants are chiefly employed in the cloth manufacture, which forms the staple of an extensive district. Pop. of parish (1851), 4469.

MINCIO (the ancient *Mincius*), a river of Northern Italy, which issues from the S. extremity of the Lago di Garda, and flowing southward, passes Mantua, and falls into the Po 12 miles below that town, after a course of about 40 miles. In the neighbourhood of Mantua the waters stagnate so as to form shallow lakes of considerable extent. The Mincius is celebrated by Virgil, who dwelt on its banks.

MINDANAO, or MAGINDANAO, the most southerly of the Philippine Islands, and the second in size of that group, is situated between 5. 32. and 9. 50. N. Lat., and 122. and 126. 13. E. Long., having a length of about 300 miles from N. to S., a breadth somewhat less, and an area estimated at 36,140 square miles. The general form of the island is that of a triangle having its base towards the E.; but its outline is very irregular, and in one part it is almost divided into two by bays running deep into the land. Of these the southern is called the Bay of Illano, and the northern the Bay of Siddum. The island is mountainous, containing several volcanoes; and the hills are covered with dense forests nearly to their summits. A great part of the low lands of the island is also wooded; but there are in many places extensive plains covered with fine grass. Mindanao contains a large number of lakes, and from this circumstance the island derives its name. The largest lake is that of Malanao or Lano, near the centre of the island. There are also many rivers, of which the principal is the Batuan. The products of Mindanao are similar to those of the other islands of the group to which it belongs, and consist of gold-dust, timber, coffee, cocoa, rice, nutmeg, cinnamon, pepper, &c. The principal animals found here are buffaloes, horses, oxen, deer, goats, and wild hogs. The island was visited by Mohammedans from Arabia at an early period; but the first European who reached it was Magelhaens, who took possession of the island for Spain in 1529. The Spaniards, however, have only colonized the northern part, and have great difficulty in retaining possession even of that portion. Their territory is divided into two provinces, Caraga and Missamis, the former of which is very rich in gold. The chief town in the Spanish possessions is Samboangan, which is used as a place of banishment for the Philippines, and is strongly fortified. The inhabitants resemble greatly those of the surrounding islands; and though some tribes are said to be cruel and ferocious, others are mild and inoffensive, employing themselves in gathering gold-dust, and bartering it with the Spaniards. The south-eastern corner of the island belongs to the sultan of Mindanao, and is inhabited chiefly by Malays; while the S. and S.W. portions are occupied by the Illanos, a tribe of pirates, who have their chief seat on the Bay of Illano. These people, who are a mixed race, partly of Malayan and partly of native extraction, profess to be subject to the sultan of Mindanao, but are in reality quite independent. They are Mohammedans in religion, and live entirely by piracy, scouring the sea with light vessels of a peculiar construction. Their voyages extend as far as New Guinea towards the E., and Malacca towards the W., and they sometimes even enter the Bay of Manilla in defiance of the Spanish authorities. Pop. of the whole island probably about 1,000,000; of the Spanish provinces, 76,298.

MINDEN, a strongly fortified town of Prussian Westphalia, capital of a government of the same name, on the left bank of the Weser, here crossed by an old bridge 600 feet long, 37 miles W. from Hanover. This is one of the oldest towns in Germany. The Emperor Henry IV. resided here for a long time; and at the imperial diet held here in 1026 his father Henry III. was chosen emperor. The town is irregularly built, and contains few good buildings. It has five churches, the principal of which, the cathedral, is a handsome edifice 200 feet long by 82 wide. Among its educational institutions are a gymnasium, a normal school, and a Lutheran young ladies' seminary. The manufactures are considerable, comprising woollen stuffs, linen, hosiery, hats, leather, tobacco, soap, beer, brandy, sugar, &c. Minden also carries on some trade by means of the river. The French were defeated in the vicinity of this town on 1st August 1759 by an Anglo-Hanoverian army under Prince Ferdinand. Pop. (1849) 13,060.

MINDORO, one of the Philippine Islands, is situated to the S. of Luzon, from which it is separated by the Strait of Manilla, between 12. 10. and 13. 30. N. Lat., and 120. 27. and 121. 43. E. Long. Length about 100 miles; average breadth between 40 and 50; area estimated at 4150 square miles. Its form is triangular, and the coasts are skirted with a range of hills; while in the interior the surface gradually rises to a very great elevation. The surface is well wooded, and watered by a great number of streams rising in the centre of the island. There are some Spanish settlements in Mindoro; and the aborigines are employed largely in piratical expeditions. Pop. 28,060.

MINEHEAD, a decayed borough and market-town of England, county of Somerset, on the Bristol Channel, 22 miles W. by N. from Taunton. Minehead was formerly a place of some trade, and returned two members to Parliament till disfranchised by the Reform Act; but it is now chiefly known as a watering-place. A small trade is still carried on with Bristol and Wales; and the herring fishery is prosecuted to some extent. Pop. of parish (1851), 1542.

MINERAL WATERS. Great curative powers have always been ascribed to certain natural sources of waters springing from the ground, and differing for the most part from ordinary sources, either by the excess or remarkable character of their constituents, or by their temperature. The savage of America, the Romans, the inhabitants of Asia, not to speak of the moderns, have all expressed in various modes their conviction of the fact. The way in which some of the more important springs have been discovered,—either by the congress of animals and their cure from various diseases (and there are more authentic narratives of the kind than that of Bladud and his swine), or by fortuitous cures in man, many of which are well authenticated,—is in itself a strong presumption in favour of the actual power of many mineral waters. But when we add to this the fact, that the chemical composition of many waters is that of very powerful medicinal agents; when we consider the effects which, on physiological principles, are likely to result from the imbibition of quantities of water well imbued with mineral principles, as well as from bathing in such waters hot or cold,—little doubt can remain as to the possession of real power by mineral waters. Add to this, that the remedy, such as it is, is generally administered with all the accessories likely to increase its beneficial action. Removal from care, good air and exercise, and improved hygienic relations, are almost always employed in conjunction with this cure.

1. The principal difficulty which we encounter at the outset of any inquiry into the nature of mineral waters is to determine what a mineral water really is. All waters, except very carefully distilled water, contain salts. Rain water, river water, and spring water, all contain salts. Malvern, one of the purest springs in England, contains about five grains of salts to the gallon. The question is, to what extent is the solution of foreign substances in a water to proceed,—or how far can it depart in other respects from the characters of ordinary water,—to entitle it to be called *mineral?*

Perhaps when the amount of salts and other solids held in solution in a water exceeds 60 grains in the imperial gallon it should be entitled to the term mineral. It is to be observed, that the constituents of a water which may exercise medicinal effects cannot be restricted now-a-days to the mineral or gaseous constituents of water only, seeing that a principle or congeries of substances, which exists in a great many mineral waters, of an organic vegeto-animal nature, variously termed zoogine, glairine, baregine, &c., is supposed to produce considerable effects. The extractive matters derived from the earth and from plants also contribute to the action of waters. The amount of gases, or the temperature of the water, may be sufficient to give the characters of mineral waters where the solid constituents are in very small quantities. Thus in this country the waters of Moffat and Gilsland are entitled to be called mineral, although there is nothing in the amount of salts they contain to give them this character. It is due, however, to their gaseous constituents, especially their sulphuretted hydrogen, one of the most powerful poisonous and medicinal agents, and in solution especially calculated to act upon the skin or the kidneys, and excite their secretions. On the Continent the waters of Pfeffers and Wildbad have been found by long experience to be capable of curing disease, although their mineral constituents are insignificant.

2. The most obvious division of mineral waters is into thermal and cold. Of the origin of the former many theories have been given. They probably arise from more than one source, and from various causes. The origin of thermal springs may be ascribed to the following causes:—*1st*, To water coming in contact with certain chemical agents in the interior of the earth; *2d*, The proximity of volcanoes; *3d*, The internal heat of the earth; and, *4th*, To electrical changes, in which the very production of these mineral springs, and the charging of them with their various constituents, are concerned.

None of these explanations, except the last, satisfies all the conditions of the problem, and the last itself is altogether hypothetical. Against the second hypothesis it may be urged, that on the volcanic theory we cannot account for the uniform constitution of almost all thermal springs at different times and at all times; and that many hot springs occur which are neither in volcanic regions nor in the neighbourhood of volcanoes. It is an undoubted fact, proved by the phenomena observed in regard to Artesian wells, and by observations in mines, that the temperature of the earth increases as an approach is made towards the centre of the planet, in the ratio of 1° 8′ of Fahrenheit for every 101 English feet. This theory of the depth may account very well for the heat of many thermal springs, but not for all; for although most thermal springs continue to preserve the same temperature, others occasionally vary, and many have been observed to undergo great changes during earthquakes. Thus Carlsbad and Aix in Savoy lost temperature at the time of the earthquake at Lisbon. The electrical theory would account for almost everything, including the chemical composition of many thermal spas; since such gases as free carbonic acid and sulphuretted hydrogen are precisely the gases which we might expect to have disengaged by the chemical action of electrical currents; and the heat-producing power of electricity admits of no doubt: but what do we know concerning the currents of electricity in the interior of the earth? We must be content, then, with admitting, that of the causes of the thermality of many mineral springs we know little with certainty. In all ages these natural hot baths, some of which issue at the temperature of boiling water, have been preferred to artificial baths. The Romans in all the conquered provinces invariably seized with avidity on these sources, and erected splendid thermæ, with which nothing in modern times can compare. The *admitted* superior efficacy of the natural over the artificial baths has led to many conjectures as to the cause. The supposition that the specific heats of natural and artificial waters were different was refuted by a series of careful experiments performed by M. Longchamps and others. There remains the supposition, thrown out of late years, that the superior efficacy of natural thermæ may be due to their electricity; but at present it is unsupported by direct experiment. Besides those springs of the temperature of the body or above it, which deserve to be called hot, as Wildbad, about 98°, Bath, 118°, there are other springs below the temperature of the body, yet hotter than ordinary water, as Buxton, 83°, and the misnamed hot wells of Bristol, only 76°.

After thermal springs come the cold, which are variously classified, according as the writer gives more or less importance to this or that predominating ingredient. Perhaps the best and most natural division is into sulphuretted, carbonated, saline, and chalybeate. The first contain large quantities of sulphuretted hydrogen gas, with or without saline ingredients. Thus Harrowgate and Gilsland contain about 2 cubic inches of sulphuretted hydrogen to the pint (imperial); but the former (old well) contains 133·7 6 grains of salts in that quantity, while the latter has only 2·93. The carbonated waters are those which are highly charged with carbonic acid gas, a very valuable property, since it causes them to sit easy on the stomach. These waters, besides being grateful to the palate, possess stimulating and tonic properties. In this class of waters Britain is unfortunately entirely deficient. It is true the Leamington waters contain above 2 cubic inches of it to the pint; but this quantity is not sufficient, as it would be in the case of sulphuretted hydrogen, to give the characteristic properties. On the Continent some of the waters,

as Pyrmont, are so highly charged that the gas escapes almost with explosive violence. The saline waters admit of a very important subdivision,—viz., into alkaline, muriated, and sulphated. The first are characterized by the presence of such a quantity of the carbonate of soda as to give them marked alkaline properties; in some cases, as at Vichy, these waters are thermal. In this valuable class of waters we are unfortunately deficient in this country. Their alkalinity renders them especially useful in gouty and calculous affections; and when, besides, they are thermal, they may be considered invaluable, admitting of the use of hot alkaline baths and the absorption of the curative agent through the skin, as well as of its internal administration. We have in this country waters containing trifling quantities of carbonate of soda, but nothing to give an alkaline *character* to the waters. Many of these waters also contain large quantities of carbonic acid. The muriated waters are those which contain large quantities of alkaline and earthy muriates or chlorides. The sulphated waters are those which contain as their chief ingredients the alkaline and earthy sulphates. Metallic sulphates, as those of iron and manganese, do also exist, but the waters then generally belong to the class of chalybeates. Chalybeate waters are those which contain iron almost always in the form of the carbonate or sulphate, in such quantity as to cause the effects of the water to be ascribed chiefly to its iron. The carbonate is generally held in solution by excess of carbonic acid. This is the reason why, on boiling such waters, a portion of the iron is precipitated, owing to the carbonic acid being driven off; and why, also, the stones in the course of chalybeate waters exhibit a red tinge, as the excess of carbonic acid with which the water was imbued flies off on exposure to the air, and the oxide of iron is precipitated. Most of the carbonated-iron waters are weak; still they produce undoubted effects. Tunbridge wells contain a very little more than the quarter of a grain in the pint. The sulphated-iron waters, again, are of a very different character, both because the ingredient itself is more powerful, and because, being exceedingly soluble, much larger quantities of it are held in solution. Very valuable waters of this class exist in Great Britain, some of them but little known. Some of these waters are too strong for use in an undiluted form, as Sandrock in the Isle of Wight, which contains no less than 41·4 grains of the sulphate of iron in the pint.

Besides these classes of bodies, other substances of importance exist in mineral waters. Iodine and bromine are found occasionally in saline springs. The former element has been found so useful in scrofula and bronchocele that its presence has been considered of much consequence. Woodhall spa, in England, contains rather more than half a grain of iodine in the gallon. Arsenic of late years has been discovered in minute quantities in several waters in France and Germany; and in fact the only limit to the number of substances found in mineral waters would appear to be the extent to which the analyses are carried. Organic acids, as the acetic and formic, as well as others of a different kind, have lately been found by Scherer in the waters of Bruckenan. The principle termed zoogine or glairine, already alluded to, deserves consideration; and so much weight has been attached to it, that in artificial sulphur baths animal gelatine is sometimes substituted for it.[1]

The analysis of mineral waters does not give the principles either as they exist in the waters, or as they are generally arranged in the published tables. For instance, in a water said to contain so much sulphate of soda and so much muriate of lime, in reality the sulphuric acid is obtained by throwing it down by means of muriatic or nitrate of baryta in the form of sulphate of baryta, from the weight of which the amount of sulphuric acid in the water is calculated. The other acids and bases are obtained by analogous methods,—the bases generally in combination with an acid, the acids with a base; and from these new compounds the amounts of acids and bases in the waters are calculated. The general rule is to give the strongest acid to the strongest base. In this way the constitution of waters is generally arrived at with considerable accuracy.

The most powerful of all mineral waters of the saline class is the sea itself. It differs somewhat in composition according to the amount of evaporation. Thus the water of the Mediterranean is more dense and saline than that of the ocean. According to the analysis of MM. Mialhe and Figuier, the water of the British Channel at Havre contains 280 grains of salts to the pint. The chief ingredients are chlorides of sodium, magnesium, and potassium, and sulphates of magnesia and lime; with a proportion of bromide of sodium. There are also other salts, traces of iodine, and probably of everything that is found soluble on the earth's surface.

3. *Of the Applications of Mineral Waters, and their Use in the Cure of Disease.*—Their use is external and internal. The external use of mineral waters is almost confined to the thermal waters. Here the alleged superiority of natural heat over artificial again becomes a question, several of the thermal springs being nearly pure water. How much of the superiority of these baths may be ascribed to the same causes as those which tell in favour of mineral waters generally—as change of air and scene, and improved regimen—it is most difficult to say. In speaking of the waters of Leuk in the Valais, Sir John Forbes has some excellent observations on this point in his *Physician's Holiday.* The springs are merely pure water, and if of ordinary temperature might be used as good drinking water. They vary in temperature from 95° to 124°. The baths are employed for many chronic diseases, but their greatest reputation is in cutaneous diseases, scrofula, chronic rheumatism, and indolent gout. The effect of such bathing is to stimulate greatly the powers of the skin, and so to cause free perspiration, thereby carrying off effete principles from the system, and causing a derivation from the internal organs, as the liver, lungs, and kidneys; increasing also the energy of the heart's action. Hence these thermal springs are chiefly employed in gout and rheumatism of a chronic character, in skin diseases, diseases of the joints, old wounds, and diseases of the bones, tumours of all kinds, and sometimes in dyspepsia. By increasing the energy of the circulation, they tend to produce absorption. In kidney diseases and in diabetes, and in chronic dropsical affections, where there is little or no disease of the heart, those springs which are sulphuretted possess, in addition to their heat, a principle, sulphuretted hydrogen, which, applied in this way, powerfully excites the skin, and is perhaps absorbed into the system. This class of waters is especially beneficial in skin diseases and in chronic rheumatism. Of the effect of other gases, as carburetted hydrogen, azote, and carbonic acid, in thermal springs, little is known, except that the last produces a prickling sensation on the surface of the body, which it greatly stimulates.

Among the number of external applications must be

[1] Several species of confervæ have been found in this substance: *Calothrix nivea* in the sulphur springs of Yorkshire, Durham, and Aix-la-Chapelle; also in the hot sulphur springs of Greoulx in Provence; *Oscillaria labyrinthiformis*, the *Tremella thermalis* of some, one of the most common species, in several of the continental thermal-sulphur and other springs. But these confervæ are not the sole constituents of this matter. An animal principle also exists in many cases which some have supposed to be derived from organic remains. It is that which gives the odour of chicken broth, or bad broth much rotted, as one writer calls it, to such waters as the Kochbrunnen at Wiesbaden.

mentioned the mud baths much in use lately. The most important of these are at Franzensbad in Germany. The mineral mud of which they are prepared is found in great abundance, and is very rich in active substances. Its principal constituent parts are salts of iron, soda, lime, and alumina; it also contains ulmic acid in large quantity, and other vegetable matters of a gummy or resinous character. The mud is smooth and soft to the touch, and of an extremely styptic taste; heated by steam, or diluted with water, it forms a sort of cataplasm like bread crumb coloured with ink, and is used for baths or fomentations locally. From this application the best effects are said to have been derived in anemia and chlorosis (green sickness), in old rheumatic and gouty affections, sciatica, paralysis where there is no organic disease of the spinal cord or brain, in old fractures, and in some diseases of the skin. After the surface of the body has been washed on leaving the bath, the skin is unctuous and smooth; and on taking exercise perspiration is readily induced.

Cold sulphuretted waters are sometimes heated for baths, as is practised at Harrowgate; but there is in this case much escape of the sulphuretted hydrogen. This remedy is chiefly used in skin diseases, chronic liver diseases, and chronic rheumatism. Few of the ordinary cold waters are used externally. The celebrated fountain at Ilkley in Yorkshire is merely pure cold water issuing in a full stream from the mountain, and which, applied as a douche or used as a plunge-bath, produces excessive chill, then great reaction either in the part to which it is applied or the whole surface of the body, and therefore comes under the category of simple cold baths. Besides these applications, all waters may be directed as douches to any particular part; ascending douches are used in several female complaints, and in this way carbonic and sulphuretted hydrogen gases from springs have been applied either by tubes to some particular part (carbonic acid, for example, to the ear in certain cases of deafness), or to the whole body inclosed in a suitable apparatus.

With regard to the action of cold mineral waters, it is generally either what is termed alterative or tonic. In the former case the fluids are altered in character, and this is mostly done by exciting the secretions, especially those of the skin and kidneys. The effect of this increased secretion is to remove more quickly from the system the worn-out constituents of the frame, and with them many morbific elements, and thus give fair play to the vital forces of the system, if these still retain sufficient energy to set about the work of reparation. Many of the saline waters, especially those containing alkaline sulphates and muriates, associated with sulphuretted hydrogen or without it, act powerfully on the bowels and promote the action of the liver. Of this class are Harrowgate and Cheltenham in this country, and Carlsbad abroad, which is, however, also a thermal water.[1] Cheltenham waters contain various proportions of salts. The strongest of them, the Old Well and the Montpellier, have respectively 81·51 and 80·13 of solids to the imperial pint, being muriates and sulphates of soda, and muriates of lime and magnesia. Of the efficacy of this and similar waters in liver affections, the constant resort of sufferers from the diseases of tropical climates may be supposed to afford a proof. The saline muriated waters, many of which contain traces of iodine and bromine, besides their alterative properties, act as tonics, and are especially suited for scrofulous affections, especially if they contain iron. In many of these waters it is possible for a patient to take into the system in the course of the day a *medicinal* dose of the earthy muriates long ago recommended by *Hufeland* as powerful remedies in scrofula; and in addition to these large quantities of muriate of soda, also a remedy in scrofula, with small quantities of bromides and iodides, whose efficacy in this class of diseases is undoubted. And it is a curious fact, that the springs in Piedmont, in which iodine was first discovered by M. Cantu, had been long renowned in scrofula; just as the ashes of burnt sponge were recognised as a remedy in goitre hundreds of years before iodine was discovered, or they were known to contain it, or M. Coindet of Geneva had demonstrated the efficacy of iodine in this disease, so common in the valleys of Switzerland and Savoy.

The virtues of chalybeate waters are popularly appreciated, and the diseases in which they are beneficial generally known. They act by strengthening the tone of the stomach, and perhaps by some chemico-vital influence in increasing the number of red particles in the blood, in which iron forms an important ingredient, and has been supposed by Liebig to perform an active part in the phenomena of respiration. Certain it is, that of all the class of tonics none equal iron in giving a healthy bloom to the complexion. The use of chalybeates is apt, however, to congest the head, and therefore they should be employed with caution where there is any tendency to such congestion. The waters containing iron are among the few requiring often some kind of medicinal preparation for their use. The bowels should be well opened previously, if possible, by some mild preparation, as the compound rhubarb pill, and their state should be attended to while the use of the water is continued. In waters containing the sulphate, alumina is often present, which makes it the more requisite to observe this caution. The dose of the sulphate should not exceed one, or at most, two grains twice a day. In those waters which contain manganese as well, it may be reckoned as so much iron. Very powerful effects indeed are often obtained from such waters, in chlorosis, anemia, general debility, &c.[1]

Among the prodigious list of diseases which have been supposed to be benefited by the use of mineral waters may be enumerated phthisis and chronic bronchitis. Some of the mild thermal waters, as those of Wiesbaden, taken internally, have been found beneficial in allaying pulmonary irritation in these diseases. Hot bathing in such cases is a very dangerous remedy. Chalybeate waters in incipient phthisis have been often found beneficial; but in this class of diseases, as a general rule, removal to a spa should only take place when the situation affords a favourable change in hygienic conditions. The same may be said of asthma and diseases of the heart. In diarrhœa from debility, the strong astringent ferruginous waters, especially those which contain sulphate of iron and alumina, have been found beneficial. In constipation, hypochondriasis, enlargement of the liver and spleen, biliary calculi, all the saline waters, both sulphated and muriated, thermal, or impregnated with sulphuretted hydrogen and carbonic acid gas, are useful; and in biliary calculi the alkaline waters, as those of Carlsbad and Vichy, have been found especially valuable. In catarrh of the bladder, gravel, and urinary calculi, mild thermal waters, baths of these, and alkaline saline waters, especially those of Vichy and Carlsbad, have been attended with the best results. In amenorrhœa and dysmenorrhœa, chalybeates; in the latter, thermal waters externally and in-

[1] Carlsbad waters contain a large quantity of carbonic acid, and are remarkable for the variety of their contents: manganese and iron, iodine and bromine, arsenic and boracic acid, copper, lead, tin, and antimony, are among these. Perhaps the variety of the constituents has to do with the number of diseases in which these waters are found beneficial. Two of their best ascertained beneficial effects are in cases of recently united fractures, in consolidating the callus, and in reducing enlarged livers.

[1] It has been proved by the experiments of Andral, Gavarret, Becquerel, and others, that of 1000 parts of blood the quantity of red globules, which was 46·6 before the use of preparations of iron, was augmented by the use of this agent to 95·7. In some cases under the use of iron the solids of the blood increased by one-half, while the water diminished in the proportion of 871 to 806.

ternally; in the former, and in cases of sterility, sea-bathing, especially combined with the use of chalybeates,—a combination which may be obtained, for example, at Scarborough,—should be employed. The same have been found useful in certain male affections of a sexual character. In diseases of the skin especially, the sulphuretted waters should be used externally and internally. In chronic rheumatism and gout the thermal waters are the best. In these diseases we have in this country the well-established renown of Buxton and Bath. Where gouty deposits are formed there is little chance of their removal by the use of any mineral water. In those formidable diseases, diabetes and albuminuria, thermal waters (in the former especially the waters of Vichy) should be employed. In old wounds, and the results of contusions and fractures, the same class of waters have been found beneficial.

It has been a question how far artificial waters are able to supply the place of the natural springs. In point of fact, most of the natural waters can be imitated with sufficient exactitude. The artificial seltzer water manufactured at Brighton is perhaps even superior to that of the renowned spring itself; but the adjuncts of change of air, freedom from the usual sources of anxiety, pleasant scenery, &c., are wanting. The same applies to waters sent to a distance from the springs. It is as in an ordinary prescription, where the physician to the basis of his prescription adds what will assist its operation and render it as grateful as possible. The *adjuvantia* to the use of mineral waters are the *air* and the *places*, without which the medicine loses very much of its effect; not but that a vast number of mineral waters are real medicines, which may be taken anywhere with benefit. (R. M. G.)

MINERALOGICAL SCIENCE.

On account of the sudden death of Professor Edward Forbes, who had engaged to furnish the article Geology *for this work, it was found necessary to defer it to the present heading. Under* Mineralogical Science, *therefore, will be found first,* Mineralogy *properly so called; and secondly,* Geology.

I.—MINERALOGY.

Mineralogy is sometimes understood as comprising the natural history of every portion of inorganic nature. Here we consider it as limited to the natural history of simple minerals or mineral species. In the strictest sense, a mineral species is a natural inorganic body, possessing a definite chemical composition, and assuming a regular determinate form or series of forms. This definition excludes many bodies often regarded as minerals: as, all the artificial salts of the chemists, all the inorganic secretions of plants and animals, all the remains of former living beings now imbedded in rocks. Some substances originally organic products have indeed, by common consent, found a place in mineral systems, as coal, amber, and mineral resins; but this is a departure from the strictness of the definition, and in most cases had perhaps better have been avoided. So also some amorphous substances, with no precise form or chemical composition, as some kinds of clay, have been introduced into works on mineralogy, but we believe often improperly, and with no beneficial result. Aggregates of simple minerals or rocks are likewise excluded from this science, though the various associations of minerals, their modes of occurrence, and their geological position, are important points in the history of the different species.

One most important object of a treatise on mineralogy should be to give such descriptions of minerals, their essential properties and distinctive characters, as will enable the student to distinguish the various species, and to recognise them when they occur in nature. But to accomplish this he must first become acquainted with the terminology or nomenclature of the science; that is, with the meaning of the terms used in describing these properties, and the various modifications they may undergo. With this is necessarily conjoined an account of the properties themselves, and of the more general laws by which their various changes are regulated. A second and closely-related portion of mineralogy is the system or classification, giving an account of the order in which the species are arranged, and the reasons for which it has been adopted. The third and most important part of mineralogy, to which these two are properly preparatory, is the physiography of the various species, giving an account of their characteristic marks, and a description of their appearance or external aspect and forms; their principal physical and chemical properties; their mode of occurrence, with their geological and geographical distribution; and their various uses, whether in nature or in the arts. Each of these departments will be considered in the following treatise in the order just mentioned.

PART I.—TERMINOLOGY.

Chap. I.—FORM OF MINERALS.

The physical properties of a mineral comprise all those properties belonging to it as a body existing in space, and consisting of matter aggregated in a peculiar way. The more important of these are,—its form as shown in crystallization; its structure as determining its mode of cleavage and fracture; its hardness and tenacity; its weight or specific gravity; and its relations to light, heat, electricity, and magnetism.

Crystalline and Amorphous.—Mineral substances occur in two distinct modes of aggregation. Some consist of minute particles simply collected together, with no regularity of structure or constancy of external form, and are named amorphous. All fluid minerals are in this condition, together with some solid bodies, which appear to have condensed either from a gelatinous condition like opal, when they are named *porodine*, or from a state of igneous fluidity like obsidian and glass, when they are named *hyaline*. The other class have their ultimate atoms evidently arranged according to definite law, and are named *crystalline*, when the regularity of structure appears only in the internal disposition of the parts; and *crystallized*, when it also produces a determinate external form, or a *crystal*.

Crystals.

Faces, Edges, Angles, Axes of Crystals.—The word *crystal* in mineralogy designates a solid body exhibiting an

original (not artificial) more or less regular polyhedric form. It is thus bounded by plane surfaces, named *faces*, which intersect in straight lines or *edges*, and these again meet in points and form *solid angles*, bounded by three or more faces. The space occupied by a crystal is often named a *form of crystallization*, which is thus the mathematical figure regarded as independent of the matter that fills it. Crystals bounded by equal and similar faces are named *simple forms;* whilst those in which the faces are not equal and similar are named *compound forms*, or *combinations*, being regarded as produced by the union or combination of two or more simple forms. The cube or hexahedron (fig. 1), bounded by six equal and similar squares; the octahedron (fig. 2), by eight equilateral triangles; and the rhombohedron, by six rhombs,—are thus simple forms. An *axis* of a crystal is a line passing through its centre and terminating either in the middle of two faces, or of two edges, or in two angles; and axes terminating in similar parts of a crystal are named similar axes. In describing a crystal, one of its axes is supposed to be vertical or upright, and is then named the *principal axis*, and that axis is chosen which is the only one of its kind in the figure. A few other technical terms used in describing crystals will be explained as they occur.

Systems of Crystallization.—The forms of crystals that occur in nature seem almost innumerable. On examining them, however, more attentively, certain relations are discovered even between highly complex crystals. When the axes are properly chosen, and placed in a right position, the various faces are observed to group themselves in a regular and beautiful manner around these axes, and to be all so related as to compose connected series produced according to definite laws. In every mineral species there is a certain form of crystal from which, as a primary, every other form of crystal observed in that mineral species may be deduced. In each species the axes, bearing to each other definite numerical proportions, intersect at angles which are constant. So also the faces of the various forms are related to each other, and to their primary, according to certain definite laws. When viewed in this manner, and referred to their simplest forms, the innumerable variety of crystals occurring in nature may all be reduced to six distinct groups, or, as they are named, systems of crystallization. The following are the names given to these systems of crystallization in some of the best authors:—

Naumann.	Mohs.	Weiss and G. Rose.
1. Tesseral System.	Tessular.	Regular.
2. Tetragonal System.	Pyramidal.	2 and 1 axial.
3. Hexagonal System.	Rhombohedral.	3 and 1 axial.
4. Rhombic System.	Orthotype.	1 and 1 axial.
5. Monoclinohedric System.	Hemiorthotype.	2 and 1 membered.
6. Triclinohedric System.	Anorthotype.	1 and 1 membered.

In the following treatise the terminology of Naumann is adopted, his method of classifying and describing crystals appearing the simplest and best adapted to promote the progress of the student.

Holohedric and Hemihedric.—Before describing these systems, it must be observed that certain crystals appear as the half of others, and are therefore named *hemihedric;* whilst the crystals with the full number of faces are named *holohedric*. Hemihedric crystals are formed when the alternate faces or groups of faces of a holohedric crystal increase symmetrically, so as to obliterate the other faces. Thus, if four alternate faces of the octohedron increase so as to obliterate the other four, a tetrahedron with half the number of faces is formed.

1. Tesseral system.

The first, or *Tesseral System*, named from *tessera*, a cube, which is one of the most frequent varieties, is characterized by three equal axes intersecting each other at right angles. Properly speaking, this system has no chief axis, as any one of them may be so named, and placed upright in drawing and describing the crystals. Of these there are thirteen varieties, which are thus classed and named from the number of their faces:—

1. One Tetrahedron, or form with four faces.
2. One Hexahedron, with six faces.
3. One Octahedron, with eight faces.
4. Four Dodecahedrons, with twelve faces.
5. Five Icositetrahedrons, with twenty-four faces.
6. One Tetracontaoctahedron, with forty-eight faces.

The dodecahedrons are further distinguished, according to the form of their faces, into rhombic, trigonal, deltoid, and pentagonal dodecahedrons; and some of the icositetrahedrons have also received peculiar names.

The following is a description, with figures, of the different forms above mentioned, beginning with

The *Holohedric forms.*

1. The hexahedron or cube (fig. 1) is bounded by six equal squares, has twelve edges, formed by faces meeting at 90°, and eight trigonal angles. The principal axes join the centre points of any two opposite faces.—Examples are fluor spar, lead-glance, boracite.

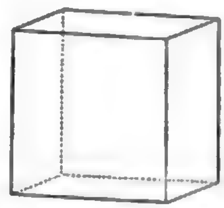


Fig. 1.

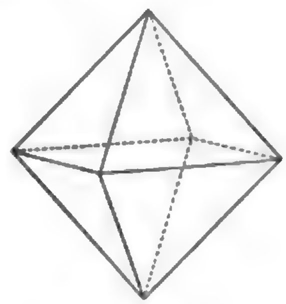


Fig. 2.

2. The octahedron (fig. 2), bounded by eight equilateral triangles, has twelve equal edges, with planes meeting at 109° 28′, and six tetragonal angles. The principal axes join the opposite angles, two and two.—Example, alum, spinel, magnetic iron ore.

3. The rhombic-dodecahedron (fig. 3) is bounded by twelve equal and similar rhombs (diagonals as 1 and $\sqrt{2}$),

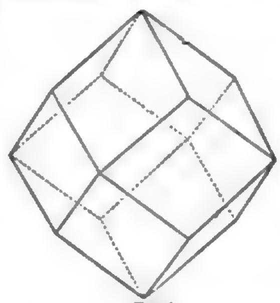


Fig. 3.

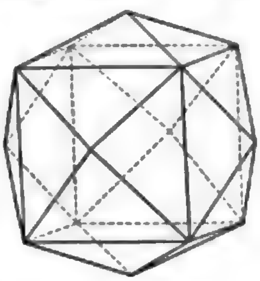


Fig. 4.

has twenty-four equal edges of 120°, and six tetragonal and eight trigonal angles. The principal axes join two opposite tetragonal angles.—Ex., garnet, red copper ore, boracite.

4. The tetrakishexahedrons (variety of icositetrahedron, fig. 4), are bounded by twenty-four isosceles triangles, arranged in six groups of four each. They have twelve longer edges which correspond to those of the primitive or inscribed cube, and twenty-four shorter edges placed over each of its faces. The angles are eight hexagonal and six tetragonal; the latter joined two and two by the three principal axes. This form varies in general aspect, approaching, on the one hand, to the cube; on the other, to the rhombic-dodecahedron.—Ex., fluor spar, gold.

5. The triakisoctahedrons (variety of icositetrahedron, fig. 5), are bounded by twenty-four isosceles triangles, in eight groups of three, and, like the previous form, vary in

Mineralogy.

general aspect from the octahedron on one side, to the rhombic-dodecahedron on the other. The edges are twelve longer, corresponding with those of the inscribed octahedron, and twenty-four shorter, three and three over each of the faces. The angles are eight trigonal and six ditetragonal (formed by eight faces); the latter angles joined two and two by the principal axes.—Ex., galena, diamond.

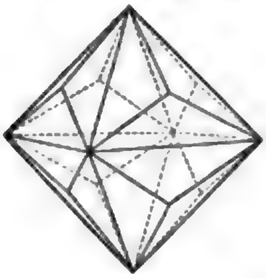


Fig. 5.

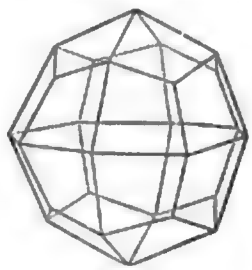


Fig. 6.

6. The icositetrahedrons (most common variety, fig. 6) are bounded by twenty-four deltoids or figures with four sides, of which two and two adjacent ones are equal. This form varies from the octahedron to the cube, sometimes approaching the former and sometimes the latter in general aspect. The edges are twenty-four longer and twenty-four shorter. The angles are six tetragonal joined by the principal axes, eight trigonal, and twelve rhombic, or tetragonal with unequal angles.

7. The hexakisoctahedrons (fig. 7), bounded by forty-eight scalene triangles, vary much in general aspect, approaching more or less to all the preceding forms; but most frequently they have the faces arranged either in six groups of eight, or eight of six, or twelve of four faces. There are twenty-four long edges, often corresponding to those of the rhombic-dodecahedron; twenty-four intermediate edges lying in pairs over each edge of the inscribed octahedron; and twenty-four short edges in pairs over the edges of the inscribed cube. There are six ditetragonal angles joined by the principal axes, eight hexagonal and twelve rhombic angles.—Ex., fluor spar, garnet, diamond.

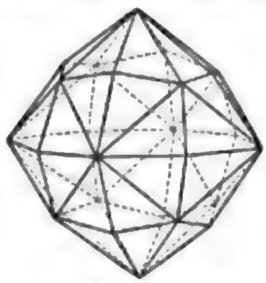


Fig 7.

The seven forms of crystals now described are related to each other in the most intimate manner. This will appear more distinctly from the following account of the derivation of the forms, with which is conjoined an explanation of the crystallographic signs or symbols by which they are designated. We have adopted these symbols throughout this work, in the belief that they not only mark the forms in a greatly abbreviated manner, but also exhibit the relations of the forms and combinations in a way which words could hardly accomplish.

Derivation of crystalline forms.

The *derivation of forms* is that process by which, from one form chosen for the purpose, and considered as the *type*—the *fundamental* or *primary form*—all the other forms of a system may be produced, according to fixed principles or general laws. In order to understand this process or method of derivation, the student should keep in mind that the position of any plane is fixed when the positions of any three points in it, not all in one straight line, are known. To determine the position, therefore, of the face of a crystal, it is only necessary to know the distance of three points in it from the centre of the crystal, or the points in which the face or its supposed extension would intersect the three axes of the crystal. The portion of the axes between this point and the centre are named parameters, and the position of the face is sufficiently known when the relative length or proportion of these parameters is ascertained. When the position of one face of a simple form is thus fixed or described, all the other faces are in like manner fixed, since they are all equal and similar, and all intersect the axes in a uniform manner; and the expression which marks or describes one face, marks and describes the whole figure.

The octahedron is generally adopted as the primary or fundamental form of the tesseral system, and distinguished by the first letter of the name, O. Its faces cut the half axes at equal distances from the centre; so that these semiaxes, or the parameters of the faces, have to each other the proportion 1 : 1 : 1. In order to derive the other forms from the octahedron, the following construction is employed. The numbers refer to the descriptions above.

Suppose a plane so placed in each angle of the octahedron as to be vertical to the axis passing through that angle, and consequently parallel to the two other axes (or to cut them at an infinite distance = ∞); then the hexahedron or cube (1) is produced, designated by the crystallographic sign ∞O∞; expressing the proportion of the parameters of its faces, or ∞ : ∞ : 1. If a plane is supposed placed in each edge parallel to one axis, and cutting the two other axes at equal distances, the resulting figure is the rhombic-dodecahedron (3), designated by the sign ∞O, the proportion of the parameters of its faces being ∞ : 1 : 1. The triakisoctahedron (5) arises when on each edge of the octahedron planes are placed cutting the axis not belonging to that edge at a distance from the centre *m* which is a rational number greater than 1. The proportion of its parameters is therefore *m* : 1 : 1, and its sign *m*O; the most common varieties being $\frac{3}{2}$O, 2O, and 3O. When, on the other hand, from a similar distance *m* in each two semiaxes prolonged, a plane is drawn to the other semiaxis, or to each angle, an ikositetrahedron (6) is formed; the parameters of its faces have consequently the proportion *m* : 1 : *m*, and its sign is *m*O*m*; the most common varieties being 2O2 and 3O3, the former very frequent in leucite, analcime, and garnet. When, again, planes are drawn from each angle, or the end of one semiaxis of the octahedron, parallel to a second axis, and cutting the third at a distance *n*, greater than 1, then the tetrakishexahedron (4) is formed, the parameter of its faces ∞ : 1 : *n*; its sign ∞O*n*; and the most common varieties in nature ∞O$\frac{3}{2}$, ∞O2, and ∞O3. Finally, if in each semiaxis of the octahedron two distances, *m* and *n*, be taken, each greater than 1, and *m* also greater than *n*, and planes be drawn from each angle to these points, so that the two planes lying over each edge cut the second semiaxis belonging to that edge, at the smaller distance *n*, and the third axis at the greater distance *m*, then the hexakisoctahedron (7) is produced, the parameters, which are *m* : *n* : 1, its sign *m*O*n*, and the most common varieties 3O$\frac{3}{2}$, 4O2, and 5O$\frac{5}{3}$.

The next class of crystals are the *semi-tesseral forms*; and first, those with oblique faces, often named tetrahedral, from their relation to the tetrahedron. (1.) This form (fig. 8)

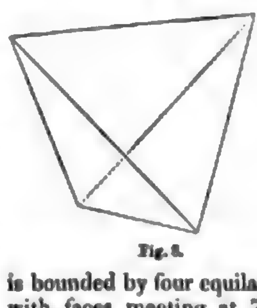


Fig. 8.

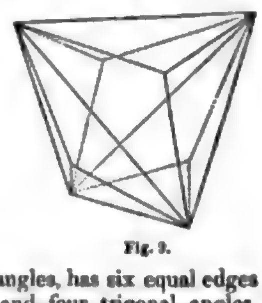


Fig. 9.

is bounded by four equilateral triangles, has six equal edges with faces meeting at 70° 32′, and four trigonal angles. The principal axes join the middle points of each two op-

posite edges.—Ex., gray-copper ore, boracite, and helvine. (2.) The trigonal dodecahedrons (fig. 9) are bounded by twelve isosceles triangles, and vary in general form from the tetrahedron to the hexahedron. There are six longer edges corresponding to those of the inscribed tetrahedron, and twelve shorter, placed three and three over each of its faces; and four hexagonal and four trigonal angles.—Ex., gray-copper ore, and bismuth-blende. (3.) The deltoid-dodecahedrons (fig. 10) are bounded by twelve deltoids, and vary in general form from the tetrahedron on the one hand, to the rhombic-dodecahedron on the other. They have twelve longer edges lying in pairs over the edges of the inscribed tetrahedron; and twelve shorter edges, three and three over each of its faces. The angles are six tetragonal (rhombic), four acute trigonal, and four obtuse trigonal angles. The principal axes join two and two opposite rhombic angles.—Ex., gray-copper ore. (4.) The hexakistetrahedrons (fig. 11) are bounded by twenty-four scalene triangles, and most commonly have their faces grouped in four systems of six each. The edges are twelve shorter and twelve longer, lying in groups of three over each face of the inscribed tetrahedron, and twelve intermediate in pairs over its edges. The angles are six rhombic, joined in pairs by the principal axes, and four acuter and four obtuser hexagonal angles.—Ex., diamond.

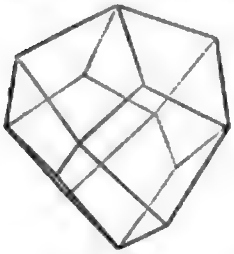


Fig. 10.

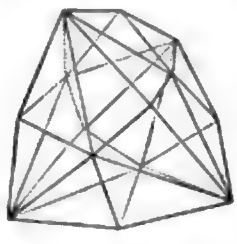


Fig. 11.

The derivation and signs of these forms are as follows:—The tetrahedron arises when four alternate faces of the octahedron are enlarged, so as to obliterate the other four, and its sign is hence $\frac{O}{2}$. But, as either four faces may be thus enlarged or obliterated, two tetrahedrons can be formed similar in all respects except in position, and together making up the octahedron. These are distinguished by the signs + and −, added to the above symbol, but only the latter in general expressed thus $-\frac{O}{2}$. In all hemihedric systems two forms similarly related occur, which may thus be named complementary forms. The trigonal dodecahedron is derived from the icositetrahedron by the expansion of the alternate trigonal groups of faces. Its sign is $\frac{mOm}{2}$, the most common variety being $\frac{2O2}{2}$, found in gray-copper ore. The deltoid-dodecahedron is in like manner the result of the increase of the alternate trigonal groups of faces of the triakisoctahedron, and its sign is $\frac{mO}{2}$. Lastly, the hexakistetrahedron arises in the development of alternate hexagonal groups of faces in the hexakisoctahedron, and its sign is $\frac{mOn}{2}$.

The parallel-faced semitesseral forms are two. (1.) The pentagonal dodecahedrons (fig. 12) are bounded by twelve symmetrical pentagons, and vary in general aspect between the hexahedron and rhombic-dodecahedron. They have six regular (and in general longer) edges, lying over the faces of the inscribed hexahedron, and twenty-four generally shorter (seldom longer) edges, usually lying in pairs over its edges. The angles are eight of three equal angles, and twelve of three unequal angles. Each principal axis unites two opposite regular edges. This form is derived from the tetrakishexahedron, and its sign is $\frac{\infty On}{2}$, one of the most common varieties being $\frac{\infty O2}{2}$, found frequently in iron pyrites and cobaltine. (2.) The dyakisdodecahedron (fig. 13), bounded by twenty-four trapezoids with two sides equal, has twelve short, twelve long, and twenty-four intermediate edges. The angles are six equiangular rhombic, united in pairs by the principal axes, eight trigonal, and twenty-four irregular tetragonal angles. It is derived from the hexakisoctahedron, and its sign is $\left[\frac{mOn}{2}\right]$, the brackets being used to distinguish it from the hexakistetrahedron, also derived from the same primary form. It occurs in iron pyrites and cobaltine. There are two other tetrahedral forms, the pentagonal dodecahedron (fig. 14), and the pentagonal icositetrahedron (fig. 15), both bounded by irregular pentagons, but not yet observed in nature.

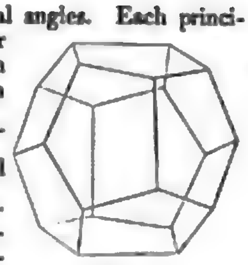


Fig. 12.

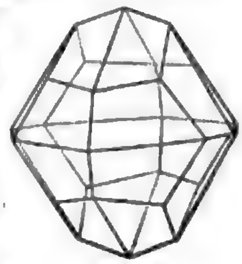


Fig. 13.

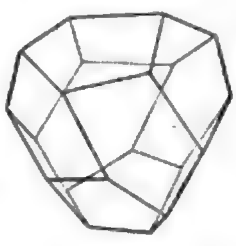


Fig. 14.

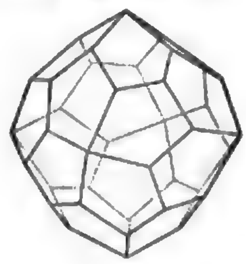


Fig. 15.

Combinations.

Combinations.—These forms of the tesseral system (and this is true also of the five other systems of crystallization), not only occur singly, but often two, three, or more united in the same crystal, forming what are named combinations. In this case it is evident that no one of the individual forms can be completely developed, because the faces of one form must partially interfere with the faces of the other forms. A combination therefore implies that the faces of one form shall appear symmetrically disposed between the faces of other forms, and consequently in the room of certain of their edges and angles. These edges and angles are thus, as it were, cut off, and new ones produced in their place, which properly belong neither to the one form nor the other, but are edges or angles of combination. Usually, one form predominates more than the others, or has more influence on the general aspect of the crystal, and hence is distinguished as the predominant form, the others being named subordinate. The following terms used on this subject require explanation. A combination is *developed* when all the forms contributing to its formation are pointed out; and its sign consists of the signs of these forms, written in the order of their influence on the combination, with a point between. An angle or edge is said to be *replaced* when it is cut off by one or more secondary planes; it is *truncated* when cut by one plane, forming equal angles with the adjacent faces; and an edge is *bevelled* when replaced by two planes, which are equally inclined to the adjacent faces.

It will be readily seen that such combinations may be exceedingly numerous, or rather infinite; and only a few

Mineralogy.

of the more common can be noticed, simply as specimens of the class. Many others more complicated will occur in the descriptive part of this treatise. Among plenotesseral combinations, the cube, octahedron, and also the rhombic-dodecahedron, are the predominant forms. In fig. 16 the

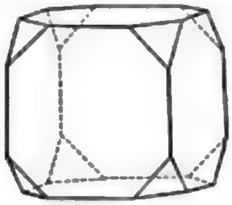


Fig. 16.

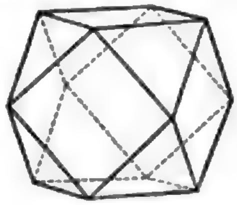


Fig. 17.

cube has its angles replaced by the faces of the octahedron, and the sign of this combination is $\infty O \infty \,.\, O$. In fig. 17

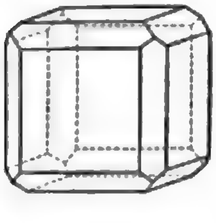


Fig. 18.

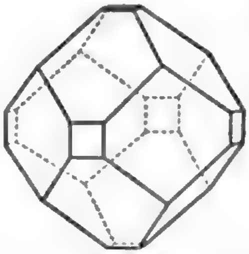


Fig. 19.

this process may be regarded as having proceeded still further, so that the faces of the octahedron now predominate, and the sign of the same two elements but in reverse order is $O \,.\, \infty O \infty$. In fig. 18 the cube has its edges replaced by the faces of the rhombic-dodecahedron, the sign being $\infty O \infty \,.\, \infty O$; whilst in fig. 19 there is the same combination, but with the faces of the cube subordinate, and hence the symbol is $\infty O \,.\, \infty O \infty$. The former figure, it will be seen, has more the general aspect of the cube; the latter of the dodecahedron.

In combinations of semitesseral forms with oblique faces, the tetrahedron, the rhombic-dodecahedron, or even the hexahedron, seldomer a trigonal-dodecahedron, are the more common predominant forms. In fig. 20 two tetrahedrons

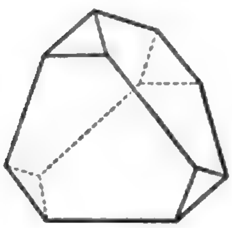


Fig. 20.

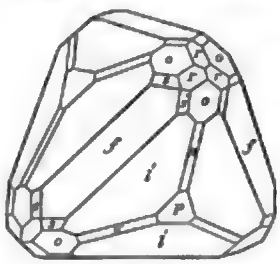


Fig. 21.

in opposite positions, $\frac{O}{2} \,.\, -\frac{O}{2}$, are combined. In fig. 21 a

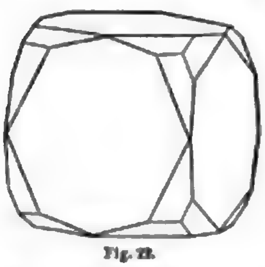


Fig. 22.

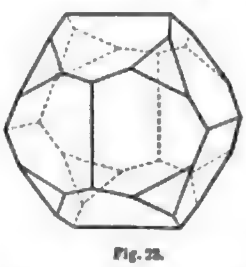


Fig. 23.

very complex combination of seven forms is represented in a crystal of grey-copper ore, its full sign being—

$$\frac{2O2}{2}(l) \,.\, \infty O \infty (f) \,.\, \infty O (o) \,.\, \frac{O}{2}(P) \,.\, -\frac{2O2}{2}(r) \,.\, \frac{\frac{1}{2}O}{2}(n) \,.\, \infty O3 (s);$$

the letters in brackets connecting them with the respective faces of the figure. As examples of combinations of semitesseral forms with parallel faces, we may take fig. 22, in which each of the angles of the cube is unsymmetrically replaced by three faces of the dyakisdodecahedron, and hence $\infty O \infty \,.\, \left[\frac{4O2}{2}\right]$; or fig. 23, in which the pentagonal-dodecahedron has its trigonal angles replaced by the faces of the octahedron, consequently with the sign $\frac{\infty O2}{2} \,.\, O$. Figure 24 represents

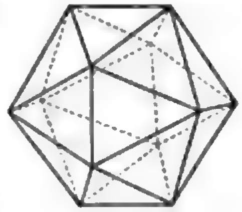


Fig. 24.

the same combination but with greater predominance of the faces of the octahedron, the crystal being bounded by eight equilateral and twelve isosceles triangles.

2. Tetragonal system.

Tetragonal System.—This system has three axes at right angles, two of them equal and one unequal. The last is the principal axis, and when it is brought into a vertical position the crystal is said to be placed upright. Its ends are named poles, and the edges connected with them polar edges. The two other axes are named subordinate or lateral axes, and a plane passing through them is named the basis of the crystal. The two planes that pass through the principal and one of the lateral axes are named normal chief sections, and a plane through the chief axis intermediate to them a diagonal chief section. The name tetragonal is derived from the form of the basis, which is usually quadratic.

There are eight tetragonal forms, of which five are *closed*,—that is, bounded on all sides by planes, and of definite extent; and three *open*, which in certain directions are not bounded, and consequently of indefinite extent.

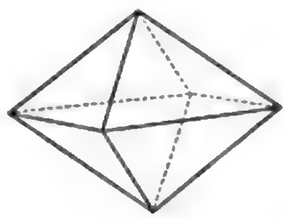


Fig. 25.

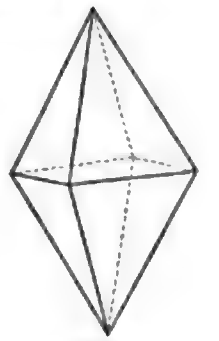


Fig. 26.

The description of the varieties is as follows, it being premised that a crystallographic pyramid is equivalent to two geometrical pyramids joined base to base. *Closed forms.*—(1.) Tetragonal pyramids (figs. 25, 26) are inclosed by eight isosceles triangles, with four middle edges all in one plane, and eight polar edges. There are three kinds of this form, distinguished by the position of the lateral axes. In the first these axes unite the opposite angles; in the second they intersect the middle edges equally; and in the third they lie in an intermediate position, or divide these edges unequally; the latter being hemihedral forms. These pyramids are also distinguished as obtuse (fig. 25) or acute (fig. 26), according as the vertical angle is greater or less than in the octahedron, which, though intermediate, is never a tetragonal form. (2.) Ditetragonal pyramids (fig. 27) are bounded by sixteen scalene triangles, whose base lines are all in one plane. This form rarely occurs except in combinations. (3.) Tetragonal sphenoids (fig. 28), bounded by four isosceles

Mineralogy.

triangles, are the hemihedral forms of the first variety of tetragonal pyramids. (4.) The tetragonal scalenohedron (fig. 29), bounded by eight scalene triangles, whose bases rise and fall in a zig-zag line, is the hemihedral form of the

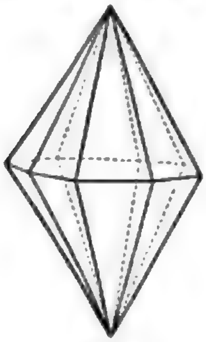


Fig. 27.

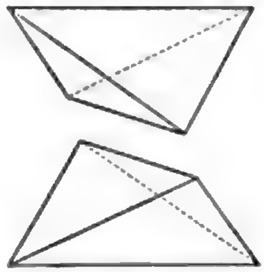


Fig. 28.

ditetragonal pyramid. The latter two forms are rare. *Open forms.*—Tetragonal prisms (fig. 30) bounded by four planes parallel to the principal axis; ditetragonal prisms by eight similar planes. In these prisms the principal axis is supposed to be prolonged infinitely, or to be unbounded. Where it is very short and the lateral axes

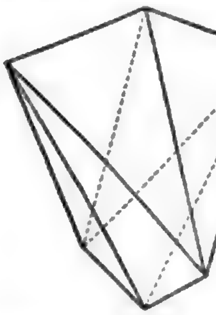


Fig. 29.

Fig. 30.

infinite, the basal pinacoid is formed, consisting merely of two parallel faces.

The various series of tetragonal crystals are distinguished from each other only by their relative dimensions. To determine these, one of the series must be chosen as the fundamental form, and for this purpose a tetragonal pyramid of the first variety, designated by P as its sign, is selected. The angle of one of its edges, especially the middle edge, found by measurement, determines its angular dimensions; whilst the proportion of the principal axis (a) to the lateral axes supposed equal to 1, gives its linear dimensions. The parameters, therefore, of each face of the fundamental form are $1 : 1 : a$.

Now if m be any (rational) number, either less or greater than one, and if from any distance ma in the principal axis planes be drawn to the middle edge of P, then new tetragonal pyramids of the first kind, but more or less acute or obtuse than P, are formed. The general sign of these pyramids is mP, and the most common varieties ½P, 2P, 3P; with the chief axis equal to ½, twice or thrice that of P. If m becomes infinite, or $= \infty$, then the pyramid passes into a prism, indefinitely extended along the principal axis, and with the sign ∞P; if $m = 0$, which is the case when the lateral axes are supposed infinite, then it becomes a pinacoid, consisting properly of two basal faces, open towards the lateral axes, and designated by the sign 0P. The ditetragonal pyramids are produced by taking in each lateral axis distances n greater than 1, and drawing two planes to these points from each of the intermediate polar edges. The parameters of these planes are therefore $m : 1 : n$, and the general sign of the form mPn, the most common values of n being ½, 2, 3, and ∞. When $n = \infty$, a tetragonal pyramid of the second kind arises, designated generally by mP∞, the most common in the mineral kingdom being P∞ and 2P∞. The relation of these to pyramids of the first kind is shown in fig. 31, where ABBBX is the first, and ACCCX the second kind of pyramid. In like manner from the prism ∞P, the ditetragonal prisms ∞Pn are derived, and finally when $n = \infty$, the tetragonal prism of the second kind, whose sign is ∞P∞.

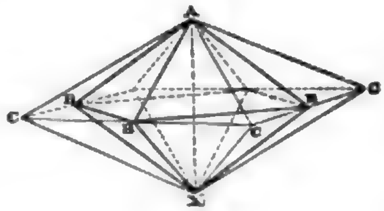


Fig. 31.

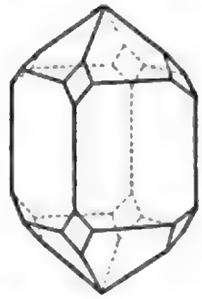


Fig. 32.

The combinations of the tetragonal system are either holohedric or hemihedric; but the latter are rare. Prisms and pinacoids must always be terminated on the open sides by other forms. Thus in fig. 32 a square prism of the first kind is terminated by the primary pyramid, and has its lateral angles again replaced by another more acute pyramid of the second kind, so that its sign is ∞P . P . 2P∞. In fig. 33 a prism of the second kind is first bounded by

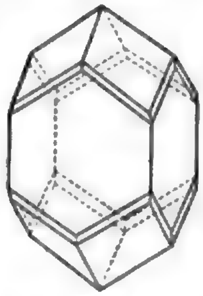


Fig. 33.

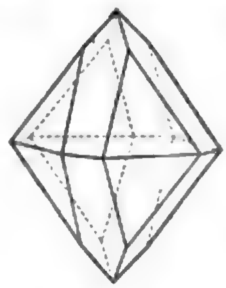


Fig. 34.

the fundamental pyramid, and then has its edges of combination replaced by a ditetragonal pyramid, and its sign is here ∞P∞ . P . 3P3. In fig. 34 the polar edges of the pyramid are replaced by another pyramid, its sign being P. P∞. In fig. 35 a hemihedric form very characteristic of copper pyrites is represented, P and P′ being the two sphenoids, a the basal pinacoid, and b, c, two ditetragonal pyramids.

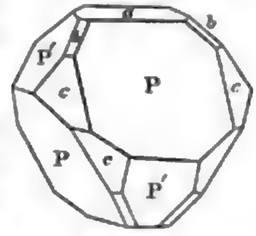


Fig. 35.

3. Hexagonal system.

The Hexagonal System.—The essential character of this system is, that it has four axes,—three equal lateral axes intersecting each other in one plane at 60°, and one principal axis at right angles to them. The extremities of the principal axis are named poles, and sections through it and one lateral axis, normal chief sections. The plane through the lateral axes is the basis, and from its hexagonal form gives the name to the system. As in the last system, its forms are either closed or open; and are divided into holohedral, hemihedral, and tetartohedral,—the last, forms with only a fourth part of their faces developed. The tetartohedral and many of the hemihedral forms are of rare occurrence, and only a few of the more common require to be here described.

The hexagonal pyramids (figs. 36, 37) are bounded by twelve isosceles triangles, and are of three kinds, according

as the lateral axes fall in the angles, in the middle of the lateral edges, or in another point of these edges, the latter being hemihedral forms. They are also classed as acute or obtuse, but without any very precise limits. The trigonal pyramid is bounded by six triangles, and may be viewed as the hemihedral form of the hexagonal. The dihexagonal pyramid is bounded by twenty-four scalene triangles, but has never been observed alone, and rarely even in combinations. The more common prisms are the hexagonal of six sides, and the dihexagonal of twelve sides.

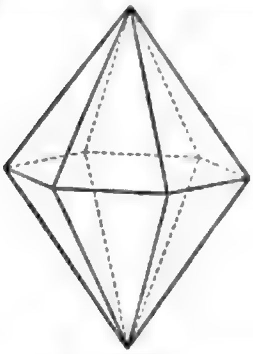


Fig. 36.

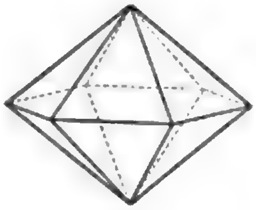


Fig. 37.

As the fundamental form of this system, a particular pyramid P is chosen, and its dimensions determined either from the proportion of the lateral to the principal axis ($1 : a$), or from the measurement of its angles. From this form (mP) others are derived exactly as in the tetragonal system. Thus dihexagonal pyramids are produced with the general sign mPn, the chief peculiarity being that, whereas in the tetragonal system n might have any rational value from 1 to ∞, in the hexagonal system it can only vary from 1 to 2, in consequence of the geometric character of the figure. When $n = 2$ the dihexagonal changes into an hexagonal pyramid of the second kind, whose sign is mP2. When m is $= \infty$ various prisms arise from similar changes in the value of n; and when $m = 0$ the basal pinacoid.

Few hexagonal mineral species form perfect holohedric combinations. Though quartz and apatite appear as such, yet properly the former is a tetartohedral, the latter a hemihedral species. In holohedric species the predominant faces are usually those of the two hexagonal prisms ∞P and ∞P2 or of the pinacoid 0P; whilst the pyramids P and 2P2 are the most common subordinate forms. Figure 38 represents the prism, bounded on the extremities by two pyramids; one, P, forming the point, the other 2P2 the rhombic faces on the angles, or ∞P . P . 2P2. In some crystals the lateral edges of the prism are replaced by the

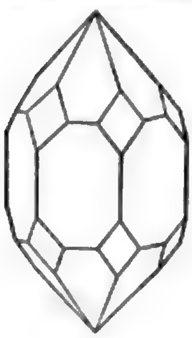


Fig. 38.

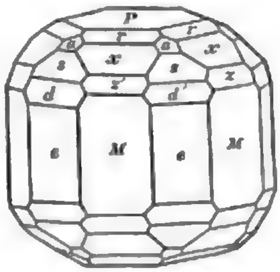


Fig. 39.

second prism ∞P2, producing an equiangular twelve-sided prism, which always represents the combination ∞P . ∞P2, and cannot occur as a simple form. An example of a more complicated combination is seen in fig. 39, of a crystal of apatite, whose sign with the corresponding letters is ∞P(M) . ∞P2(e) . 0P(P) . $\frac{1}{2}$P(r) . P(x) . 2P(z) . P2(a) . 2P2(s) . 4P2(d).

Hexagonal minerals more frequently crystallize in those series of hemihedral forms that are named rhombohedral,

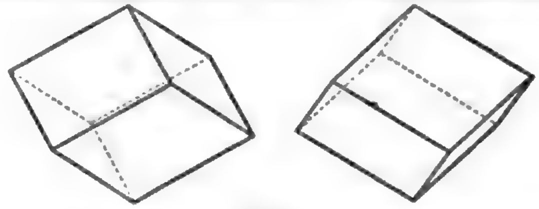


Fig. 40.

from the prevalence in them of rhombohedrons. These are (fig. 40) bounded by six rhombs, whose lateral edges do *not* lie in one plane, but rise and fall in a zig-zag manner. The principal axis unites the two trigonal angles, formed by three equal plane angles, and in the most common variety the secondary axes join the middle points of two opposite edges. When the polar edges form an angle of more than 90° the rhombohedrons are named obtuse; when of less, acute. Hexagonal scalenohedrons (figure 41) are bounded by twelve scalene triangles, whose lateral edges do not lie in one plane. The principal axis joins the two hexagonal angles, and the secondary axis the middle points of two opposite lateral edges.

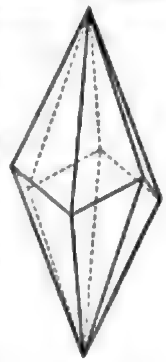


Fig. 41.

The rhombohedron is derived from the first kind of hexagonal pyramid by the hemihedric development of its alternate faces. Its general sign should therefore be $\frac{mP}{2}$; but on several grounds it is found better to designate it by R or mR, and its complimentary figure by $-m$R. When the prism or pinacoid arise as its limiting forms, they are designated by ∞R and 0R, though in no respect changed from the limiting forms ∞P and 0P of the pyramid. The scalenohedron is properly the hemihedric form of the dihexagonal pyramid, but is better derived from the inscribed rhombohedron mR. If the halves of the principal axis of this are multiplied by a definite number n, and then planes drawn from the extremities of this enlarged axis to the lateral edges of the rhombohedron, as in figure 42, the scalenohedron is constructed. Hence it is designated by mR^n, the n being written on the right hand, like an algebraic exponent: and the dihexagonal prism is in like manner designated by ∞R^n.

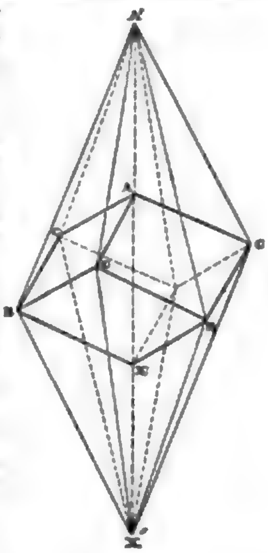


Fig. 42.

The combinations of rhombohedric forms are very numerous, some hundreds being described in calc-spar alone. Among the more common is the prism in combination with a rhombohedron, as in the twin crystal of calc-spar (fig. 43), with the sign ∞R . $-\frac{1}{2}$R, the lower half being the same form with the upper, but turned round 180°. In figure 44, the rhombohedron mR has its polar edges replaced by another rhombohedron $-\frac{1}{2}m$R; and in figure 45 its lateral edges bevelled by the scalenohedron mR^n. A more com-

plex combination of five forms is represented in the crystal of calc-spar, fig. 46, its sign with the letters on the faces

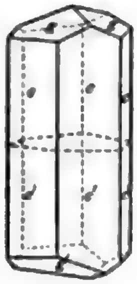


Fig. 43.

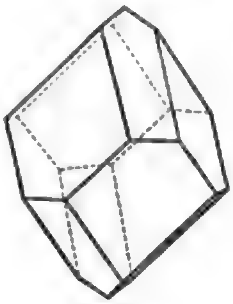


Fig. 44.

being $R^3(y) \,.\, R^3(r) \,.\, R(P) \,.\, 4R(m) \,.\, \infty R(c)$. Tetartohedric combinations are seen most distinctly in pure quartz or rock-

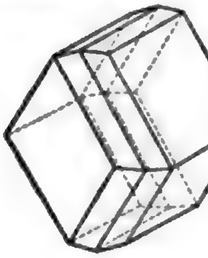


Fig. 45.

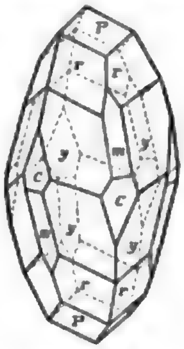


Fig. 46.

crystal, the pyramids of the first kind appearing as rhombohedrons, those of the second kind as trigonal pyramids, the dihexahedral prisms are ditrigonal prisms, and the prism $\infty P2$ as a trigonal prism. Most of these forms, however, occupy but a very subordinate place in the combinations which consist essentially of the prism ∞P, and the rhombohedron $R = \frac{P}{4}$.

4. Rhombic system.

Rhombic System.—The rhombic system is characterized by three axes, all unequal, but at right angles to each other. One of these is assumed as the chief axis, when the others are named subordinate. The plane passing through the secondary axes or the basis forms a rhomb, and from this the name is derived. This system comprises only a few varieties of forms that are essentially distinct, and its relations are consequently very simple.

The closed forms are,—(1*st.*) The rhombic pyramids

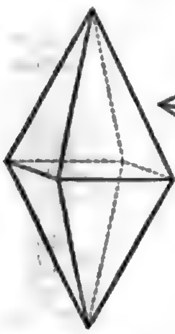


Fig. 47.

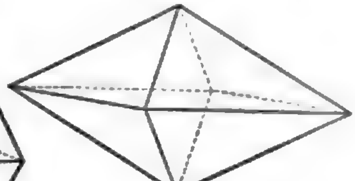


Fig. 48.

(figs. 47, 48), bounded by eight scalene triangles, whose lateral edges lie in one plane, and form a rhomb. They have eight polar edges,—four acute and four more obtuse,—and four lateral edges, and six rhombic angles, the most acute at the extremities of the longest axis. (2*d.*) The rhombic sphenoids (fig. 49) are bounded by four scalene triangles with their lateral edges not in one plane; and are a hemihedric form of the rhombic pyramid of unfrequent occurrence. The open forms again are, (3*d.*) Rhombic prisms bounded by four planes parallel to one of the axes which is indefinitely extended. They are divided into upright and horizontal prisms, according as either the principal or one of the lateral axes is supposed to become infinite. For the latter form the name doma or dome has been used; and two kinds, the macrodome and the brachydome, have been distinguished. Rhombic pinacoids also arise when one axis becomes $=0$, and the two others are indefinitely extended.

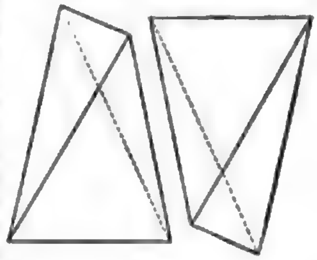


Fig. 49.

In deriving these forms from a primary, a particular rhombic pyramid P is chosen, and its dimensions determined either from the angular measurement of two of its edges, or by the linear proportion of its axes $a : b : c$; the greater lateral axis b being assumed equal to 1. To the greater lateral axis the name macrodiagonal is frequently given; to the shorter, that of brachydiagonal; and the two principal sections are in like manner named macrodiagonal and brachydiagonal, according to the axis they intersect. The same terms are applied throughout all the derived forms, where they consequently mark only the position of the faces in respect to the axes of the fundamental crystal, without reference to the relative magnitude of the derived axes.

By multiplying the principal axis by any rational number m, greater or less than 1, a series of pyramids arise, whose general sign is mP, and their limits the prism and pinacoid, the whole series being contained in this formula, $0P$ - - - - - mP - - - - P - - - -mP - - - - ∞P; which is the fundamental series, the lateral axes always remaining unchanged. From each member a new series may, however, be developed in two directions by increasing one or other of the lateral axes. When the macrodiagonal is thus multiplied by any number n greater than 1, and planes drawn from the distance n to the polar edges, a new pyramid is produced, named a macropyramid, with the sign $m\bar{P}n$, the mark over the P pointing out the axis enlarged. When $n = \infty$ a macrodome results, with the sign $m\bar{P}\infty$. If the shorter axis is multiplied, then brachypyramids and brachydomes are produced with the signs $m\breve{P}n$ and $m\breve{P}\infty$. So also from the prism ∞P, on the one side, numerous macroprisms $\infty\bar{P}n$, with the limiting ma-

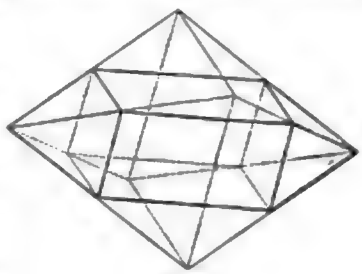


Fig. 50.

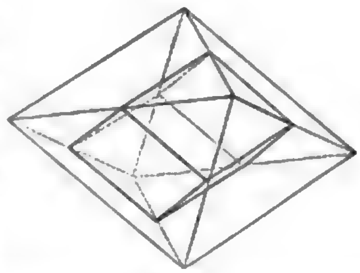


Fig. 51.

Mineralogy.

cropinacoid $\infty\bar{P}\infty$; on the other, numerous brachyprisms $\infty\breve{P}n$, with the limit form $\infty\breve{P}\infty$, or the brachypinacoid. In figs. 50, 51, the two domes are shown in their relation to the primitive pyramid.

The pyramids seldom occur independent, or even as the predominant forms in a combination,—sulphur, however, being an exception. Prisms or pinacoids usually give the general character to the crystal, which then appears either in a columnar or tabular, or even in a rectangular pyramidal form. The determination of the position of these crystals,

Fig. 52.

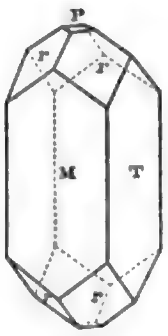


Fig. 53.

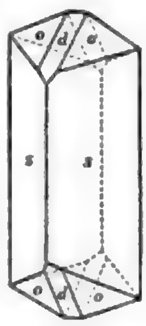


Fig. 54.

as vertical or horizontal, depends on the choice of the chief axis of the fundamental form. In the topaz crystal (fig. 52) the brachyprism and the pyramid are the predominant elements, associated with the prism, its sign and letters being $\infty\breve{P}2(l)\ .\ P(o)\ .\ \infty P(m)$. Fig. 53 of stilbite is another example, the macropinacoid $\infty\bar{P}\infty$ or *M*, being combined with the pyramid P(*r*), the brachypinacoid $\infty\breve{P}\infty$ (*T*), and the basal pinacoid 0P (*P*). Another instance is fig. 54 of a lievrite crystal, where the brachyprism and pyramid combine with the macrodome, or $\infty\breve{P}2\ .\ P\ .\ \bar{P}\infty$. The following figures are very common forms of barytes; figs. 55 and 56 being both composed of the pinacoid, a brachydome and macrodome with sign 0P (*c*) . $\breve{P}\infty$ (*f*) $\frac{1}{2}\bar{P}\infty$(*d*), the variation in aspect arising from the predominance of different faces; and fig. 57 consisting of the macrodome $\frac{1}{2}\bar{P}\infty$, the prism ∞P(*g*), and the pinacoid 0P.

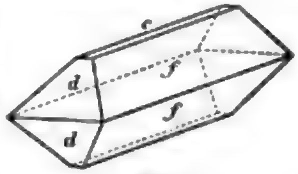


Fig. 55.

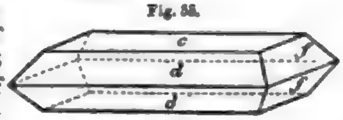


Fig. 56.

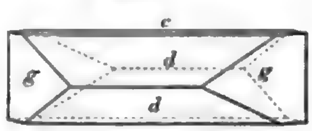


Fig. 57.

5. Monoclinohedric system.

The Monoclinohedric System.—This system is characterized by three unequal axes, two of which intersect each other at an oblique angle, and are cut by the third at right angles. One of the oblique axes is chosen as the chief axis, and the other axes are then distinguished as the orthodiagonal (right-angled), and clinodiagonal (oblique-angled). The same terms are applied to the chief sections, and the name of the system refers to the fact that these two planes and the base, together with two right angles, form also one oblique angle *C*.

The forms of this system approach very near to those of the rhombic series, but the inclination of the axes, even when almost a right angle, gives them a peculiar character, by which they are always readily distinguished. Each pyramid thus separates into two altogether independent forms or hemipyramids. Three varieties of prism also occur—vertical, inclined, and horizontal—with faces parallel to the chief axis, the clinodiagonal or the orthodiagonal. The horizontal prisms, like the pyramids, separate into two independent partial forms, named hemiprisms or hemidomes. The inclined prisms are often designated clinodomes, the term prism being restricted to the vertical forms. Orthopinacoids and clinopinacoids are also distinguished from their position in relation to the axes.

The monoclinohedric pyramids (fig. 58) are bounded by eight scalene triangles of two kinds, four and four only being similar. Their lateral edges lie all in one plane, and the similar triangles are placed in pairs on the clinodiagonal polar edges. The two pairs in the acute angle between the orthodiagonal and basal section are designated the positive hemipyramid; whilst the two pairs in the obtuse angles of the same sections form together the negative hemipyramid. But as these hemipyramids are wholly independent of each other, they are rarely observed combined. More frequently each occurs alone, and then forms a prism-like figure, with faces parallel to the polar edges, and open at the extremities. Hence, like all prisms, they can only appear in combination with other forms. The vertical prisms are bounded by four equal faces parallel to the principal axis, and the cross section is a rhomb; the clinodomes have a similar form and section; whilst the horizontal prisms or domes have unequal faces, and their section is a rhomboid.

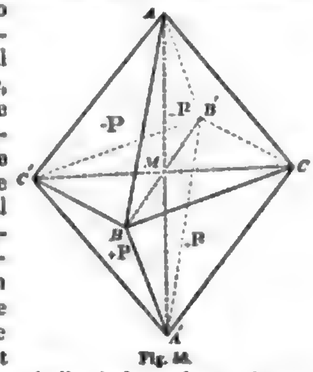


Fig. 58.

The mode of derivation of these forms closely resembles that of the rhombic series. A complete pyramid is assumed as the fundamental form, and designated $\pm$ P, in order to express the two portions of which it consists. Its dimensions are given when the proportion of its axes $a:b:c$, and the angular inclination of the oblique axes *C*, which is also that of the orthodiagonal section to the basis, are known. The fundamental series of forms is, 0P ..... $\pm m$P ..... $\pm$P ..... $\pm m$P ..... ∞P; from each of whose members, by changing the dimensions of the other axes, new forms may be again derived. Thus from $\pm m$P, by multiplying the orthodiagonal by any number n, a series of orthopyramids $\pm m$Pn is produced, with the orthodomes $\pm m$P∞ as limiting forms. The clinodiagonal produces a similar series, distinguished from the former by the sign being put in brackets, thus, $\pm$(mPn), with the limiting clinodome (mP∞) always completely formed, and therefore without the signs $\pm$ attached. From ∞P arise orthoprisms ∞Pn, and the orthopinacoid ∞P∞; and clinoprisms (∞Pn), and the clinopinacoid (∞P∞).

The combinations of this system may be easily understood from their resemblance to those of the rhombic; the

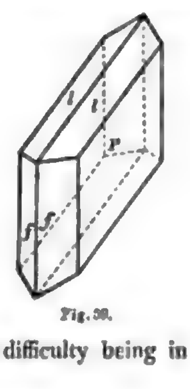


Fig. 59.

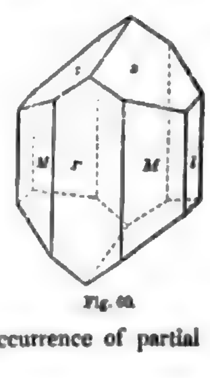


Fig. 60.

chief difficulty being in the occurrence of partial forms,

Mineralogy.

which, however, closely resemble the hemihedric forms of the previous systems. We shall therefore only select a few examples frequently observed in the mineral kingdom. Fig. 59 represents a very common form of gypsum crystals (∞P∞) (*P*) . ∞P(*f*) . P(*b*). The most common form of augite is represented in fig. 60, with the sign ∞P(*m*) . ∞P∞(*r*) . (∞P∞)(*l*) . P(*s*). Fig. 61 is a crystal of common felspar or orthoclase, composed of the clinopinacoid (∞P∞) (*M*), the prism ∞P(*T*), the basal pinacoid 0P (*P*), and the hemidomes 2P∞(*y*): to which, in fig. 62 of

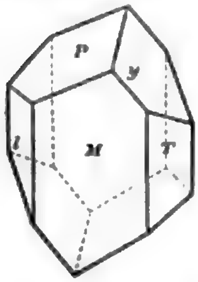


Fig. 61.

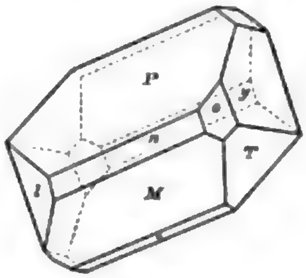


Fig. 62.

the same mineral, the hemipyramid P(*o*), and the clinodome (2P∞) (*n*), are added.

6. Triclinohedric system.

Triclinohedric System.—This is the least regular of all the systems, and departs the most widely from symmetry of form. The axes are all unequal, and inclined at angles none of which are right angles, so that to determine any crystal or series of forms the proportion of the axes $a : b : c$, and also their angles, or those of the inclination of the chief sections, must be known. As in the previous system, one axis is chosen as the principal axis, and the two others distinguished as the macrodiagonal and brachydiagonal axes. In consequence of the oblique position of the principal sections, this system consists entirely of partial forms wholly independent on each other, and each composed only of two parallel faces. The complete pyramid is thus broken up into four distinct quarter pyramids, and the prism into two hemiprisms. Each of these partial forms is thus nothing more than a pair of parallel planes, and the various forms consequently mere individual faces. This circumstance renders many triclinohedric crystals very unsymmetrical in appearance.

Triclinohedric pyramids (fig. 63) are bounded by eight triangles, whose lateral edges lie in one plane. They are equal and parallel two and two to each other; each pair forming, as just stated, a tetartopyramid or open form, only limited by combination with other forms, or, as we may suppose, by the chief sections. The prisms are again either vertical or inclined; the latter named domes, and their section is always rhomboidal. In deriving the forms, the fundamental pyramid is placed upright with its

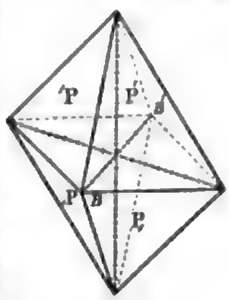


Fig. 63.

brachydiagonal axis to the spectator, and the partial forms designated, the two upper by 'P and P', the two lower by ,P and P,, as in the figure. The further derivation now follows as in the rhombic system, with the modifications already mentioned, so that we need not delay on it longer, especially as the minerals crystallizing in these forms are not numerous.

Some combinations of this system, as the series exhibited by most of the felspars, approach very near to the monoclinohedric system; whilst others, as the blue copper, or vitriol, and axinite, show great incompleteness and want of symmetry. In the latter case the determination of the forms is often difficult and requires great attention. As specimens, we may notice the albite crystal (fig. 64), in which

Mineralogy.

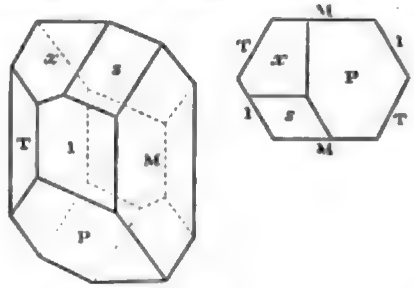


Fig. 64.

P is the basal pinacoid 0P, *M* the brachydiagonal pinacoid $\infty\breve{P}\infty$, *s* the upper right pyramid P', *l* the right hemiprism ∞P', *T* the left hemiprism ∞'P, and *x* the hemidome '$\breve{P}$'∞. Figures 65 and 66 are crystals of axinite, the

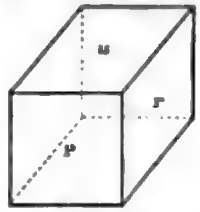


Fig. 65.

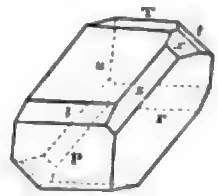


Fig. 66.

former from Dauphiné, the latter very common in Cornwall, of whose faces the following is the development,—*r* the macropinacoid $\infty\bar{P}\infty$; *P* the left hemiprism ∞'P; *u* the left upper quarter pyramid 'P; *l* the left upper quarter pyramid 2'P; *s* the left upper partial form of the macropyramid 3'$\bar{P}$3, and *x* the hemidome 2'P,∞.

Imperfections of Crystals.

In the foregoing description of the forms of crystals the planes have been supposed smooth and even, the faces equal and uniform, or at the same distance from the centre or point of intersection of the axes, and each crystal also perfect or fully formed and complete on every side. In nature, however, these conditions are rarely if ever realized, and the edges of crystals are seldom straight lines, or the faces mathematical plane surfaces. A very interesting variety of these irregularities, which pervades all the systems except the tesseral, is named *hemimorphism*. In this the crystals are bounded on the opposite ends of their chief axis by faces belonging to distinct forms, and hence only the upper or under half of each form is produced, or the crystal, as the name implies, is half-formed. Figure 67 represents a common variety of tourmaline, bounded on the

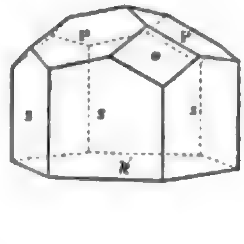


Fig. 67.

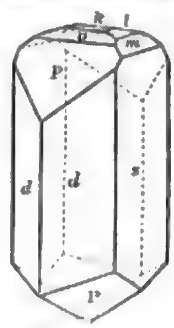


Fig. 68.

upper end by the planes of the rhombohedrons R and −2R, and on the lower end by the basal pinacoid. In fig. 68 of electric calamine the upper extremity shows the basis *k*,

two brachydomes *o* and *p*; and two macrodomes *m* and *l*; whilst on the lower end it is bounded by the faces P of the primary form. This appearance becomes more interesting from the fact, that most hemimorphic crystals acquire polar electricity from heat,—that is, exhibit opposite kinds of electricity at opposite ends of the crystal.

The faces of crystals are very frequently rendered imperfect by *striæ* or minute linear and parallel elevations and depressions. These arise in the oscillatory combination of two crystal forms, alternately prevailing through small spaces. The striæ, therefore, are in reality the edges of combined forms. They are very common on quartz, shorl, and some other minerals; and frequently indicate combinations where only a simple form would otherwise appear to exist. The cubes and pentagonal dodecahedrons of iron pyrites are frequently striated, and in three directions at right angles to each other. In calc-spar the faces of the rhombohedron, $-\frac{1}{2}$R (*g* in fig. 43 above) are almost never without striæ parallel to the oblique diagonal. The striation is said to be simple when only one series of parallel lines appears on each face, or feathered when two systems diverge from a common line. In other crystals the faces, then said to be *drusy*, are covered by numerous projecting angles of smaller crystals; an imperfection often seen in fluor spar. The faces of crystals occasionally appear curved either as in tourmaline and beryl from the peculiar oscillatory combination mentioned, or by the union of several crystals at obtuse angles, like stones in a vault, as in stilbite and prehnite. A true curvature of the faces probably occurs in the saddle-shaped rhombohedrons of brown spar and iron spar, in the lens-like crystals of gypsum, and in the curved faces so common on diamond crystals. In chabasite similar curved faces occur, but concave. In galena and augite the crystals are often rounded on the corners as if by an incipient state of fusion. On other crystals the faces are rendered uneven from inequalities following no certain rule. These imperfections furnish valuable assistance in developing very complex combinations, all the faces of each individual form being distinguished by the same peculiarity of surface.

Irregularities in the forms of crystals are produced when the corresponding faces are placed at unequal distances from the centre, and consequently differ in form and size. Thus the cubes and octahedrons of iron pyrites, galena, and fluor spar, are often lengthened along one axis. Quartz is subject to many such irregularities, which are seen in a very remarkable manner on the beautiful transparent and sharply angular crystals from Dauphiné. In such irregular forms, instead of one line, the axes are then represented by an infinite number of lines, parallel to the ideal axis of the figure. The same irregularity carried to a greater extent frequently causes certain faces required for the symmetry of the form, altogether to disappear. Again, some crystals do not fill the space marked out by their outline, holes and vacancies being left in the faces, occasionally to such an extent that they seem little more than mere skeletons. This appearance is very common on crystals produced artificially, as in common salt, alum, bismuth, silver, &c. A perfect crystal can only be produced when during its formation it is completely isolated, so as to have full room to expand on every side. Hence the most perfect crystals have been originally imbedded singly in some uniform rock mass. Next to them in perfection are forms that grow singly on the surface of some mass of similar or distinct composition, especially when the point of adherence is small. An incompleteness of form, or at least a difficulty in determining it, arises from the minuteness of some crystals, or from their contracted dimensions in certain directions. Thus some appear mere tabular, or lamellar planes, whilst others run out into acicular, needle-shaped, or capillary crystals. Amid all these modifications of the general form of the crystal, of the condition and aspect of its individual faces, or of its linear dimensions, one important element, the angular measurement, remains constant. In some monoaxial crystals, indeed, increase of temperature produces an unequal expansion in different directions, slightly changing the relative inclination of the faces, but so small as to be scarcely perceptible in common measurements, and hence producing no ambiguity. More important are the angular changes which in many species accompany slight changes in chemical composition, particularly in the relative proportions of certain isomorphous elements. But notwithstanding these limitations of the great truth of the permanence of the angular dimensions of crystals, announced by Romé de l'Isle, remains unaffected; only, as Mohs well states, it must not be interpreted with a rigid immutability, inconsistent with the whole analogy of other parts of nature.

The Goniometer and Measurement of Crystals.

The fact just stated of the permanence of the angular dimensions of crystals shows the importance of some accurate method of measuring their angles; that is, the inclination of two faces to each other. Two instruments have been specially used for this purpose,—the common or contact goniometer, invented by Caringeau, and the reflecting goniometer of Wollaston. The former is simply two brass rulers turning on a common centre, between which the crystal is so placed that its faces coincide with the edges of the rulers, and the angle is then measured on a graduated arc. This instrument is sufficiently accurate for many purposes and for large crystals; but for precise determination is far inferior to the reflecting goniometer. This requires smooth and even faces, but these may be very small, even the hundredth of an inch, in skilful hands; and as small crystals are generally most perfect, far greater accuracy can be attained, and the measurement depended on to one minute (1′).

The reflecting goniometer is represented in the annexed figure. It consists essentially of a graduated circle *mm*, divided on its edge into twice 180°, or more often into half degrees, the minutes being read off by the vernier *hh*. This circle turns on an axis connected with *tt*, so that by turning this the circle is moved round, but is stopped at 180°, when moving in one direction, by a spring at *k*. The other part of the instrument is intended to attach and adjust the crystal to be measured. The first axis of *mm* is hollow, and a second axis, *aa*, passes through it from *ss*, so that this and all the connected parts from *b* to *f* can be turned without moving the circle *mm*. The axis *d* passes through a hole in *bc*, so that it can turn the arm *de* into any required position; *f* is a similar axis turning the arm *og*; and *pq* a fourth axis, in like manner moveable in *g*, and with a small knob at *q*, to which the crystal to be measured is attached.

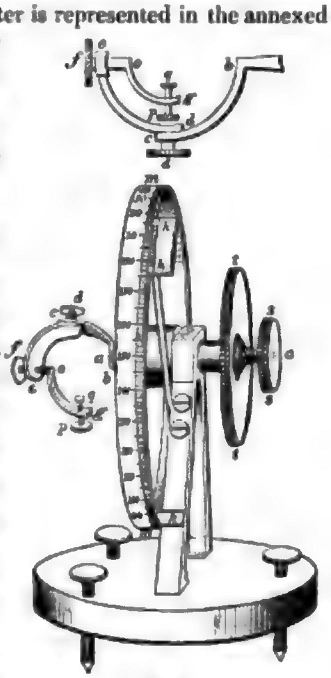


Fig. 69.

When about to use the instrument it should be placed

on a table, with its base horizontal, which is readily done by the screws in it, and opposite to a window at about 12 or 15 feet distance, so that its axis shall be parallel to the horizontal bars of the window. One of the upper bars of the window, and also the lower bar, or, instead of the latter, a white line on the floor or table parallel to the window, should then be chosen in order to adjust the crystal. The observer places himself behind the instrument with the side *a* at his right hand. The crystal is then attached to *q* by a piece of wax with the two faces to be measured upwards. The axis *fo* is made parallel to *aa*, and the eye being brought near to the first face of the crystal, the axes *aa* and *p* are turned till the image of the window is seen reflected in the face with the horizontal and vertical bars in their position. The axis *d* is then turned through a considerable angle (say 60°), and the image of the window again sought and brought into its proper place by turning the axis *f*, without moving *p*. When this is done that face is brought into its true position, normal to *d*, so that no motion of *d* can disarrange it. Hence the image of the window may now be sought in the second face and brought into its true position, with the horizontal bars seen horizontal, by moving the axes *d* and *a*. When this is done the crystal is properly adjusted, and the angle is thus measured. First bring the zero of the circle and vernier to coincide, and then turn the inner axis *a* or *ss*, and move the eye till the image of the upper bar of the window reflected from the more distant face of the crystal coincides with the lower bar or horizontal line seen directly. Keeping the eye in its place, turn the outer axis *tt* till the reflected image of the upper bar in the other face in like manner coincides with the lower line, and the angle of the two faces is then read off on the divided circle. As the angle measured is not directly that of the faces, but of the rays of light reflected from them, or the difference of the angle wanted from 180°, the circle has the degrees numbered in the reverse direction, so as to give the angle without the trouble of subtracting the one from the other.

The above apparatus for adjusting the crystal is an improvement suggested by Naumann. In the original instrument the axis *fo* was made to push in or out in a sheath, and had a small brass plate, bent at right angles, inserted in a cleft at *o*, to which the crystal was attached. The crystal was adjusted, as formerly, by moving the plate, or the axis *fo*, and by slight motion of the arm *de*, which should be at right angles nearly to *be* when used. A considerable improvement is, to have a small mirror fixed on the stand below the crystal, with its face parallel to the axis *aa*, and inclined at 45° to the window, when the lower line can be dispensed with, and the instrument used for various other purposes of angular measurement. Many alterations have been suggested for the purpose of insuring greater accuracy; but the simple instrument is sufficient for all purposes of determinative mineralogy, and the error from the instrument will in most cases be less than the actual variations in the dimensions of the crystals. Greater simplicity is indeed rather desirable, and the student will often find it sufficient to attach the crystal by a piece of wax to the axis *a* directly, and give it the further adjustment by the hand. The only use of the parts from *b* to *q* is to enable the observer to place the crystal properly; that is, with the edge to be measured parallel to the axis of the instrument, and as nearly as possible coinciding with its centre. This is effected when the reflection of the horizontal bar in the two faces appears parallel to that edge.

Macles or Twin Crystals.

When two similar crystals of a mineral species are united with their similar faces and axes parallel, the one forms merely a continuation or enlargement of the other, and every crystal may be regarded as thus built up of a number of smaller crystals. Frequently, however, crystals are united according to precise laws, though all their similar faces and axes are not parallel, and then are named macles or twin crystals. In one class of macles the axes of the two crystals are parallel, and in another they are inclined. The former only occur among hemihedric forms, and the two crystals are then combined in the exact position in which they would be derived from or reproduce the primary holohedric form. The second class, with oblique axes, occur both in holohedric and hemihedric forms, and the two individuals are placed in perfect symmetry to each other, in reference to a particular face of the crystal which forms the plane of union or the equator of the macle. We may also suppose the two crystals originally parallel, and the one turned round the normal of the united faces by 180° (often 90° or 60°), whilst the other is stationary. Or we may suppose a crystal cut into halves in a particular direction, and one-half turned 180° on the other; and hence the name of hemitrope given to them by Hauy. The position of the two individuals in this case corresponds with that of an object and its image in a mirror, whose surface then represents the plane of union.

The manner in which the crystals unite also differs. Some are merely opposed or in simple contact; others are, as it were, grown together, and mutually interpenetrate, occasionally so completely as to appear like one individual, The twin edges and angles in which the two unite are often re-entering; or they may coincide in one plane, when the line of union is either imperceptible, or is only marked by the meeting of two systems of striæ, or other diversity in the physical characters of the two faces.

The formation of twin crystals may be again repeated, forming groups of three, four, or more. When the faces of union are parallel to each other, the crystals form rows of indeterminate extent; where they are not parallel, they may return into each other in circles, or form bouquet-like or other groups. Where crystals are merely in juxtaposition, they are sometimes much shortened in the direction of the twin axis; and where many occur in a series with parallel position, are often compressed into very thin plates, frequently not thicker than paper, giving to the surface of the aggregate a peculiar striated aspect.

Only a few twin crystals in the different systems can be

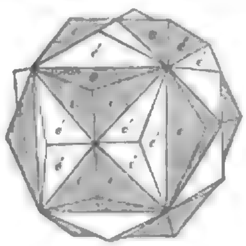


Fig. 70.

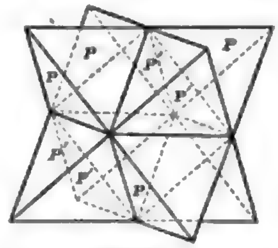


Fig. 71.

noticed, chiefly as examples of this mode of formation. In

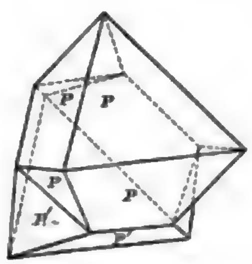


Fig. 72.

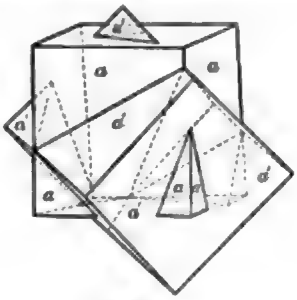


Fig. 73.

the tesseral system forms that unite with parallel axes pro-

duce intersecting macles like the pentagonal dodecahedrons of iron pyrites in fig. 70, and the tetrahedrons of grey-copper or fahlore in fig. 71, a similar formation also occurring in the diamond. In macles with inclined axes the two forms almost always unite by a face of the octahedron, and the two individuals are then generally apposed and shortened in the direction of the twin axis by one-half, so that they appear like a crystal that has been divided by a plane parallel to one of its faces, and the two halves turned round on each other by an angle of 180°. In this manner two octahedrons of the spinel, magnetic iron ore, or automolite (fig. 72), are frequently united. The same law prevails in the intersecting cubes of fluor spar, iron pyrites, and galena, represented in fig. 73. In fig. 74 of zinc-blende two rhombic dodecahedrons are united by a face of the octahedron.

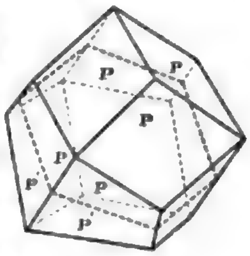


Fig. 74.

In the tetragonal system twin crystals with parallel axes rarely occur, but are seen in copper pyrites, and one or two other minerals. Where the axes are inclined the plane of union is very often one of the faces of the pyramid $P\infty$, or one of those faces that would regularly replace the polar edges of the fundamental form P. The crystals of tin ore obey this law, as seen in fig. 75, where the individuals are pyramidal, and in the knee-shaped crystal (fig. 76), where they are more prismatic.

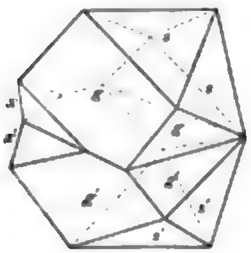


Fig. 75.

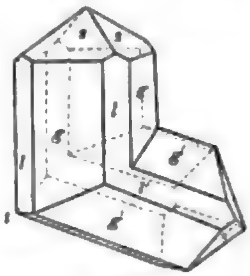


Fig. 76.

Hausmanite appears like fig. 77, in which the fundamental pyramid P prevails, on whose polar edges other crystals are often very symmetrically repeated, a central individual appearing like the support of all the others. Almost identical forms occur in copper pyrites.

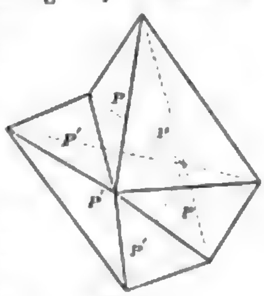


Fig. 77.

In the hexagonal system twin crystals with parallel axes are common, as in calc-spar, chabasite, hæmatite, and other rhombohedric minerals. In calc-spar they often form very regular crystals, the two individuals uniting by a plane parallel to the base, so as to appear like a single crystal, as in fig. 78, where each end shows the forms $\infty R . -\frac{1}{2}R$, but in a complementary position; or in fig. 79 of two scalenohedrons R^3 from Derbyshire. The rhombohedric crystals of chabasite often appear intersecting each other, like those of fluor spar in fig 73 above. The purer varieties of quartz or rock-crystal, in consequence of the tetartohedric character of its crystallization, often exhibit twins. In these the pyramid P separates into two rhombohedrons *P* and *r*, which though geometrically similar, are yet physically distinct. In fig. 80 the two individuals are only grown together, but more commonly they penetrate each other in an irregular manner, forming apparently a single crystal. Twins with oblique axes are also common, the plane of union being usually one face of the rhombohedron. Thus in calc-spar two rhombohedrons

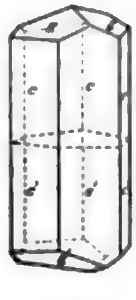


Fig. 78.

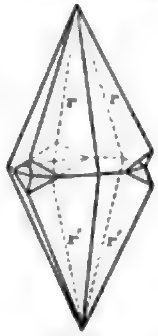


Fig. 79.

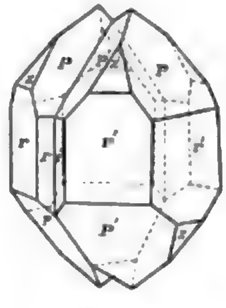


Fig. 80.

are often joined by a face of $-\frac{1}{2}R$, the two axes forming an angle of 127° 34′; occasionally a third individual is interposed in a lamellar form, as in fig. 81, when the two outer crystals become parallel. This latter arrangement is very common in the highly cleavable varieties of Iceland spar. When the crystals unite in a face of the rhombohedron R, fig. 82, they form an angle of 89° 8′, differing

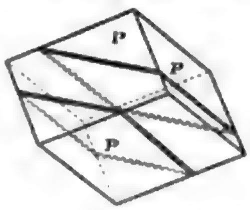


Fig. 81.

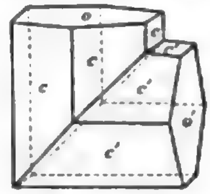


Fig. 82.

little from a right angle, by which the occurrence of this law is very easily recognised, especially in prismatic varieties.

In the rhombic system twin crystals with parallel axes are very rare, but those with oblique axes common, the plane of union being one of the faces of the prism ∞P. Twins of this kind are very distinctly seen in arragonite, carbonate of lead, marcasite, stephanite, mispickel, and other minerals. In arragonite the crystals partly interpenetrate, partly are in mere juxtaposition, as in fig. 83, where the individuals are formed by the combination $\infty P(m) . \infty\breve{P}\infty(h), \breve{P}\infty(k)$, and in figure 84 where several crystals of the same combination form a series with parallel planes of union; the inner members being so shortened that they appear like mere lamellar plates producing striæ on the faces $\breve{P}\infty$ and $\infty\breve{P}\infty$ of the macle. In fig. 85 four crys-

Fig. 83.

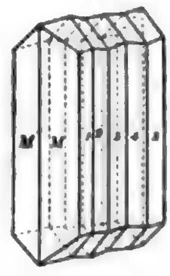


Fig. 84.

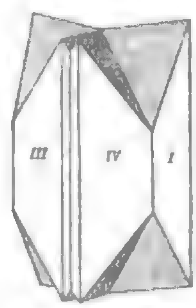


Fig. 85.

tals, each of the combination $\infty P . 2\breve{P}\infty$, having united in inclined planes, form a circular group, returning into itself. The carbonate of lead often occurs in macles in all respects similar. In staurolite, individuals of the prismatic combination $\infty P . \infty\breve{P}\infty . 0P$, combine either, as in fig. 86, by a face of the brachydome $\frac{3}{2}\breve{P}\infty$, with their chief axes almost at right angles; or, as in fig 87, by a face of the brachypy-

ramid $\frac{3}{2}\breve{P}\frac{3}{2}$, the chief axes and the brachypinacoids (o) of the two single crystals meeting at an angle of about 60°.

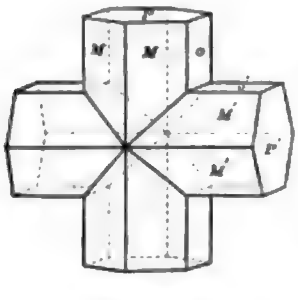


Fig. 86.

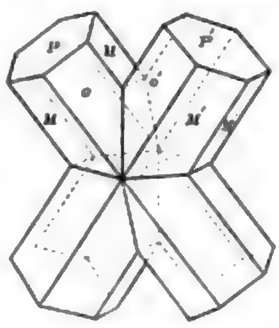


Fig. 87.

Finally, in fig. 88 two harmotome crystals of the most common combination $\infty\bar{P}\infty$. $\infty\breve{P}\infty$. P . $\bar{P}\infty$, intersect each other so nearly at right angles, that their principal axes seem to coincide, and the brachypinacoid (q) of the one crystal (with rhombic striæ) is parallel to the macropinacoid (o) of the other.

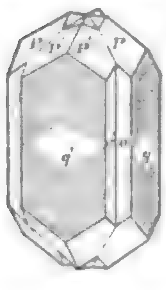


Fig. 88.

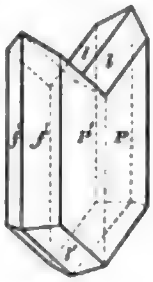


Fig. 89.

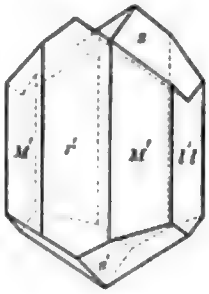


Fig. 90.

In the monoclinohedric system the most common macles are those in which the principal axes and the chief sections of the two crystals are parallel to each other, and consequently the principal axis is also the twin axis. Usually the two individuals are united by a face parallel to the orthodiagonal chief section, as in figure 89 of gypsum, where two crystals of the combination (∞P∞) . ∞P . $-$P, shown in fig. 59, unite so regularly that the faces of the pinacoids (P and P') form only one plane. In a similar manner the augite crystals of the combination ∞P . ∞P∞ . (∞P∞) . P, represented singly in fig. 60, are in fig. 90 united in a macle so very symmetrical and regular that the line of junction cannot be observed on the face of the clinopinacoid. The two hemipyramids P(s) (like $-$P(l) in the gypsum crystal above) form on one side a re-entering, on the other a salient angle. Hornblende, wolfram, and other minerals exhibit a similar appearance. In other cases the individuals partially penetrate each other, being, as it were, crushed together in the direction of the orthodiagonal. This mode of union is not uncommon in gypsum, and very frequent in orthoclase felspar. Two crystals of the latter, of the combination (∞P∞) . ∞P . 0P . 2P∞, as in fig. 61 above, are often pushed sidewise into each other as shown in fig. 91.

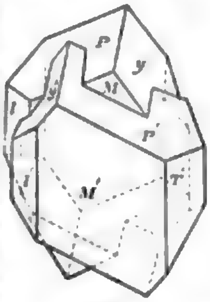


Fig. 91.

In the triclinohedric system some twin formations are of great importance as a means of distinguishing the triclinohedric from the monoclinohedric species of felspar. In one variety the twin axis is the normal to the brachydiagonal chief section. But in the triclinohedric felspars this section is not, as it is in the monoclinohedric species, perpendicular to the basis, and consequently the two bases form on one side a re-entering, on the other a salient angle; whereas in the monoclinohedric felspars (where the brachydiagonal chief section corresponds to the clinodiagonal), no twin crystals can be produced in conformity to this law, and the two bases fall in one plane. The albite and oligoclase very often exhibit such twins, as in figure 92, where the very obtuse angles formed by the faces of 0P, or P and P' (as well as those of '$\breve{P}$'∞, or x and x') are a very characteristic appearance, marking out this mineral at once as a triclinohedric species. Usually the twin formation is repeated, three or more crystals being combined, when those in the centre are reduced to mere plates. When very numerous, the surfaces P and x are covered with fine striæ, often only perceptible with a microscope. A second law observed in triclinohedric felspars, particularly the albite and labradorite, is that the twin axis corresponds with that normal of the brachydiagonal, which is situated in the plane of the base. In pericline, a variety of albite, these twins appear as in fig. 93, where the two crystals are united by a face of the basal pinacoid P, whilst the faces of the two brachypinacoids (M and M') form edges with very obtuse angles (173° 22'), re-entering on the one side and salient on the other. These edges, or the line of junction between M and M', are also parallel to the edges formed by these faces and the base, or those between M and P. In this case also the macles are occasionally several times repeated when the faces appear covered with fine striæ.

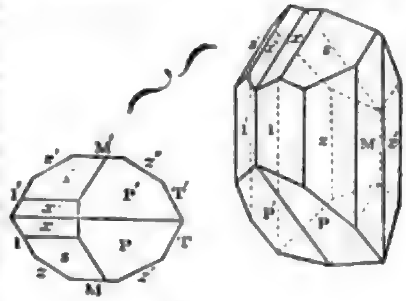


Fig. 92.

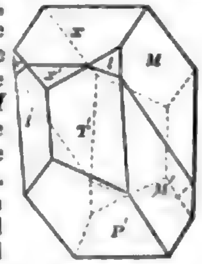


Fig. 93.

Irregular Aggregation of Crystals.

Besides the regular unions now described crystals are often aggregated in peculiar ways, to which no fixed law can be assigned. Thus some crystals, apparently simple, are composed of concentric crusts or shells, which may be removed one after the other, always leaving a smaller crystal like a kernel, with smooth distinct faces. Some specimens of quartz from Beeralston in Devonshire consist apparently of hollow hexagonal pyramids placed one within another. Other minerals, as fluor spar, apatite, heavy spar, and calc-spar, exhibited a similar structure by bands of different colours.

Many large crystals, again, appear like an aggregate of numerous small crystals, partly of the same, partly of different forms. Thus some octahedrons of fluor spar from Schlaggenwald are made up of small dark violet-blue cubes, whose projecting angles give a drusy character to the faces of the larger form. Such polysynthetic crystals, as they may be called, are very common in calc-spar.

A similar, but still more remarkable formation, is where two crystals of distinct species are conjoined. Such unions of cyanite and staurolite have been long well known, and the graphic-granite exhibits a similar union between large felspar crystals and many smaller ones of mica and quartz.

Forms of Crystalline Aggregates.—Crystals have often

been produced under conditions preventing the free development of their forms. They then compose crystalline aggregates, of which the following may be distinguished:—*Granular*, formed of grains, generally angular, but rarely rounded or flattened. *Lamellar* consist of broad plates, which are *tabular* when of uniform thickness, *lenticular* when becoming thinner on the edges, *wedge-shaped* when sharpened towards one edge, and *scaly* when the plates are very small. *Columnar*, in which the individuals are drawn out in one direction more than in the others; *bacillary* or rod-like, in which the columns are of uniform thickness; *acicular* or needle-shaped, in which they are pointed; and *fibrous*, in which they are very fine. In the broad-columnar the columns are, as it were, compressed, or broader in one direction than the other. The distinctions of large, coarse, small, or fine-granular; thick or thin scaly; straight, curved, or twisted-columnar; parallel, diverging, or confused-fibrous; and such like, are easily understood.

Aggregates which have been able to crystallize, at least, with a certain degree of freedom, have been distinguished by Mohs into crystal groups and druses; the former including all unions of several imbedded crystals; the latter those of crystals that have grown together on a common support. In the groups crystals with their faces otherwise perfect are conjoined in various ways. Sometimes they radiate, as it were, from a common centre, and produce spheroidal, ellipsoidal, or other forms, frequent in gypsum, iron pyrites, and other minerals imbedded in clay. Where many such masses are united, they are named *botryoidal* when like bunches of grapes, *mammellated* where the spheres are larger and less distinct, and *reniform* or kidney-shaped where the masses are still larger. Some groups are partially attached by a small point; but the mass is generally free.

Crystals are often grouped in rows or in one direction, forming, when they are very small, capillary or hair-like, and filiform, thread, or wire-like forms, which are common among native metals, as gold, silver, copper, and bismuth, in silver glance and a few other minerals. Sometimes the masses are dentiform, consisting of portions resembling teeth; as is very common in silver. Often these groups expand in several directions, and produce arborescent, dendritic, foliated, feathered, or other forms, very common in copper. In these groups, however, a certain dependence on the crystallographic character of the species may be observed. The lamellar minerals often form fan-shaped, wheel-like, almond-shaped, comb-like, or other groups. The fibrous types, again, are disposed in parallel or diverging bundles, or in radiating, stellar, and other masses. Coralloidal (like coral), fruticose (like cauliflower), and other forms, have also been observed.

In druses, many crystals rise side by side from a common support; sometimes only the granular mass composed of their united bases, at other times some distinct body. The form of a druse is determined by that of the surface on which it grows, and consequently is often very irregular or wholly accidental. Where completely inclosed they have been named drusy cavities, and when of a spheroidal form, geodes. A drusy crust, again, consists of a thin layer of small crystals investing the surface of a large crystal or of some other body.

The minute or cryptocrystalline minerals form similar aggregates. In the globular or the oolitic the minute crystals often appear to radiate from a centre, or form concentric crusts. Somewhat similar are the stalactites and stalagmites, in which the mineral, especially rock-salt, limestone, chalcedony, opal, limonite, has been deposited from a fluid dropping slowly from some overhanging body. In this case the principal axis of the figure, generally a hollow tube, is vertical, whilst the individual parts are arranged at right angles to this direction. In other cases the mineral has apparently been deposited from a fluid mass moving slowly in a particular direction, which may be regarded as the chief axis of the figure, whilst the axes of the individual crystals may assume a different position.

By far the largest masses of the mineral kingdom have, however, been produced under conditions in which a free development of their forms was excluded. This has been the case with the greater portion of the minerals composing rocks or filling veins and dykes. The structure of these masses on the large scale belongs to geology, but some varieties of the texture visible even in hand specimens may be noticed. The individual grains or masses have seldom any regular form, but appear round, long, or flat, according to circumstances, and as each has been more or less checked in the process of formation. Even then, however, a certain regularity in the position of the parts is often observable, as in granite, in which the cleavage planes, and consequently the axes of the felspar crystals, are parallel. Where these grains are all pretty similar in size and shape, the rock is named massive when they are small, or granular when they are larger and more distinct. Sometimes the rock becomes slaty, dividing into thin plates; or concretionary, forming roundish masses; at other times the interposition of some foreign substance (gas or vapour) has rendered it porous, cellular or vesicular, giving rise to drusy cavities. These cavities are often empty, but have occasionally been filled by other minerals, when the rock is named amygdaloidal, from the almond-like shape of the inclosed masses.

Many of the above external forms appear also in the amorphous solid minerals, in which no trace of individual parts, and consequently of internal structure, is observable. They are not unfrequently disposed in parallel or concentric layers, of uniform or distinct colours; and may assume spherical, cylindrical, stalactitic, and other appearances.

Pseudomorphism.—When the substance of one mineral assumes the external form of some other mineral it is named a pseudomorph. In some named incrusting pseudomorphs the original crystal is covered by a rough or drusy surface of the second mineral, frequently not thicker than paper. Occasionally the first crystal has been removed, and nothing but the shell remains; or the cavity has been filled by a distinct mineral species, or a crystalloid, as it may be named, forming an exact representation of the original, but of a different substance.

More commonly the new mineral substance has gradually expelled the old, and replacing it, as it were, atom by atom, has assumed its exact form. In other cases not the whole substance of the original crystal, but only one or more of its elements, has been changed, or the whole matter has remained, but in a new condition. Thus arragonite crystals have been converted into calc-spar, the chemical composition of both being identical; or gaylussite has been changed into calc-spar, andalusite into cyanite, by the loss of certain elements. On the other hand, anhydrite becomes gypsum, red-copper ore malachite, by addition of new matter. Or the elements are partially changed, as felspar into kaolin, quartz or pearl spar into talc, iron pyrites or iron glance into brown-iron ore, azurite into malachite, augite into green earth. The true nature of such bodies is shown by the internal structure, having no relation to the external form or apparent system of crystallization.

The process of petrifaction of organic bodies is in reality a species of pseudomorphic formation, and has been produced in all the above modes. External and internal casts of organic bodies are not uncommon. In other cases the original substance has been replaced by some mineral which has preserved not merely the external form, but even the minutest detail of internal structure; so that the different kinds of wood have been distinguished in their silicified trunks. The most common petrifying substances are silica and carbonate of lime. In encrynites, echinites, belem-

nites, and other fossils, the crystals of calc-spar often occur in very regular positions. In some varieties of petrified wood both the ligneous structure and the cleavage of the calc-spar are observable.

Different from the above are mineralized bodies, in which the original structure is still retained, but their chemical nature partially changed. In these a complete series may be often traced, as from wood or peat, through the varieties of brown coal, common coal, anthracite, and graphite, perhaps even to the diamond.

Chap. II.—PHYSICAL PROPERTIES OF MINERALS.

The physical characters of minerals comprehend,—1*st*. Those properties derived from the nature of the substance itself, as coherence, mode of fracture, elasticity, and density or specific gravity. 2*d*. Those phenomena called forth in minerals by the influence of some external power or agent, as their optical, electric, or thermal relations; and, 3*d*. Other characters depending on the personal sensation of the observer, on his taste, smell, and touch. All these properties furnish useful characters in distinguishing and describing mineral species.

Cleavage and Fracture.

In many species there are certain planes at right angles to which cohesion seems to be at a minimum, so that the mineral separates along or parallel to these planes far more readily than in any other direction. This property is named cleavage, and these planes cleavage-planes. They have a strictly definite position, and do not show any transition or gradual passage into the greater coherence in other directions. The number of these parallel cleavage-planes is altogether indefinite; so that the only limit that can be assigned to the divisibility of some minerals, as gypsum and mica, arises from the coarseness of our instruments.

These minima of coherence or cleavage-planes are always parallel to some face of the crystal, and similar equal minima occur parallel to every other face of the same form. Hence they are always equal in number to the faces of the form, and the figures produced by cleavage agree in every point with true crystals, except that they are artificial. They are thus most simply and conveniently described by the same terms and signs as the faces of crystals. Some minerals cleave in several directions parallel to the faces of different forms, but the cleavage is generally more easily obtained and more perfect in one direction than in the others. This complex cleavage is well seen in calc-spar, and fluor spar, and very remarkably in zinc-blende, where it takes place in no less than six directions. As in each of these the division may be indefinitely continued, it is clear that no lamellar structure in any proper sense can be assigned to the mineral. All that can be affirmed is, that contiguous atoms have less coherence in the normal of these planes than in other directions. When the cleavage takes place in three directions, it of course produces a perfect crystal form, from which the system of crystallization and angular dimensions of the species may be discovered, and is thus often of very great importance.

The common cleavage in the different systems is as follows, those of most frequent occurrence being put in italics:—(1.) In the tesseral, *Octahedric*, O, along the faces of the octahedron; *Hexahedric*, $\infty O \infty$, along those of the cube; and Dodecahedric, ∞O. (2.) In the tetragonal system, Pyramidal, P or $2P\infty$; *Prismatic*, ∞P or $\infty P \infty$; or *Basal*, 0P. (3.) In the hexagonal system with holohedric forms, Pyramidal, P or P2; *Prismatic*, ∞P or $\infty P2$; or *Basal*, 0P; with rhombohedral forms, *Rhombohedric*, R; Prismatic, ∞R; or *Basal*, 0R. (4.) In the rhombic system, Pyramidal, P; *Prismatic*, ∞P; Makro or Brachydomatic, $\bar{P}\infty$ or $\breve{P}\infty$; *Basal*, 0P; Macrodiagonal, $\infty\bar{P}\infty$; or *Brachydiagonal*, $\infty\breve{P}\infty$. (5.) In the monoclinohedric system, Hemipyramidal, P or $-P$; *Prismatic*, ∞P; Clinodomatic, $(P\infty)$; Hemidomatic, $P\infty$ or $-P\infty$; *Basal*, 0P; *Orthodiagonal*, $\infty P\infty$; or *Clinodiagonal*, $(\infty P\infty)$. (6.) In the triclinohedric system, Hemiprismatic, $\infty P'$ or $\infty' P$; Hemidomatic either along the macrodome or brachydome; *Basal*, 0P; Macrodiagonal, $\infty\bar{P}\infty$; or *Brachydiagonal*, $\infty\breve{P}\infty$.

In some minerals the cleavage is readily procured; in others only with extreme difficulty. The planes produced also vary much in their degree of perfection, being *highly* perfect in some, as mica and gypsum; imperfect in others, as garnet and quartz. In a very few crystalline minerals cleavage-planes can hardly be said to exist. Cleavage must be carefully distinguished from the planes of union in twin crystals, and the division-planes in the laminar minerals.

Fracture surfaces are formed when a mineral breaks in a direction different from the cleavage-planes. They are consequently most readily observed when the cleavage is least perfect. The form of the fracture is named *conchoidal* when composed of concave and convex surfaces like shells, *even* when nearly free from inequalities. The character of the surface is *smooth*; or *splintery* when covered by small wedge-shaped splinters adhering by the thicker end; or *hackly* when covered by small slightly-bent inequalities, as in iron and other malleable bodies; or *earthy* when it shows only fine dust.

Hardness and Tenacity.

The hardness of minerals, or their power of resisting any attempt to separate their parts, is also an important character. As it differs considerably in the same species, according to the direction and the surface on which the trial is made, its accurate determination is difficult, and the utmost that can usually be obtained is a mere approximation found by comparing different minerals one with another. For this purpose Mohs has given the following scale:—

1. *Talc*, of a white or greenish colour.
2. *Rock-salt*, a pure cleavable variety, or semitransparent uncrystallized *gypsum*, the transparent and crystallized varieties being generally too soft.
3. *Calcareous spar*, a cleavable variety.
4. *Fluor spar*, in which the cleavage is distinct.
5. *Apatite*, the asparagus-stone, or phosphate of lime, from Saltzburg.
6. *Adularia felspar*, any cleavable variety.
7. *Rock-crystal*, a transparent variety.
8. *Prismatic topaz*, any simple variety.
9. *Corundum* from India, which affords smooth cleavage surfaces.
10. The *Diamond*.

Two other degrees are obtained by interposing foliated mica between 2 and 3, and scapolite, a crystalline variety, between 5 and 6. The former is numbered 2·5, the latter 5·5.

To ascertain the hardness of a mineral, first try which of the members of the scale is scratched by it, and in order to save the specimens, begin with the highest numbers, and proceed downwards, until reaching one which is scratched. Then take a fine hard file, and draw along its surface, with the least possible force, the specimen to be examined, and also that mineral in the scale whose hardness is immediately above the one which has been scratched. From the resistance they offer to the file, from the noise occasioned by their passing along it, and from the quantity of powder left on its surface, their relative hardness is deduced. When, after repeated trials, we are satisfied to which member of the scale of hardness the mineral is most nearly allied, we

say its hardness (suppose it to be felspar) is equal to 6, and write after it H. = 6·0. If the mineral do not exactly correspond with any degree of the scale, but is found to be between two of them, it is marked by the lower with a decimal figure added. Thus, if more than 6 but less than 7, it is expressed H. = 6·5. In these experiments we must be careful to employ specimens which nearly agree in form and size, and also as much as possible in the shape of their angles.

Where the scale of hardness is wanting, or for a first rough determination, the following experiments may serve:—

Every mineral that is scratched by the finger-nail has H. = 2·5 or less.

Minerals that scratch copper have H. = 3 or more.

Polished white iron has H. = 4·5.

Window-glass has H. = 5 to 5·5.

Steel point or file has H. = 6 to 7.

Hence every mineral that will cut or scratch with a good pen-knife has H. less than 6.

Flint has H. = 7 and only about a dozen minerals, including the precious stones or gems, are harder.

Closely allied to hardness is the TENACITY of minerals, of which the following varieties have been distinguished:—A mineral is said to be *brittle* when, as in quartz, on attempting to cut it with a knife, it emits a grating noise, and the particles fly away in the form of dust. It is *sectile* or *mild* when, as in galena and some varieties of mica, on cutting, the particles lose their connection in a considerable degree; but this takes place without noise, and they do not fly off, but remain on the knife. And a mineral is said to be *soft* or *ductile* when, like native gold or lead, it can be cut into slices with a knife, extended under the hammer, and drawn into wire. From tenacity it is usual to distinguish *frangibility*, or the resistance which minerals oppose when we attempt to break them into pieces or fragments. This property must not be confounded with hardness. Quartz is hard, and hornblende comparatively soft; yet the latter is more difficultly frangible than the former. *Flexibility*, again expresses the property possessed by some minerals of bending without breaking. They are *elastic*, like mica, if, when bent, they spring back again into their former direction; or merely flexible, when they can be bent in different directions without breaking, but remain in their new position, as gypsum, talc, asbestus, and all malleable minerals.

Specific Gravity.

The density or the relative weight of a mineral, compared with an equal volume of pure distilled water, is named its specific gravity. This is a most important character for distinguishing minerals, as it varies considerably in different species, and can be readily ascertained with much accuracy, and in many cases without at all injuring the specimen. The whole process consists in weighing the body, first in air, and then immersed in water, the difference in the weight being that of an equal bulk of the latter fluid. Hence, assuming, as is commonly done, the specific gravity of pure distilled water to be equal to 1 or unity, the specific gravity (G) of the other body is equal to its weight in air (w), divided by the loss or difference (d) of weight in water (or $G = \frac{w}{d}$).

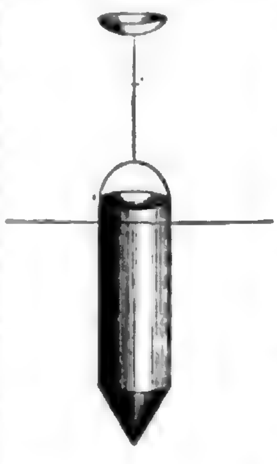


Fig. 91.

A simple and portable instrument for finding the specific gravity is the areometer of Nicholson, fig. 91. A delicate hydrostatic balance gives the gravity with far more accuracy; and even a good common balance is often preferable. The mineral may be suspended from one arm or scale by a fine silk thread or hair, and its weight ascertained, first in the air, and then in water.

There are a few precautions necessary to insure accuracy. Thus, a pure specimen must be selected which is not intermixed with other substances, and when weighed in air it should be quite dry. It must also be free from cavities, and care must be taken that when weighed in water no globules of air adhere to its surface, which render it lighter. If the body imbibes moisture, it should be allowed to remain till fully saturated before determining its weight when immersed, and it is sometimes even necessary to boil the specimen in order to expel the air from its pores. Small crystals or fragments, whose freedom from mixture can be seen, are best adapted for this purpose. The specimen experimented on should not be too heavy; thirty grains being enough where the gravity is low, and even less where it is high. It is also of importance to repeat the trial, if possible with different specimens, which will show whether any cause of error exists, and to take the mean of the whole. A correction should be made for the variation of the temperature of the water from 60° Fahr., which is that usually chosen as the standard in mineralogical works. Where the difference, however, does not exceed ten or fifteen degrees this correction may be neglected, as it only affects the third or second decimal figure of the result.

Optical Properties of Minerals.

There are few more interesting departments of science than the relations of mineral bodies to light, and the modifications which it undergoes either when passing through them or when reflected from their surface. In this place, however, we can only notice these phenomena so far as they point out distinctions in the internal constitution of minerals, or furnish characters for distinguishing one species from another.

Minerals, and even different specimens of the same species, vary much in pellucidity or in the quantity of light which can pass through them. Some transmit so much light, that small objects can be clearly seen, or letters read when placed behind them, and are named *transparent*. They are *semitransparent* when the object is only seen dimly, as through a cloud; and *translucent* when the light that passes through it is so obscured that the objects can be no longer discerned. Some minerals are only thus *translucent on the* thinnest *edges*, and in others even these transmit no light, and the body is named *opaque* or untransparent. These degrees pass gradually into each other, and cannot be separated by any precise line; and this is also the case in nature, where some minerals pass through the whole scale, as quartz, from the fine transparent rock-crystal to opaque dark-black varieties. Such minerals may be described generally as *pellucid*. This change often arises from some mixture in their composition, especially of metallic substances. Perfect opacity is chiefly found in the metals or their compounds with sulphur, though even these seem to transmit light when reduced to laminæ of sufficient thinness.

Double Refraction.—When a ray of light passes obliquely from one medium into another of different density, it is bent or refracted from its former course. The line which it then follows forms an angle with the perpendicular, which in each body bears a certain proportion to that at which the ray fell upon it, or, as definitely stated, the sine of the angle of refraction has a fixed ratio to the sine of the angle of incidence, this ratio being named the index of refraction. This simple refraction is common to all trans-

parent bodies, whether crystalline, amorphous, or fluid; but some crystals produce a still more remarkable result. The ray of light which entered them as one is divided into two rays, each following different angles, or is doubly refracted. In minerals of the tesseral system this property does not exist, but it has been always observed in minerals belonging to the other systems, though in many only after they have been cut in a particular manner, or have been otherwise properly prepared. It is most distinctly seen in crystals of calc-spar, especially in the beautiful transparent variety from Iceland, in which it was first observed and described by Erasmus Bartholin in a work published at Copenhagen in 1669.

The subjoined figure will illustrate this singular property. It represents a rhomb of Iceland spar, on the surface of which a ray of light *Rr* falls. As seen in the figure, this ray divides into two, one of which *roo'* follows the ordinary law of refraction, or the sines of the angles of incidence and refraction maintain a constant ratio. This is named the ordinary ray O. The other, hence named the extraordinary ray E, does not obey the usual law of the sines, and has no general index of refraction. In the plane perpendicular to the axis it is most widely separated from the ordinary ray, but in others oblique to it approaches nearer to O, and in one at right angles coincides, or there is no double refraction. This plane, or rather direction, in which there is no double refraction, is named the optical axis of the crystal, or the axis of double refraction. Now, in certain minerals it is found that there is only one plane with this property, whereas in others there are two such planes, and they have in consequence been divided into monoaxial and binaxial. To the former (monoaxial) belong all crystals of the tetragonal and hexagonal systems; to the latter (binaxial) all those of the three other systems. In the former the optic axis coincides with, or is parallel to, the crystallographic chief axis. In some crystals the index of refraction for the extraordinary ray E is greater than for the ordinary ray O; and in others it is smaller. The former are said to have positive (or attractive), the latter negative (or repulsive) double refraction. Quartz is an example of the former, the index of refraction, according to Malus, being for O = 1·5484, for E = 1·5582; and calc-spar of the latter, the index of O being = 1·6543, of E = 1·4833. The index of E is in both cases taken as its maximum.

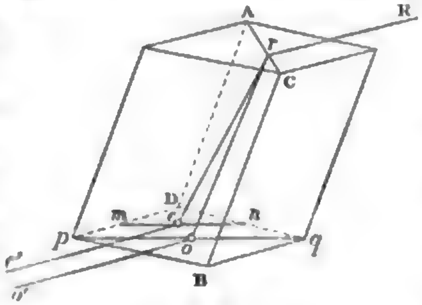


Fig. 95.

It should be observed that the optic axes are not single lines, but directions parallel to a line, or innumerable parallel lines, passing through every atom of the crystal. It is also important to remark that this property divides the systems of crystallization into three precise groups,—the tesseral, with single refraction; the tetragonal and hexagonal, with double refraction, and monoaxial; the other three systems also double, but binaxial. It is therefore of use to determine the system to which a mineral belongs, but is not of great value as a character for distinguishing species.

Polarization of Light.—Intimately connected with this property is that of the polarization of light, which being more easily and precisely observable than double refraction, is in many cases of higher value as a mineralogical character. By this term is meant a peculiar modification which a ray of light undergoes, in consequence of which its capability of being transmitted or reflected towards particular sides is either wholly or partially destroyed. Thus, if from a transparent prism of tourmaline two thin plates are cut parallel to its axis, they will transmit light, as well as the prism itself, when they are placed above each other with the chief axis of both in the same direction. But when the one slip of tourmaline is turned at right angles to the other, either no light at all or very little is transmitted, and the plates consequently appear black. Hence, in passing through the first slip the rays of light have acquired a peculiar property, which renders them incapable of being transmitted through the second, except in a parallel position, and they are then said to be polarized. The same property is acquired by a ray of light when reflected, at an angle of $35\frac{1}{2}°$ (or angle of incidence $54\frac{1}{2}°$), from a plate of glass, one side of which is blackened, or from some other non-metallic body. When such a ray falls on a second similar mirror at an equal angle, but so that the plane of reflection in the second is at right angles to that in the first, it is no longer reflected, but wholly absorbed. When, on the other hand, the planes of reflection are parallel, the ray is wholly and at any intermediate angle partially reflected. A ray of light polarized by reflection is also incapable of transmission through a tourmaline slip in one position, which, however, is at right angles to that in which a ray polarized by passing through another slip is not transmitted.

In order to observe the polarization of light, a very simple instrument will be found useful (fig. 96). At one end of a horizontal board B a black mirror *a* is fixed. In the middle is a pillar to which a tube *cd* is fastened, with its axis directed to the mirror at an angle of $35\frac{1}{2}°$.

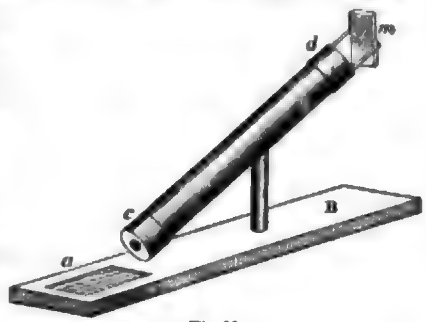


Fig. 96.

On the lower end is a cover *c*, with a small hole in the centre, and at the upper end another cover with a small black mirror *m* attached to it by two arms, as in the figure, and also at an angle of $35\frac{1}{2}°$. With this instrument the mirror *m* can be so placed in relation to *a* that the planes of reflection shall have any desirable inclination to exhibit the simple polarization of light.

This instrument furnishes a simple test whether minerals that cleave readily into thin lamellæ are optically monoaxial or binaxial. Place the two mirrors with their polarization-planes at right angles, and fix a plate of the mineral with a little wax over the hole *c*, and then observe what takes place in the second mirror during the time that the cover *c* is turned round. If the mineral belongs to the binaxial system, the light from the first mirror *a*, in passing through it, is doubly refracted and has its polarization changed, and consequently can be again reflected from the second mirror *m*, and in each revolution of *c* will show four maxima and four minima of intensity. If, on the contrary, the mineral is monoaxial, the ray will pass through the lamina unaltered, and will not be reflected from the second mirror in any position of *c*.

Another beautiful phenomenon of polarized light, in like manner connected with the crystalline structure of minerals, is the coloured rings which laminæ of the doubly-refracting species, when of a proper thickness, exhibit in certain positions. These rings are easily seen in the above apparatus by interposing a thin plate of gypsum or mica between the two mirrors. When the interposed plate belongs to a monoaxial mineral, there is seen in the second mirror a system of circular concentric coloured rings in-

tersected by a black cross (fig. 97). If the mineral is binaxial, one or two systems of elliptical coloured rings appear, each intersected by a black stripe (fig. 98). In certain cases this stripe is curved, or the two systems of rings unite in a lemniscoidal form (fig. 99). When the planes of polarization are parallel, the black cross and stripe appear white (fig. 100), showing that in this direction the crystals act like singly-refracting minerals. Quartz, again, in close relation to its system of crystallization, exhibits a circular polarization of splendid prismatic colours, which on turning the plate change in each point in the order of the spectrum, from red to yellow, green, and blue. In order to produce these changes, however, in some specimens the plate must be turned to the right, in others to the left, showing a difference in the crystalline structure.

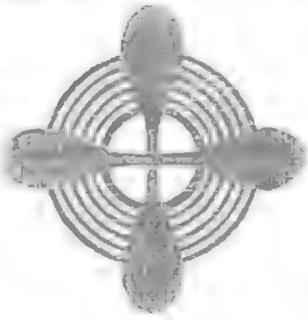


Fig. 97.

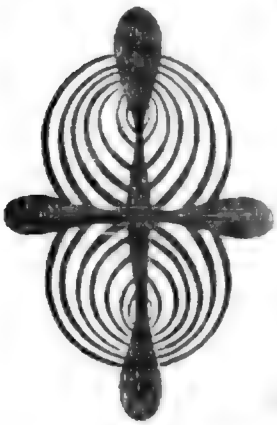


Fig. 98.

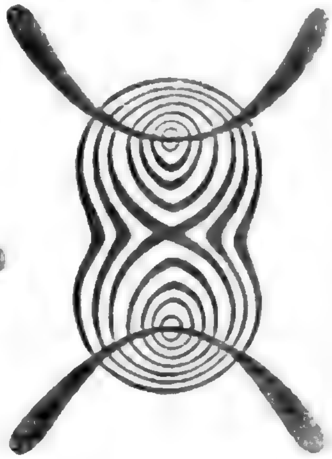


Fig. 99.

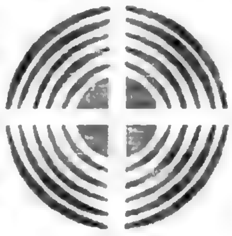


Fig. 100.

Pleochroism.—Closely connected with double refraction is that property of transparent minerals named pleochroism (many-coloured), in consequence of which they exhibit distinct colours when viewed by transmitted light in different directions. Crystals of the tesseral system do not show this property; whilst in those of the other systems it appears in more or less perfection; and in the tetragonal and hexagonal minerals as dichroism (two colours), in the rhombic and clinohedric systems as trichroism (three colours). In most cases these changes of colour are not very decided, and appear rather as different tints or shades than as distinct colours. The most remarkable of dichromatic minerals are the magnesian mica from Vesuvius, the tourmaline and ripidolite; of trichromatic, the iolite, the andalusite from Brazil, the diaspore from Schemnitz, and the axinite.

Some crystalline minerals exhibit a very lively play or change of colours from reflected light in certain directions. It is well seen in many various hues on the cleavage-planes of Labrador felspar, and seems produced by a multitude of very thin quadrangular pores, interposed in the mineral-like minute parallel laminæ. On the cleavage-planes of the hypersthene it appears copper-red, and is occasioned by numerous small brown or black laminæ of some foreign substance interposed in a parallel position between the planes of the hypersthene. The chatoyant, or changing colours of the sun-stone, arise from scales of iron glance similarly interposed. The play of colour in the noble opal seems to be produced very nearly in the same manner with that in the labradorite. A similar opalescence is seen in certain minerals when cut in particular forms. In the sapphire, cut hemispherically over the chief axis, it appears like a star with six rays; in certain varieties of chrysoberl and adularia it has a bluish tint; and is also very remarkable in the cat's-eye variety of quartz. Iridescence often arises from very fine fissures, producing semicircular arches of prismatic tints, which, like the colours of thin plates in general, are referred to the interference of light.

Mineralogy.

Lustre and Colour.

Though these properties admit of no precise or mathematical determination, they are of considerable value in mineralogy. One highly important distinction founded on them is that of minerals of metallic and non-metallic aspect or character. This distinction can hardly be described in words, and the student will best learn to distinguish metallic colours and lustre from non-metallic by observing them in nature. Transparency and opacity nearly coincide with this division, the metallic minerals being almost constantly opaque; the non-metallic more or less transparent. Minerals which are perfectly opaque, and show metallic colour and lustre, are named metallic; those with only two of these three properties, semi-metallic or metalloid; and those with the opposite properties non-metallic.

Lustre has reference to the intensity and quality of the reflected light, considered as distinct from colour. Several degrees in intensity have been named. (1.) *Splendent*, when a mineral reflects light so perfectly as to be visible at a great distance, and lively, well-defined images are formed in its faces, as galena, rock-crystal, or calc-spar. (2.) *Shining*, when the reflected light is weak, and only forms indistinct and cloudy images, as heavy spar. (3.) *Glistening*, when the reflected light is so feeble as not to be observable at a greater distance than arm's length, and the surface can no longer form an image. (4.) *Glimmering*, when the mineral held near the eye in full clear daylight presents only a number of small shining points, as red hæmatite and granular limestone. When, as in chalk, the lustre is so feeble as to be indiscernible, it is said to be *dull*.

In regard to the kind or quality of the lustre, the following varieties are distinguished:—(1.) The *metallic*, seen in much perfection in native metals and their compounds with sulphur, and imperfectly in glance coal. (2.) *Adamantine*, found in beautiful perfection in the diamond, and in some varieties of blende and carbonate of lead. (3.) *Vitreous* or glassy, seen in rock-crystal or common glass, or inclining to adamantine in flint-glass. (4.) *Resinous*, when the body appears as if smeared with oil, as in pitchstone and garnet. (5.) *Pearly*, like mother-of-pearl, seen in stilbite, gypsum, mica. (6.) *Silky*, the glimmering lustre seen on fine fibrous aggregates like amianthus.

Colour.—This property is not in all cases of equal value as a character. Thus some minerals are naturally coloured, showing in all modes of their occurrence one determinate colour, which is therefore essential, and forms a characteristic of the species. This class includes the metals, pyrites, blendes, with many metallic oxides and salts. A second class of minerals are colourless, their purest forms being white, or clear like water, as ice, calc-spar, quartz, adularia, and many silicates. But these minerals are occasionally coloured,—that is, accidentally tinged, sometimes from the chemical or mechanical admixture of some colouring substance, as a metallic oxide, carbon, or particles of coloured minerals; at other times from the substitution of

a coloured for an uncoloured isomorphous element. The colours of these minerals therefore vary indefinitely, and can never characterize the species, but only its varieties. Thus, quartz, calc-spar, fluor spar, gypsum, and felspar are often coloured accidentally by pigments mechanically mixed; and hornblende, augite, garnet, and other colourless silicates acquire green, brown, red, or black tints from the introduction of the isomorphic colouring elements.

Werner, who bestowed much attention on this portion of mineralogy, distinguished eight principal colours,—white, gray, black, blue, green, yellow, red, and brown,—each with several varieties or shades arising from intermixture with the other colours. He also divided them into metallic and non-metallic as follows:—

METALLIC COLOURS.

1. *White.*—(1.) Silver-white, as in leucopyrite and native silver. (2.) Tin-white; native antimony.

2. *Gray.*—(1.) Lead-gray; galena or lead glance. (2.) Steel-gray; native platina.

3. *Black.*—(1.) Iron-black; magnetite.

4. *Yellow.*—(1.) Brass-yellow; chalcopyrite. (2.) Bronze-yellow; iron pyrites. (3.) Gold yellow; native gold.

5. *Red.*—(1.) Copper-red; native copper and nickeline.

NON-METALLIC COLOURS.

1. *White.*—(1.) Snow-white; new fallen snow, Carrara marble, and common quartz. (2.) Reddish-white; heavy spar. (3.) Yellowish-white; chalk. (4.) Greyish-white; quartz. (5.) Greenish-white; amianthus. (6.) Milk-white; skimmed milk, chalcedony.

2. *Gray.*—(1.) Bluish-gray; limestone. (2.) Pearl-gray; porcelain jasper, and rarely quartz. (3.) Smoke-gray or brownish-gray; dense smoke, dark varieties of flint. (4.) Greenish-gray; clay-slate and whet-slate. (5.) Yellowish-gray; chalcedony. (6.) Ash-gray; wood-ashes, zoisite, zircon, and slate-clay.

3. *Black.*—(1.) Grayish-black; basalt, Lydian stone, and lucullite. (2.) Velvet-black; obsidian and schorl. (3.) Pitch-black or brownish-black; cobalt ochre, bituminous coal, and some varieties of mica. (4.) Greenish-black or raven-black; hornblende. (5.) Bluish-black; fluor spar.

4. *Blue.*—(1.) Blackish-blue; dark varieties of azurite. (2.) Azure-blue; bright varieties of azurite and Lapis lazuli. (3.) Violet-blue; amethyst and fluor spar. (4.) Lavender-blue; lithomarge and porcelain jasper. (5.) Plum-blue; spinel and fluor spar. (6.) Berlin-blue; sapphire, rock-salt, cyanite. (7.) Smalt-blue; pale-coloured smalt, gypsum. (8.) Duck-blue; talc and corundum. (9.) Indigo-blue; earthy-blue iron or vivianite. (10.) Skye-blue; lirocnite, some varieties of fluor spar and of blue spar.

5. *Green.*—(1.) Verdigris-green; amazon stone and lirocnite. (2.) Celandine-green; green earth, Siberian and Brazilian beryl. (3.) Mountain-green; beryl, aqua-marine topaz. (4.) Leek-green; common actynolite and prase. (5.) Emerald-green; emerald, and some varieties of green malachite. (6.) Apple-green; chrysoprase. (7.) Grass-green; uranite, smaragdite. (8.) Blackish-green; augite and precious serpentine. (9.) Pistachio-green; chrysolite and epidote. (10.) Asparagus-green; the apatite or asparagus-stone from Spain and Salzburg. (11.) Olive-green; garnet, pitch-stone, and olivine. (12.) Oil-green; olive-oil, blende, beryl. (13.) Siskin-green; uranite, and some varieties of pyromorphite.

6. *Yellow.*—(1.) Sulphur-yellow; native sulphur. (2.) Straw-yellow; pycnite and karpholite. (3.) Wax-yellow; opal and wulfenite. (4.) Honey-yellow; dark honey, fluor spar, and beryl. (5.) Lemon-yellow; rind of ripe lemons, orpiment. (6.) Ochre-yellow; yellow-earth and jasper. (7.) Wine-yellow; Saxon and Brazilian topaz and fluor spar. (8.) Cream-yellow or Isabella-yellow; bole from Strigau, and compact limestone. (9.) Orange-yellow, rind of the ripe orange, uran-ochre, and some varieties of wulfenite.

7. *Red.*—(1.) Aurora, or morning-red; realgar. (2.) Hyacinth-red; hyacinth or zircon, and garnet. (3.) Tile-red; fresh-burned bricks, porcelain-jasper, and heulandite. (4.) Scarlet-red; light-red cinnabar. (5.) Blood-red; blood, pyrope. (6.) Flesh-red; felspar and barytes. (7.) Carmine-red; carmine, spinel, particularly in thin splinters. (8.) Cochineal-red; cinnabar and certain garnets. (9.) Crimson-red; oriental ruby and erythrine. (10.) Columbine-red; precious garnet. (11.) Rose-red; diallogite and rose-quartz. (12.) Peach-blossom red; blossoms of the peach, red cobalt-ochre. (13.) Cherry-red; spinel, kermes, and precious garnet. (14.) Brownish-red; reddle and columnar-clay ironstone.

8. *Brown.*—(1.) Reddish-brown; brown blende from the Hartz, and zircon. (2.) Clove-brown; the clove, rock-crystal, and axinite. (3.) Hair-brown; wood-opal and limonite. (4.) Broccoli-brown; zircon. (5.) Chesnut-brown; Egyptian jasper. (6.) Yellowish-brown; iron-flint and jasper. (7.) Pinchbeck-brown; tarnished pinchbeck, mica. (8.) Wood-brown; mountain wood and old rotten wood. (9.) Liver-brown; boiled liver, common jasper. (10.) Blackish-brown; mineral pitch and brown coal.

The accidentally coloured minerals sometimes present two or more colours or tints, even on a single crystal; very remarkable examples occurring in fluor spar, apatite, sapphire, amethyst, tourmaline, and cyanite. This is still more common in compound minerals, on which the colours are variously arranged in points, streaks, clouds, veins, stripes, bands, or in brecciated and ruin-like forms. Some minerals again change their colour from exposure to the light, the air, or damp. Sometimes merely the surface is affected or *tarnished*, and then appears covered as with a thin film, producing in some minerals, as silver, arsenic, bismuth, only one colour; in others, as copper pyrites, hæmatite, stibine, and common coal, various or iridescent hues. Occasionally the change pervades the whole mineral, the colour sometimes becoming paler, or disappearing as in chrysoprase and rose-quartz; at other times darker, as in brown spar, siderite, and rhodonite. In a few minerals a complete change of colour takes place, as in the chlorophæite of the Western Isles, which, on exposure for a few hours, passes from a transparent yellow-green to black. These mutations seem generally connected with some chemical change. The tarnished colours sometimes only appear on certain faces of a crystal belonging to a peculiar form. Thus a crystal of copper pyrites (like fig. 35) has one face P′ free from tarnish; the faces *b* and *c*, close to P′, are dark blue; the remainder of *c*, first violet, and then, close to P, gold-yellow. The colour of the powder formed when a mineral is scratched by a hard body is often different from that of the solid mass. This is named the *streak*, and is very characteristic of many minerals. It also often shows a peculiar lustre where the mineral is soft, as in talc and steatite.

Phosphorescence, Electricity, Magnetism.

Phosphorescence is the property possessed by particular minerals of producing light in certain circumstances without combustion or ignition. Thus some minerals appear luminous when taken into the dark after being for a time exposed to the sun's rays, or even to the ordinary daylight. Many diamonds and calcined barytes exhibit this property in a remarkable degree; less so, arragonite, calc-spar, and chalk; and in a still inferior degree, rock-salt, fibrous gypsum, and fluor spar. Many minerals, including the greater part of those thus rendered phosphorescent by the influence of the sun, also become so through heat. Thus some topazes, diamonds, and varieties of fluor spar become luminous by the heat of the hand; other varieties of fluor spar and the phosphorite require a temperature near that of boiling water; whilst calc-spar and many silicates are only phosphorescent at from 400° to 700° Fahr. Electricity produces it in some minerals, as in green fluor spar and calcined barytes. In others it is excited when they are struck, rubbed, split, or broken; as many varieties of zinc-blende and dolomite when scratched with a quill, pieces of quartz when rubbed on each other, and plates of mica when suddenly separated.

Friction, pressure, and heat also excite *electricity* in minerals. To observe this property delicate electroscopes are required, formed of a light needle, terminating at both ends in small balls, and suspended horizontally on a steel pivot by an agate cup. Such an instrument can be negatively electrified by touching it with a stick of sealing-wax, excited by rubbing, or positively when the wax is only brought so near as to attract the needle. When the instrument is in this state the mineral, if also rendered elec-

tric by heat or friction, will attract or repel the needle according as it has acquired electricity of an opposite or similar kind; but if the mineral is not electric, it will attract the needle in both conditions alike. Most precious stones become electrical from friction, and are either positive or negative according as their surface is smooth or rough. Pressure even between the fingers will excite distinct positive electricity in pieces of transparent double-refracting calc-spar. Topaz, arragonite, fluor spar, carbonate of lead, quartz, and other minerals show this property, but in a much smaller degree.

Heat or change of temperature excites electricity in many crystals, as in tourmaline, calamine, topaz, calc-spar, beryl, barytes, fluor spar, diamond, garnet, and others, which are hence said to be thermo- or pyro-electric. Some acquire polar pyro-electricity, or the two electricities appear in opposite parts of the crystal, which are named its electric poles. Each pole is alternately positive and negative,—the one when the mineral is heating, the other when it is cooling. The poles that become positive during an increase of temperature are named analogue; those that become negative in the same condition, antilogue poles, as shown in this table:—

Temperature.	Produces	Electricity.
+ or rising − or falling	in analogue poles	+ or vitreous. − or resinous.
+ or rising − or falling	in antilogue poles	− or resinous. + or vitreous.

As already noticed, many polar electric minerals are also remarkable for their hemimorphic crystal forms. The number and distribution of the poles likewise vary. In many monoaxial minerals, as tourmaline and calamine, there are only two poles, one at each end of the chief axis; whereas boracite has eight poles corresponding to the angles of the cube. In prehnite and topaz, again, two antilogue poles occur on the obtuse lateral edges of the prism ∞P, and one analogue pole corresponding to the macrodiagonal chief section, or in the middle of the diagonal joining the obtuse edges.

Magnetism, or the power to act on the magnetic needle, is very characteristic of the few minerals in which it occurs, chiefly ores of iron or nickel. It is either simple, attracting both poles of the needle; or polar, when one part attracts, and another repels the same pole. Some magnetic iron ores, or natural magnets, possess polar magnetism; whilst the common varieties, meteoric iron, magnetic pyrites, precious garnet, and other minerals, are simply magnetic. Most minerals are only attracted by the magnet, but do not themselves attract iron.

Smell, taste, and *touch* furnish a few characters of minerals. Most have no smell, but some give out a peculiar odour when rubbed: as quartz an empyreumatic odour, or smell of burning; fluor spar of chlorine; clay of clay; some limestones and marls of bitumen, or a fœtid odour. Aluminous minerals acquire a smell when breathed on. Other odours caused by heat, and often highly characteristic, are noticed under tests by the blow-pipe.

Taste is produced by all the salts soluble in water. Some are saline, like common salt; sweetish astringent, like alum; astringent, like blue vitriol; bitter, like epsom salt; cooling, like saltpetre; pungent, like sal-ammoniac; alkaline, like soda; acid or sour, like sassoline, &c.

Touch.—Some minerals are distinguished by a greasy feeling, like talc; others feel meagre, like clay; others cold. The last character readily distinguishes true gems from their imitations in glass.

CHAP. III.—CHEMICAL PROPERTIES OF MINERALS.

The consideration of the chemical nature of minerals,—that is, of the elements that enter into their composition,—of the manner in which these elements combine, and the variations in proportion which they may undergo without destroying the identity of the species, forms an important branch of mineralogical science. The methods of detecting the different elements, and the characters which are thus furnished for the discrimination of minerals, are also of much value. This is especially true of the metallic ores and other substances, sought not as objects of curiosity, but for their economic qualities.

Composition of Minerals.

At present about sixty elements, or substances which have not been decomposed, are known. These are divided into metallic and non-metallic, a distinction of importance in mineralogy, though not always to be carried out with precision. The non-metallic elements are rarely of semimetallic aspect, and are bad conductors of heat and electricity. Some are commonly gaseous—oxygen, hydrogen, nitrogen, chlorine, and fluorine; one fluid—bromine; the others solid—carbon, phosphorus, sulphur, boron, silenium, and iodine. The metallic elements are, except mercury, solid at usual temperatures, have generally a metallic aspect, and are good conductors of heat and electricity. They are divided into light and heavy metals, the former with a specific gravity under 5, and a great affinity for oxygen, and again distinguished as either alkali-metals, potassium (or kalium), sodium (or natrium), lithium, barium, strontium, and calcium;—or earth-metals, magnesium, lanthanium, yttrium, glucinum, aluminium, zirconium, silicium. The heavy metals, with a specific gravity above 5, are divided into noble, which can be reduced, or separated from oxygen, by heat alone; and ignoble, whose affinity for oxygen renders them irreducible without other agents. Some of the latter are brittle and difficultly fusible,—thorium, titanium, tantalium (columbium), tungsten (wolframium), molybdenum, vanadium, chromium, uranium, manganese, and cerium; others are brittle and easily fusible or volatile—arsenic, antimony, tellurium, and bismuth; and others malleable—zinc, cadmium, tin, lead, iron, cobalt, nickel, and copper. The noble metals are,—quicksilver, silver, gold, platinum, palladium, rhodium, iridium, and osmium.

All the chemical combinations observed in the mineral kingdom follow the law of definite proportions; that is, two elements always combine either in the same proportion, or so that the quantity of the one is multiplied by two, three, four, or some other definite number seldom very large. As the same law prevails throughout the whole range of elements, by assuming any one, usually hydrogen or oxygen, as unity or 1, and determining from experiment the simple proportion in which the others combine with it, a series of numbers is obtained which also expresses the proportions in which all these elements combine with each other. These numbers, therefore, mark the combining proportions or equivalents, as they are named, of the elements. They are also named atomic weights, on the supposition that matter consists of definite atoms, and that its combinations consist of one atom (or sometimes two atoms) of one substance, with one, two, three, or more atoms of another. This theory is not free from difficulties, but the language is often convenient. To designate the elements chemists generally employ the first letter or letters of their Latin names. These signs also indicate one atom or equivalent of the element. Thus, O means oxygen in the proportion of one atom; H, hydrogen in the same proportion; N, an atom of nitrogen; Na, an equivalent proportion of natrium or sodium. These signs and the equivalent weights are given in the following table, in one column of which hydrogen is taken as unity, in the other oxygen. The elements are arranged according to Berzelius, beginning with the most electro-positive, and ending with the most electro-negative.

Mineralogy.

TABLE I.—*Elements arranged in Electro-Chemical order.*

Name.	Sign.	Atomic Weight. H = 1.	Atomic Weight. O = 100.	Name.	Sign.	Atomic Weight. H = 1.	Atomic Weight. O = 100.
Potassium....	K	39·2	488·85	Ruthenium...	Ru	...	...
Sodium........	Na	23·2	290·9	Iridium	Ir	99	1233·26
Lithium......	Li	7	86·9	Platinum	Pt	99	1233·26
Ammonium..	NH^4	17	...	Osmium	Os	99	1244·21
Barium.......	Ba	68·6	856·88	Gold..........	Au	168	*2458·83
Strontium....	Sr	44	547·28	Hydrogen ...	H	1	*12·48
Calcium......	Ca	20	251·5	Silicium......	Si	15	187·5 †
Magnesium..	Mg	12·5	154·5			22·2	277·31 ‡
Yttrium	Y	32	402·51	Carbon	C	6	75·415
Glucinum	G	4·7	58·08 †	Boron	B	11	136·2
Aluminium	Al	13·7	*342·33	Titanium	Ti	25	303·68
Zirconium ...	Zr	22·5	*840·4	Tantalium...	Ta	185	1153·715
Thorium	Th	59·6	744·90	Niobium	Nb	...	...
Cerium.	Ce	46	575	Pelopium I. .	Pp	...	...
Lanthanium	La	36?	...	Wolframium	W	92	1150·78
Didymium...	D	...	...	Molybdenum	Mo	46	575·83
Uranium	U	60	746·36	Vanadium...	V	66·6	855·84
Manganese...	Mn	28	345·89	Chromium ...	Cr	26·3	328·59
Iron	Fe	28	350·53	Tellurium....	Te	64	802·12
Nickel........	Ni	29	362·8	Antimony ...	Sb	122	1529·2
Cobalt	Co	30	375	Arsenic	As	75	*940·08
Zinc...........	Zn	32·2	406·59	Phosphorus ..	P	31	*392·28
Cadmium....	Cd	56	696·76	Nitrogen......	N	14	*175·06
Tin	Sn	59	735·29	Selenium	Se	40	494·58
Lead..........	Pb	104	1294·5	Sulphur	S	16	200·75
Bismuth......	Bi	208	*2600	Oxygen	O	8	100
Copper	Cu	31·7	395·69	Iodine.........	I	126	*1586
Mercury......	Hg	100	1250	Bromine......	Br	78·4	*999·62
Silver	Ag	108	1349·66	Chlorine......	Cl	36	*443·28
Palladium....	Pd	53·3	665·84	Fluorine	F	18·7	*233·80
Rhodium......	Rh	52	651·4				

* Double atoms.
† L. Gmelin, who considers silica as composed of one atom base and two oxygen.
‡ Berzelius.

The above list includes ammonium, usually considered a compound body, and omits the two new metals, erbium and terbium.

All these elements occur in minerals, but not more than twenty are common, and only about twelve abundant. They are also very rare in their simple or uncombined state; only carbon in the diamond and graphite, sulphur, and about a dozen of the native metals, being thus known. More frequently minerals consist of two or more elements combined in accordance with those laws which prevail in inorganic compounds. The most important of these laws is that the combinations are binary; that is, that the elements unite in pairs, which may again unite either with another compound of two, or with a single element. Inorganic compounds also are generally distinguished from organic by their greater simplicity.

The following principles are observed in designating the combinations of these elementary substances:—For those of the first order the signs of the two components are conjoined, and the number of atoms or equivalents of each expressed by a number following the sign like an algebraic exponent. Thus, SO, SO^2, SO^3, are the combinations of one atom sulphur with one, two, and three atoms of oxygen; FeS, FeS^2, of one atom of iron with one or two of sulphur. But as combinations with oxygen and sulphur are very numerous in the mineral kingdom, Berzelius, to whom science is indebted for this system of signs, marks the atoms of oxygen by dots over the sign of the other element, and those of sulphur by an accent; the above compounds being then designated thus—$\dot{S}$, $\ddot{S}$, $\dddot{S}$, and Fe′, Fe″. In some cases two atoms of a base combine with three or five of oxygen or sulphur, as Al^2O^3, Fe^2S^3. In such cases Berzelius marks the double atom by a line drawn through the sign of the single atom; thus, $\dddot{\mathbf{Al}}$ is two atoms aluminium with three of oxygen or alumina; $\dot{\mathbf{Cu}}$, two of copper with one of oxygen or oxide of copper. Where a number is prefixed to the sign like a coefficient in algebra it includes both elements of the combination; thus $\dot{H}$ is one atom water, 2 $\dot{H}$ two; $\dot{Ca}\ddot{C}$ is one atom carbonate of lime, 2 $\dot{Ca}\ddot{C}$ two atoms, including of course two of calcium, two of carbon, and six of oxygen.

The most common and important binary compounds are those with oxygen, contained in the following table, with their signs, atomic numbers, and amount of oxygen in 100 parts. The more electro-negative are named acids, which are often soluble in water, and then render blue vegetable colours red. The more electro-positive are named oxides or bases, and show great affinity or attractive power for the former. The most powerful are the alkaline bases, which are colourless and soluble in water; less powerful are the earths, also colourless, but insoluble in water:—

TABLE II.—*Binary Compounds with Oxygen.*

Name.	Sign.	Atomic Weight. H = 1.	Atomic Weight. O = 100.	Oxyg. in 100 parts.	Name.	Sign.	Atomic Weight. H = 1.	Atomic Weight. O = 100.	Oxyg. in 100 parts.
Alumina	$\dddot{\mathbf{Al}}$	51·4	642·33	46·70	Manganese protoxide	$\dot{Mn}$	36	446·89	22·43
Antimony oxide	$\dddot{\mathbf{Sb}}$	146	1829·2	16·40	... peroxide	$\dddot{\mathbf{Mn}}$	80	991·77	[illegible]
Antimonious acid........	$\ddot{\ddot{Sb}}$	154	1929·2	20·73	... proto-perox. (red)	$\dot{Mn}+\dddot{\mathbf{Mn}}$	116	1437·66	26·34
Antimonic acid..........	$\dddot{\ddot{Sb}}$	162	2029·2	24·64	Molybdic acid	$\dddot{Mo}$	70	875·83	34·28
Arsenious acid	$\dddot{\mathbf{As}}$	99	1240·08	...	Nickel protoxide........	$\dot{Ni}$	37	462·8	21·60
Arsenic acid	$\dddot{\ddot{\mathbf{As}}}$	115	1440·08	34·72	Nitric acid..............	$\dddot{\ddot{N}}$	54	675·06	74·07
Baryta................	$\dot{Ba}$	76·6	956·88	10·45	Phosphoric acid	$\dddot{\ddot{P}}$ or $\dddot{\ddot{\mathbf{P}}}$	71	892·28	56·04
Bismuth peroxide	$\dddot{\mathbf{Bi}}$	232	2900·00	10·34	Potassa................	$\dot{K}$	47·2	588·856	16·98
Boracic acid	$\dddot{B}$	34·8	436·20	68·78	Silica (Gmelin)	$\ddot{Si}$	31	387·5	51·61
Carbonic acid	$\ddot{C}$	22	275·0	72·73	... (Berzelius)	$\dddot{Si}$	46·2	577·31	51·96
Cerium protoxide	$\dot{Ce}$	54	674·72	14·82	Soda	$\dot{Na}$	31·2	390·90	25·58
... peroxide	$\dddot{\mathbf{Ce}}$	116	1449·39	20·70	Strontia	$\dot{Sr}$	52	647·29	15·45
Chromium oxide	$\dddot{\mathbf{Cr}}$	76·6	956·78	31·35	Sulphuric acid..........	$\dddot{S}$	40	500·75	59·91
Chromic acid...........	$\dddot{Cr}$	50·3	628·39	47·74	Tantalic acid	$\dddot{Ta}$	209	2607·43	11·51
Cobalt protoxide	$\dot{Co}$	38	475	21·05	Thorina	$\dot{Th}$	67·6	844·90	13·34
Copper suboxide (red)	$\dot{\mathbf{Cu}}$	71·4	891·39	11·12	Tin peroxide	$\ddot{Sn}$	75	935·29	21·38
... protoxide (black)...	$\dot{Cu}$	39·7	495·69	20·17	Titanic acid............	$\ddot{Ti}$	41	503·68	39·71
Glucina	$\dddot{G}$	[illegible]	490·05	63·26	Tungstic acid	$\dddot{W}$	116	1450·78	20·67
Iron protoxide	$\dot{Fe}$	36	450·527	22·19	Uranium protoxide....	$\dot{U}$	68	842·84	13·33
... peroxide (red)	$\dddot{\mathbf{Fe}}$	80	1001·054	29·97	... peroxide	$\dddot{\mathbf{U}}$	144	1792·72	10·13
... proto-peroxide (black)	$\dot{Fe}+\dddot{\mathbf{Fe}}$	116	1451·581	26·18	Vanadic acid	$\dddot{V}$	92	1165·84	26·19
Lead protoxide..........	$\dot{Pb}$	112	1394·50	7·17	Water	$\dot{H}$	9	112·48	88·89
Lime or Calcia	$\dot{Ca}$	28	351·489	28·45	Yttria	$\dot{Y}$	40	502·51	19·90
Lithia................	$\dot{Li}$	15	186·9	53·50	Zinc oxide	$\dot{Zn}$	40·2	506·59	19·74
Magnesia	$\dot{Mg}$	21	254·50	39·30	Zirconia	$\dot{Zr}-\dddot{\mathbf{Zr}}$	30·4	114·2	26·37

NOTE.—In this table double atoms are indicated by the black letters, or **Al** = Al, **Fe** = Fe, &c.

Similar to the compounds of oxygen are those with sulphur, usually named sulphurets, and considered analogous to the oxidized bases. A few of more electro-negative character, resembling acids, have been distinguished as sulphides. Some other compounds have been named haloid salts, and consist of certain electro-negative elements, combined with electro-positive ones, as bases.

Many of these combinations occur as independent species in the mineral kingdom, especially those with oxygen and sulphur. Thus the most abundant of all minerals, quartz, is an oxide, and corundum is of similar nature. Many oxides of the heavy metals, as of iron, tin, copper, and antimony; and some super-oxides, as of lead and manganese (pyrolusite),—are very common. Compounds with sulphur also abound, and either as sulphides, with the character of acids, like realgar, orpiment, and stibine; or as sulphurets, resembling bases, like galena, argentite, and pyrite. Less frequent are haloid salts, with chlorine and fluorine, as common salt and fluor spar; and still rarer those with iodine and bromine. On the other hand, metallic alloys, or combinations of electro-negative with electro-positive metals, are far from uncommon, especially those with arsenic, tellurium, or antimony.

Combinations of these binary compounds with each other are still more common, the greater number of minerals being composed of an acid and base. By far the greater number are oxygen-salts, distinguished by giving to the acid the termination *ate;* thus sulphate of lead, silicate of lime, and in like manner numerous carbonates, phosphates, arseniates, aluminates. The sulphur-salts (two metals combined with sulphur, and again combined with each other) are next in number, and perform a most important part in the mineral kingdom. The hydrates, or combinations of an oxide with water, are also common, and much resemble the oxygen salts, the water sometimes acting as an electro-positive, at other times as an electro-negative element. Combinations of a higher order are likewise common, especially the double salts, or the union of two salts into a new body; and even these again with water, as alum and many hydrous silicates. The chemical formula for these compound salts are formed by writing the signs of the simple salts with the sign of addition between them: thus $\dot{Ca}\,\ddot{C} + \dot{Mg}\,\ddot{C}$, *i.e.*, carbonate of lime and carbonate of magnesia, or brown spar; $\bar{\dddot{Al}}\,\dddot{Si}^3 + \dot{K}\,\dddot{Si}^3$, or orthoclase; $3\,Na\,F + Al^3\,F^2$, or cryolite, composed of three compound atoms of fluorine and sodium united to one compound atom, consisting of three of fluorine and two of aluminium.

Influence of the Chemical Composition on the External Characters of Minerals.

That the characters of the compound must in some way or other depend on those of its component elements, seems, as a general proposition, to admit of no doubt. Hence it might be supposed possible, from a knowledge of the composition of a mineral, to draw conclusions in reference to its form and other properties; but practically this has not yet been effected. The distinction between the mineralizing and mineralizable, or the forming and formed, elements, lies at the foundation of all such inquiries. Certain elements in a compound apparently exert more than an equal share of influence in determining its physical properties. Thus the more important non-metallic elements, as oxygen, sulphur, chlorine, fluorine, are remarkable for the influence they exert on the character of the compound. The sulphurets, for example, have more similarity among themselves than the various compounds of one and the same metal with the non-metallic bodies. Still more generally it would appear that the electro-negative element in the compound is the most influential, or exerts the greatest degree of active forming power. After the non-metallic elements the brittle, easily fusible metals rank next in power; then the ductile ignoble metals; then the noble metals; then the brittle, difficultly fusible; and last of all, the metals of the earths and alkalies.

It is sometimes stated that each particular substance can crystallize only in one particular form or series of forms. This is, however, only partially true; and sulphur, for instance, which usually crystallizes in the rhombic system, when melted may form monoclinohedric crystals. This property is named *dimorphism;* and hence the same chemical substance may form two, or even more, distinct bodies or mineral species. Thus carbon in one form is the diamond, in another graphite; carbonate of lime appears as calc-spar or arragonite; the bisulphuret of iron as pyrite and marcasite. An example of trimorphism occurs in the titanic acid, forming the three distinct species, anatase, rutile, and brookite. Even the temperature at which a substance crystallizes influences its forms, and so far its composition, as seen in arragonite, Glauber salt, natron, and borax.

Still more important is the doctrine of *isomorphism*, designating the fact that two or more simple or compound substances crystallize in one and the same form; or often in forms which, though not identical, yet approximate very closely. This similarity of form is generally combined with a similarity in other physical properties. Among minerals that crystallize in the tesseral form, isomorphism is of course common and perfect, there being no diversity in the dimensions of the primary form; but for this very reason it is of less interest. It is of more importance among mono-axial crystals, the various series of which are separated from each other by differences in the proportion of the primary form. In these perfect identity is seldom observed, but only very great similarity.

The more important isomorphic substances are the following:—

I. Simple substances:—
- (1.) Fluorine and chlorine.
- (2.) Sulphur and selenium.
- (3.) Arsenic, antimony, tellurium.
- (4.) Cobalt, iron, nickel.
- (5.) Copper, silver, quicksilver, gold (?)

II. Combinations with oxygen:—
- (1.) Of the formula $\dot{R}$.
  - (*a.*) Lime, magnesia, protoxide of iron, protoxide of manganese, oxide of zinc, oxide of nickel, oxide of cobalt, potassa, soda.
  - (*b.*) Lime, baryta, strontia, lead-oxide.
- (2.) Of the formula $\dddot{\bar{R}}$.
  - (*a.*) Alumina, peroxide of iron, peroxide of manganese, oxide of chromium.
  - (*b.*) Antimony oxide, arsenious acid.
- (3.) Formula $\ddot{R}$. Tin-oxide, titanium-oxide.
- (4.) Formula $\overset{\cdot\cdot\cdot\cdot\cdot}{\bar{R}}$. Phosphoric acid, arsenic acid.
- (5.) Formula $\dddot{R}$.
  - (*a.*) Sulphuric acid, selenic acid, chromic acid manganese acid.
  - (*b.*) Tungstic acid, molybdic acid.

III. Combinations with sulphur:—
- (1.) Formula R'. Sulphuret of iron Fe', and sulphuret of zinc Zn'.
- (2.) Formula $\bar{R}'''$. Sulphuret of antimony Sb''', and sulphuret of arsenic $\bar{As}'''$.
- (3.) Formula $\bar{R}'$. Sulphuret of copper $\bar{Cu}$, and sulphuret of silver $\bar{Ag}'$.

These substances are named vicarious, from the singular property that in chemical compounds they can mutually replace each other in indefinite proportions, and very often without producing any important change in the form or other physical properties. But there are numerous instances among the silicates, where the mutual replacement of the

isomorphic bodies, especially when the oxides of the heavy metals come in the room of the earths and alkalies, exerts a most essential influence on the external aspect of the species, particularly in regard to colour, specific gravity, and transparency. The varieties of hornblende, augite, garnet, epidote, and many other minerals, are remarkable proofs of this influence. This intermixture of isomorphic elements confers many valuable properties on minerals, and to it this department of nature owes much of its variety and beauty. Without the occasional presence of the colouring substances, especially the oxides of iron and manganese, the non-metallic combinations would have exhibited a very monotonous aspect. It is also remarkable that in some silicates the substitution of a certain portion of the metallic oxides for the earthy bases seems to be almost a regular occurrence; whilst in others, as the felspars and zeolites, this rarely happens. This fact is often of great economic importance, as drawing attention to important elements often combined with others of less value. Thus iron oxide and chrome oxide, sulphuret of copper and sulphuret of silver, nickel and cobalt, may be looked for in connection. The general chemical formula for such compounds is formed by writing R (= radicle or basis) for the whole isomorphic elements; and in special instances to place their signs either one below the other, connected by a bracket, or, as is more convenient, to inclose them in brackets one after the other, separated by a comma. Thus the general sign for the garnet is $\dot{R}^3\,\ddot{Si}^2 + \overset{\cdots}{\bar{R}}\,\ddot{Si}$, which, when fully expressed, becomes $(\dot{Ca}^3, \dot{Fe}^3, \dot{Mn}^3)\,\ddot{Si}^2 + (\overset{\cdots}{\bar{Al}}, \overset{\cdots}{\bar{Fe}})\,\ddot{Si}$.

Chemical Reaction of Minerals.

The object of the chemical examination of minerals is the discovery of those elementary substances of which they consist. This examination is named *qualitative* when the nature of the elements alone, *quantitative* when also their relative amount, is sought to be determined. Mineralogists are in general content with such an examination as will discover the more important elements, and which can be carried on with a simple apparatus, and small quantities of the substance investigated. The indications thus furnished of the true character of the mineral are, however, frequently of high importance. Two methods of testing minerals are employed, the one by heat chiefly applied through the blowpipe, the second by acids and other reagents in solution.

Use of the Blowpipe.

The blowpipe in its simplest form is merely a conical tube of brass or other metal, curved round at the smaller extremity, and terminating in a minute circular aperture not larger than a fine needle. Other forms have been proposed, one of the most useful being a cone of tin open for the application of the mouth at the smaller end, and with a brass or platina beak projecting from the side near the other or broad end. With this instrument a stream of air is conveyed from the mouth to the flame of a lamp or candle, so that this can be turned aside, concentrated, and directed upon any small object. The flame thus acted on consists of two parts,—the one nearest the beak of the blowpipe forming a blue obscure cone, the other external to this being of a shining yellow or reddish-yellow colour. The blue cone consists of the inflammable gases not yet fully incandescent, and the greatest heat is just beyond its point, where this is fully effected. The blue flame still needs oxygen for its support, and consequently tends to withdraw it from any body placed within its influence, and is named the reducing flame. At the extremity of the yellow cone, on the other hand, the whole gases being consumed, and the external air having free access, bodies are combined with oxygen, and this part is named the oxidating flame. Their action being so distinct, it is of great importance for the student to learn to distinguish accurately these two portions of the flame. This is best done by experimenting on a piece of metallic tin, which can only be kept pure in a good reducing flame, and acquires a white crust when acted on by the oxidating flame.

The portion of the mineral to be examined should not be larger than a peppercorn, or a fine splinter a line or two long. It is supported in the flame either by a pair of fine pincers pointed with platinum, or on slips of platinum-foil, or on charcoal. Platinum is best for the siliceous minerals, whereas for metallic substances charcoal must be employed. For this purpose solid uniform pieces are chosen, and a small cavity formed in the surface in which the mineral to be tested can be deposited.

In examining a mineral by heat, it should be first tested alone, and then with various reagents. When placed alone in a matrass or tube of glass closed at one end, and heated over a spirit lamp, water or other volatile ingredients, mercury, arsenic, tellurium, often sulphur, may readily be detected, being deposited in the cooler part of the tube, or, like fluorine, acting on the glass. It may next be tried in an open tube of glass, through which a more or less strong current of air passes according to the inclination at which the tube is held, so that volatile oxides or acids may be formed; and in this way the chief combinations of sulphur, selenium, tellurium, and arsenic are detected. On charcoal, in the reducing flame, arsenic, and in the oxidating flame, selenium or sulphur, are shown by their peculiar odour; antimony, zinc, lead, and bismuth leave a mark or coloured ring on the charcoal; and other oxides and sulphurets are reduced to the pure metal. On charcoal or in the platinum pincers the fusibility of minerals is tested, and some other phenomena should be observed—as whether they intumesce (bubble up), effervesce, give out fumes, become shining, or impart a colour to the flame. The colour is seen when the assay is heated at the point of the inner flame, and is—

- Reddish-yellow, from soda and its salts;
- Violet, from potash and most of its salts;
- Red, from lithia, strontia, and lime;
- Green, from baryta, phosphoric acid, boracic acid, molybdic acid, copper oxide, and tellurium oxide;
- Blue, from chloride of copper, bromide of copper, selenium, arsenic, antimony, and lead.

The fusibility, or ease with which a mineral is melted, should also be observed; and to render this character more precise, von Kobell has proposed this scale:—(1.) Antimony glance, which melts readily in the mere candle flame; (2.) Natrolite, which in fine needles also melts in the candle flame, and in large pieces readily before the blowpipe; (3.) Almandine (garnet from Zillerthal), which does not melt in the candle flame even in fine splinters, but in large pieces before the blowpipe; (4.) Strahlstein (hornblende from Zillerthal) melts with some difficulty, but still more readily than (5.) Orthoclase (or adularia felspar); and (6.) Bronzite or diallage, of which only the finest fibres can be rounded by the blowpipe. In employing this scale, fine fragments of the test minerals and of that to be tried, and nearly of equal size, should be exposed at the same time to the flame. A more common mode of expressing fusibility is to state whether it is observable in large or small grains, in fine splinters, or only on sharp angles. The result or product of fusion also yields important characters, being sometimes a glass, clear, opaque, or coloured; at other times an enamel, or a mere slag.

The most important reagents for testing minerals with the blowpipe are the following:—(1.) Soda (the carbonate), acting as a flux for quartz and many silicates, and especially for reducing the metallic oxides. For the latter purpose, the assay (or mineral to be tried) is reduced to powder, kneaded up with moist soda into a small ball, and placed in

a cavity of the charcoal. Very often both the soda and assay sink into the charcoal, but by continuing the operation they either again appear on the surface, or, when it is completed, the charcoal containing the mass is finely pounded and washed away with water, when the reduced metal is found in the bottom of the vessel. (2.) Borax (biborate of soda) serves as a flux for many minerals, which are best fused in small splinters on platina wire. The borax when first exposed to the flame swells up or intumesces greatly, and it should therefore be first melted into a small bead, in which the assay is placed. During the process the student should observe whether the assay melts easily or difficultly, with or without effervescence, what colour it imparts to the product both when warm and when cold, and also the effect both of the oxidating and reducing flames. (3.) Microcosmic salt, or salt of phosphorus (phosphate of soda and ammonia) is specially important as a test for metallic oxides, which exhibit far more decided colours with it than with borax. It is also a useful reagent for many silicates, whose silica is separated from the base and remains undissolved in the melted salt. (4.) Solution of cobalt (nitrate of cobalt dissolved in water), or dry oxalate of cobalt, serve as tests of alumina, magnesia, and zinc oxide.

In examining minerals in the moist way, the first point to be considered is their solubility, of which three degrees may be noted: (1) minerals soluble in water; (2) minerals soluble in hydrochloric or nitric acid; and (3) those unaffected by any of these fluids. The minerals soluble in water are either acids (almost only the boracic acid or sassolin and the arsenious acid), or oxygen or haloid salts. These are easily tested, one part of the solution being employed to find the electro-positive element or basis, the other the electro-negative or acid.

Minerals insoluble in water may next be tested with the above acids; the nitric acid being preferable when it is probable, from the aspect of the mineral or its conduct before the blowpipe, that it contains an alloy, a sulphuret, or arseniate of some metal. In this manner the carbonic, phosphoric, arsenic, and chromic acid salts, many hydrous and anhydrous silicates, many sulphurets, arseniates, and other metallic compounds, are dissolved, so that further tests may be employed.

The minerals insoluble either in water or these acids are sulphur, graphite, cinnabar, some metallic oxides, some sulphates, and compounds with chlorine and fluorine, and especially quartz, and various silicates. For many of these no test is required, or those furnished by the blowpipe are sufficient. The silicates and others may be fused with four times their weight of anhydrous carbonate of soda when they are rendered soluble, so that further tests may be applied.

Chemical Reaction of the more Important Elements.

It is not intended in this place to describe the chemical nature of the elementary substances, and still less to enumerate the whole of those marks by which the chemist can detect their presence. Our object is limited principally to the conduct of minerals before the blowpipe, and to a few simple tests by which their more important constituents may be discovered by the student.

I.—NON-METALLIC ELEMENTS, AND THEIR COMBINATIONS WITH OXYGEN.

Nitric Acid.—Most of its salts detonate when heated on charcoal. In the closed tube they form nitrous acid, easily known by its orange colour and smell; a test more clearly exhibited when the salt is mixed with copper filings and treated with concentrated sulphuric acid. When to the solution of a nitrate, a fourth part of sulphuric acid is added, and a fragment of green vitriol placed in it, the surrounding fluid becomes of a dark brown colour.

Sulphur and its compounds, in the glass tube or on charcoal, form sulphurous acid, easily known by its smell. The minutest amount of sulphur or sulphuric acid may be detected by melting the pulverized assay with two parts soda and one part borax, and placing the bead moistened with water on a plate of clean silver, which is then stained brown or black. Solutions of sulphuric acid give with chloride of barium a heavy white precipitate, insoluble in acids.

Phosphoric Acid.—Most combinations with this acid tinge the blowpipe flame green, especially if previously moistened with sulphuric acid. The experiment must be performed in the dark, when even three per cent. of the acid may be detected. If the assay is melted with six parts of soda, digested in water, filtered, and neutralized with acetic acid, the solution forms an orange-yellow layer round a crystal of nitrate of silver. This solution, with muriate of magnesia, forms a white crystalline precipitate.

Selenium and *Selenic Acid* are readily detected by the strong smell of decayed horse-radish, and leave a gray deposit with a metallic lustre on the charcoal.

Chlorine and its salts. When oxide of copper is melted with salt of phosphorus into a very dark-green bead, and an assay containing chlorine fused with this, the flame is tinged of a beautiful reddish blue colour, till all the chlorine is driven off. If very little chlorine is present, the assay is dissolved in nitric acid (if not soluble it must first be melted with soda on platinum wire), and the diluted solution gives, with nitrate of silver, a precipitate of chloride of silver, which is first white, but on exposure to the light becomes gradually brown, and at length black.

Iodine and its salts, treated like chlorine, impart a very beautiful bright-green colour to the flame; and heated in the closed tube with sulphate of potash, yield violet-coloured vapours. In solution it gives, with nitrate of silver, a precipitate similar to chlorine, but which is very difficultly soluble in ammonia. Its surest test is the blue colour it imparts to starch, best seen by pouring concentrated sulphuric acid over the mineral in a test tube which has a piece of paper or cotton covered with moist starch over its mouth.

Bromine and its salts, treated in the same manner with salt of phosphorus and oxide of copper, colour the blowpipe flame greenish-blue. In the closed tube with nitrate of potassa they yield bromine vapours, known by their yellow colour and peculiar disagreeable smell. Treated with sulphuric acid, bromine in a few hours colours starch pomegranate-yellow.

Fluorine is shown by heating the assay with sulphate of potassa, in a closed tube with a strip of logwood paper in the open end. The paper becomes straw-yellow, and the glass is corroded. Another test is to heat the pulverized mineral with concentrated sulphuric acid in a shallow dish of platinum (or lead), over which a plate of glass covered with a coat of wax, through which lines have been drawn with a piece of sharp-pointed wood, is placed. If fluorine is present the glass is etched where exposed.

Boracic Acid.—The mineral alone, or moistened with sulphuric acid when melting, colours the flame momentarily green. If the assay be heated with sulphuric acid, and alcohol added, and set on fire, the flame is coloured green from the vapours of the boracic acid.

Carbon, pulverized and heated with saltpetre, detonates, leaving carbonate of potassa. Carbonic acid is not easily discovered with the blowpipe, but the minerals containing it effervesce in hydrochloric acid, and the colourless gas that escapes renders litmus paper red. In solution it forms a precipitate with lime-water, with is again dissolved with effervescence in acids.

Silica, before the blowpipe, alone is unchanged; is very

slowly acted on by borax, very little by salt of phosphorus, but with soda melts entirely with a brisk effervescence into a clear glass. The silicates are decomposed by salt of phosphorus, the silica being left in the bead as a powder or a skeleton. Most of them melt with soda to a transparent glass. Some silicates are dissolved in hydrochloric acid, and this the more readily the more powerful the basis, the less proportion of silica, and the greater the amount of water they contain. Sometimes the acid only extracts the basis, leaving the silica as a powder or jelly; or the silica too is dissolved, and only gelatinizes on evaporation. The insoluble silicates may be first melted with some carbonate of an alkali, when the solution gelatinizes, and finally leaves a dry residuum of which the part insoluble in warm hydrochloric acid has all the properties of silica.

II.—THE ALKALIES AND EARTHS.

Ammonia, heated with soda in a closed tube, is readily known by its smell. Its salts, heated with solution of potassa, also yield the vapour, known from its smell, its action on turmeric paper, and the white fumes that rise from a glass tube tipped in hydrochloric acid held over it.

Soda imparts a reddish-yellow colour to the external flame when the assay is fused or kept at a strong red heat. In solution it yields no precipitate with chloride of platinum or sulphate of alumina.

Lithia is best recognised by the beautiful carmine-red colour it imparts to the flame during the fusion of a mineral containing it in considerable amount. Where the proportion is small, the colour appears if the assay be mixed with 1 part fluor spar and 1½ parts sulphate of potassa. In concentrated solutions it forms a precipitate with the phosphate and carbonate of soda, but none with bichloride of platinum, sulphate of alumina, or acetic acid.

Potassa gives a violet colour to the external cone, when the assay is heated at the extremity of the oxidating flame. The presence of lithia or soda, however, disturbs this reaction. It may still be discovered by melting the assay in borax glass coloured brown by nickel oxide, which is changed to blue by the potassa. In concentrated solutions of potassa the bichloride of platinum gives a citron-yellow precipitate; acetic acid a white, granular precipitate; and sulphate of alumina, after some time, a deposit of alum-crystals.

Baryta.—The carbonate of this earth melts easily to a clear glass, milk-white when cold; the sulphate is very difficultly fusible. Both strongly heated at the point of the blue flame impart a green tinge to the outer flame. When combined with silica it cannot be well discovered by the blowpipe. In solution, salts of baryta yield, with sulphuric acid or solution of sulphate of lime, *immediately* a fine white precipitate insoluble in acids or alkalies.

Strontia, the carbonate, even in thin plates, only melts on the edges, and forms cauliflower-like projections of dazzling brightness; the sulphate melts easily in the oxidating flame, and in the reducing flame is changed into sulphuret of strontium, which, dissolved in hydrochloric acid, and evaporated to dryness, gives a fine carmine-red colour to the flame of alcohol. Strontia in solution gives a precipitate with sulphuric acid, or with sulphate of lime, but not *immediately*.

Lime.—The carbonate is rendered caustic by heat, when it has alkaline properties, and readily absorbs water. The sulphate in the reducing flame changes to the sulphuret of calcium, which is also alkaline. Sulphuric acid precipitates lime only from very concentrated solutions; oxalic acid even from very weak ones; and silico-hydrofluoric acid not at all. As baryta and strontia also form precipitates with the first two reagents, they must previously be separated by sulphate of potassa. Chloride of calcium tinges the flame of alcohol yellowish-red.

Magnesia, alone, or as a hydrate, a carbonate, and in some other combinations, when ignited with solution of cobalt, or the oxalate of cobalt, assumes a light-red tint. It is not precipitated from a solution either by sulphuric acid, oxalic acid, or silico-hydrofluoric acid; but phosphoric acid, with ammonia, throws down a white crystalline precipitate of phosphate of ammonia and magnesia.

Alumina alone is infusible. In many combinations, when ignited with solution of cobalt, it assumes a fine blue colour. It is thrown down by potassa or soda as a white voluminous precipitate, which in excess of the alkali is easily and completely soluble, but is again precipitated by muriate of ammonia. Carbonate of ammonia also produces a precipitate which is not soluble in excess.

Glucina, *Yttria*, *Zirconia*, and *Thorina* are not properly distinguished by blowpipe tests, though the minerals in which they occur are well marked in this way. In solution glucina acts with potassa like alumina; but the precipitate with carbonate of ammonia is again soluble, with excess of the alkali, and the two earths may thus be separated. Yttria is precipitated by potassa, but is not again dissolved by excess of the alkali. With carbonate of ammonia it acts like glucina. It must be observed, however, that the substance formerly named yttria is now considered a mixture of this earth with the oxides of erbium, terbium, and lanthanium. Zirconia acts with potassa like yttria, and with carbonate of ammonia like glucina. Concentrated sulphate of potassa throws down a double salt of zirconia and potassa, which is very little soluble in pure water.

III.—THE METALS.

Arsenic and its sulphuret on charcoal yield fumes, with a smell like garlic, and sublime in the closed tube. The greater number of alloys of arsenic in the reducing flame leave a white deposit on the charcoal; or where it is in larger proportion, give out grayish-white fumes with a smell of garlic. Some alloys also yield metallic arsenic in the closed tube. In the open tube all of them yield arsenious acid, and those containing sulphur also sulphurous fumes. Many arsenic acid salts emit evident odours of arsenic when heated on charcoal with soda; and some sublime metallic arsenic when heated with pulverized charcoal in the closed tube.

Antimony melts easily on charcoal, emiting dense white fumes, and leaving a ring of white crystalline oxide on the support. In the closed tube it does not sublime, but burns in the open tube with white smoke, leaving a sublimate on the glass, which is easily driven from place to place by heat. Most of its compounds, with sulphur or with the other metals, show similar reaction. Antimony oxide on charcoal melts easily, fumes, and is reduced, colouring the flame pale greenish-blue.

Bismuth melts easily, fumes, and leaves a yellow oxide on the charcoal. In the closed tube it does not sublime, and in the open tube scarcely fumes, but is surrounded by the fused oxide, dark-brown when warm, and bright-yellow when cold. Its oxides are easily reduced. A great addition of water produces a white precipitate from its solution in nitric acid.

Tellurium fumes on charcoal, and becomes surrounded by a white mark with a reddish border, which, when the reducing flame is turned on it, disappears with a bluish-green light. In the closed tube tellurium gives a sublimate of the gray metal; and in the open tube produces copious fumes, and a white powder which can be melted into small clear drops.

Mercury in all its combinations is volatile, and yields a

metallic sublimate when heated alone, or with tin or soda in the closed tube.

Zinc, when heated with soda on charcoal, forms a deposit, which, when warm, is yellow; when cold, white; is tinged of a fine green by solution of cobalt, and is not further volatile in the oxidating flame. In solution zinc is precipitated by potassa as a white gelatinous hydrate, easily redissolved in the excess of the alkali.

Tin forms a white deposit on the charcoal behind the assay, which takes a bluish-green colour with the solution of cobalt. The oxide is easily reduced by soda.

Lead forms a sulphur-yellow deposit with a white border on the charcoal when heated in the oxidating flame, and with soda is easily reduced. The solutions of its salts are colourless, but give a black precipitate with sulphuretted hydrogen; with sulphuric acid a white, and with chromate of potassa a yellow, precipitate.

Cadmium produces, with soda, a reddish-brown or orange-yellow ring, with iridescent border on the charcoal, and also on platinum-foil.

Manganese alone, melted with borax or salt of phosphorus on the platinum wire in the oxidating flame, forms a fine amethystine glass, which becomes colourless in the reducing flame. In combination with other metals, the pulverized assay mixed with two or three times as much soda, and melted in the oxidating flame on platinum-foil, forms a bluish-green glass. Potassa or ammonia throws down from solutions of its salts a white hydrate, which in the air becomes gradually dark-brown.

Cobalt, melted with borax in the oxidating flame, gives a beautiful blue glass. Minerals of metallic aspect must be first roasted on charcoal. The salts of protoxide of cobalt form bright-red solutions, from which potassa throws down a blue flaky hydrate, which becomes olive-green in the air.

Nickel, the assay, first roasted in the open tube and on charcoal, produces in the oxidating flame, with borax, a glass, which hot, is reddish or violet-brown; when cold, yellowish or dark red; and by the addition of saltpetre changes to blue. In the reducing flame the glass appears gray. With salt of phosphorus the reaction is similar, but the glass is almost colourless when cold. The salts in solution have a bright-green colour, and with potassa form a green precipitate of hydrated nickel-oxide, which is unchanged in the air.

Copper may in most cases be discovered by melting the assay (if apparently metallic, first roasted) with borax or salt of phosphorus in the oxidating flame, when an opaque reddish-brown glass is produced, a small addition of tin aiding in the result. In the reducing flame the glass, when warm, is green; when cold, blue. With soda metallic copper is produced. A small proportion of copper may often be detected by heating the assay, moistened with hydrochloric acid, in the oxidating flame, which is then tinged of a beautiful green colour. Solutions of its salts are blue or green, and produce a brownish-black precipitate, with sulphuretted hydrogen. Ammonia at first throws down a pale-green or blue precipitate, but in excess produces a very fine blue colour.

Silver in the metallic state is at once known, and from many combinations can be readily extracted on charcoal with soda. From its solution in nitric acid silver is thrown down by hydrochloric acid as a white chloride, which in the light soon becomes black, is soluble in ammonia, and can again be precipitated from this solution by nitric acid as chloride of silver.

Gold, when pure, is readily known, and is easily separated from its combinations with tellurium on charcoal. If the grain is white, it contains more silver than gold, and must then be heated in a porcelain capsule with nitric acid, which gives it a black colour, and gradually removes the silver, if the gold is only a fourth part or less. If the proportion of gold is greater, the nitro-chloric acid must be used, which then removes the gold. From its solution in this acid the protochloride of tin throws down a purple precipitate *(purple of Cassius)*, and the sulphate of iron, metallic gold.

Platinum, and the metals usually found with it, cannot be separated from each other by heat. Only the *Osmium-iridium* strongly heated in the closed tube with saltpetre is decomposed, forming osmium acid, known from its peculiar pungent odour. The usual mixture of platinum grains is soluble in nitro-chloric acid, leaving osmium-iridium. From this solution the *platinum* is thrown down by sal-ammonia as a double chloride of platinum and ammonium. From the solution evaporated, and again diluted, with cyanide of mercury, the *palladium* separates as cyanide of palladium. The *rhodium* may be separated by its property of combining with fused bisulphate of potassa, which is not the case with platinum or iridium.

Cerium, when no iron-oxide is present, produces, with borax and salt of phosphorus, in the oxidating flame, a red or dark-yellow glass, which becomes very pale when cold, and colourless in the reducing flame. *Lanthanium* oxide forms a white colourless glass; *didymium* a dark amethystine glass.

Iron, the peroxide and hydrated peroxide, become black and magnetic before the blowpipe, and form, with borax or salt of phosphorus, in the oxidating flame, a dark-red glass, becoming bright-yellow when cold; and in the reducing flame, especially on adding tin, an olive-green or mountain-green glass. The peroxide colours a bead of borax containing copper oxide bluish-green; the protoxide produces red spots. Salts of protoxide of iron form a green solution, from which potassa or ammonia throws down the protoxide as a hydrate, which is first white, then dirty-green, and finally yellowish-brown. Carbonate of lime produces no precipitate. The salts of the peroxide, on the other hand, form yellow solutions from which the peroxide is thrown down by potassa or ammonia as a flaky-brown hydrate. Carbonate of lime also causes a precipitate.

Chromium forms, with borax or salt of phosphorus, a glass, fine emerald-green when cold, though when hot often yellowish or reddish. Its solutions are usually green, and the metal is thrown down by potassa as a bluish-green hydrate, again dissolved in excess of the alkali. The chrome in many minerals is very certainly discovered by melting the assay with three times its bulk of saltpetre, which, dissolved in water, gives with acetate of lead a yellow precipitate.

Vanadium, melted on platinum wire with borax or salt of phosphorus, gives a fine green glass in the reducing flame, which becomes yellow or brown in the oxidating flame, distinguishing it from chrome.

Uranium, with salt of phosphorus, forms in the oxidating flame a clear yellow; in the reducing flame a fine green glass. With borax its reaction is similar to that of iron.

Molybdenum forms in the reducing flame, with salt of phosphorus, a green; with borax, a brown glass.

Tungsten or *Wolfram* forms, with salt of phosphorus, in the oxidating flame, a colourless or yellow, in the reducing flame, a very beautiful blue glass, which appears green when warm. When accompanied by iron the glass is blood-red, not blue. Or melt the assay with five times as much soda in a platinum spoon, dissolve it in water, filter, and decompose the result with hydrochloric acid, which throws down the tungstic acid, which is white when cold, but citron-yellow when heated.

Tantalium, as tantalic acid, is readily dissolved by salt of phosphorus, and in large quantity into a colourless glass, which does *not* become opaque in cooling, and does *not* acquire a blue colour from solution of cobalt. Or fuse the assay with two times as much saltpetre, and three times as

much soda, in a platinum spoon; dissolve this, filter, and decompose the fluid by hydrochloric acid: the tantalic acid separates as a white powder, which does *not* become yellow when heated.

Titanium in anatase, rutile, brookite, and titanite, is shown by the assay forming, with salt of phosphorus, in the oxidating flame, a glass which is and remains colourless; in the reducing flame, a glass which appears yellow when hot, and whilst cooling passes through red into a beautiful violet. When iron is present, however, the glass is blood-red, but is changed to violet by adding tin. When titanate of iron is dissolved in hydrochloric acid, and the solution boiled with a little tin, it acquires a violet colour from the oxide of titanium. Heated with concentrated sulphuric acid, the titanate of iron produces a blue colour.

Chap. IV.—CLASSIFICATION OF MINERALS.

A mineral species was formerly defined as a natural inorganic body, possessing a definite chemical composition and peculiar external form. The account given of these properties shows that the form of a mineral species comprehends not only the primary or fundamental figure, but all those that may be derived from it by the laws of crystallography. Irregularities of form arising from accidental causes, or that absence of form which results from the limited space in which the mineral has been produced, do not destroy the identity of the species. Even amorphous masses, when the chemical composition remains unaltered, are properly classed under the same species, as the perfect crystal.

The definite chemical composition of mineral species must be taken with equal latitude. Pure substances, such as they are described in works on chemistry, are very rare in the mineral kingdom. In the most transparent quartz crystals traces of alumina and iron oxide can be detected; the purest spinel contains a small amount of silica, and the most brilliant diamond, consumed by the solar rays, leaves some ash behind. Such non-essential mixtures must be neglected, or each individual crystal would form a distinct mineral species. The isomorphous elements introduce a wider range of varieties, and render the limitation of species more difficult. Carbonate of lime, for instance, becomes mixed with carbonate of magnesia or of iron in almost innumerable proportions; and the latter substances also with the former. Where these mixtures are small in amount, variable in different specimens, and do not greatly affect the form or physical characters of the predominant element, they may safely be neglected, and the mineral reckoned to that species with which it most closely agrees. Where, however, the mixture is greater, and the two substances are frequently found in definite chemical proportions, these compounds must be considered as distinct species, especially should they also show differences in form and other external characters.

Amorphous minerals with definite composition must also be considered as true species. But when they show no definite composition, as in many substances classed as clays and ochres, they cannot be accounted true mineral species, and properly ought not to be included in a treatise on mineralogy. Some of them, however, from their importance in the arts, others from other circumstances, have received distinct names and a kind of prescriptive right to a place in mineralogical works, from which they can now scarcely be banished. Many of them are properly rocks, or indefinite combinations of two or more minerals; others are the mere products of the decomposition of such bodies. Their number is of course indefinite, and their introduction tends much to render mineralogy more complex and difficult, and to destroy its scientific character.

In collecting the species into higher groups, and arranging them in a system, several methods have been pursued. Some, like Mohs, have looked only at the external characters, and asserted that they alone were sufficient for all the purposes of arranging and classifying minerals. Others, led by Berzelius, have, on the contrary, taken chemistry as the foundation of mineralogy, and classed the species by their composition, without reference to form or physical characters.

Neither system can be exclusively adopted, and a natural classification of minerals should take into account all their characters, and that in proportion to their relative importance. Among these the chemical composition undoubtedly holds a high rank, as being that on which the other properties will probably be ultimately found to depend. Next in order is their crystalline form, especially as exhibited in cleavage; and then their other characters of gravity, hardness, and tenacity. But the properties of minerals are as yet far from showing that subordination and co-relation which has been observed in the organic world, where the external forms and structures have a direct reference to the functions of the living being. Hence even when all the characters are taken into account, there is not that facility in classifying the mineral that is presented by the other kingdoms of nature. Many, or rather most, of the species stand so isolated that it is scarcely possible to find any general principle on which to collect them into larger groups, especially such groups as, like the natural families of plants and animals, present important features of general resemblance, and admit of being described by common characteristics. Certain groups of species are indeed united by such evident characters, that they are found together in almost every method; but other species are not thus united, and the general order of arrangement is very uncertain. Hence, though some classifications of very considerable merit have been proposed, no natural system of minerals commanding general assent has yet appeared.

The arrangement followed in this treatise is chiefly founded on that proposed by Professor Weiss of Berlin. We have, however, made considerable changes, which the progress of the science and the more accurate knowledge of many species require. This classification appears to us to come nearer than any other we have seen to a natural system, which in arranging and combining objects takes account of all their characters, and assigns them their place, from a due consideration of their whole nature, and is thus distinguished from artificial systems, which classify objects with reference only to one character.

Besides species, two higher grades in classification seem sufficient at once to exhibit the natural relations, and to facilitate an easy and complete review of the species composing the mineral kingdom. These are families and orders. In forming the families those minerals are first selected which occupy the more important place in the composition of rocks, and consequently in the crust of the globe. Thus quartz, felspar, mica, hornblende, garnet, among siliceous minerals; calc-spar, gypsum, rock-salt, less so fluor spar and heavy spar, among those of saline composition, stand out prominently as the natural centres or representatives of so many distinct families. To these certain metallic minerals, as iron pyrites, lead-glance or galena, blende, magnetic iron ore, the sparry iron ore, and a few more, are readily associated as important families. But the minerals thus geologically distinguished are not sufficient to divide the whole mineral kingdom into convenient sections, and additional groups must be selected from the peculiarity of their natural-historical or chemical properties. Thus the zeolites are easily seen to form such a natural group. The precious stones or gems also, notwithstanding their diverse chemical composition, must ever appear a highly natural

family, when regarded as individual objects. Their great hardness, tenacity, high specific gravity without the metallic aspect, their brilliant lustre, transparent purity, and vivid colours,—all mark them out as a peculiar group. Only the diamond, which might naturally seem to take the chief place in this class, differs so much, not only in elementary composition, but in physical properties, that it must be assigned to a diverse place.

Round these species thus selected the other less important minerals are arranged in groups or families. It is evident that no precise definition of these families can be given, as the connection is one of resemblance in many points, not of identity in any single character. In other words, it is a classification rather according to types than from definitions, as every true natural classification must be. The same cause, however, leaves the extent of the families somewhat undefined, and also permits considerable license in the arrangement of species. But both circumstances are rather of advantage in the present state of the science, as allowing more freedom in the grouping of species than could be obtained in a more rigid system of classification.

In collecting the families into orders, the guidance of chemistry is followed rather than of natural history, though the latter is also taken into consideration. Chemical names are assigned to the orders, but still regarded *as names* derived from the prevailing chemical characters, and *not as definitions.* Hence it must not be considered an error should two or three mineral species be found in an order with whose name, viewed as a definition, they may not agree.

Guided by these, and similar considerations, minerals may be divided into the following orders and families:—

Order I.—The Oxidized Stones.

Families :—1. Quartz. 8. Serpentine.
2. Felspar. 9. Hornblende.
3. Scapolite. 10. Clays.
4. Haloid stones. 11. Garnet.
5. Leucite. 12. Gems.
6. Zeolite. 13. Metallic stones.
7. Mica.

Order II.—Saline Stones.

Families :—1. Calc spar. 4. Gypsum.
2. Fluor spar. 5. Rock salt.
3. Heavy spar.

Order III.—Saline Ores.

Families :—1. Sparry iron ores. 3. Copper salts.
2. Iron salts. 4. Lead salts.

Order IV.—Oxidized Ores.

Families :—1. Iron ores. 4. Red copper ores.
2. Tinstone. 5. White antimony ores.
3. Manganese ores.

Order V.—Native Metals.

Form only one family.

Order VI.—Sulphuretted Metals.

Families :—1. Iron pyrites. 4. Gray copper ore.
2. Galena. 5. Blende.
3. Gray antimony ore. 6. Ruby-blende.

Order VII.—The Inflammables.

Families :—1. Sulphur. 4. Mineral resins.
2. Diamond. 5. Combustible salts.
3. Coal.

In describing the species we have followed this general plan. First, that name which it seems most expedient to adopt is given, with the principal synonyms, followed in the same line by the probable chemical formula. In these, silica is commonly assumed as $\dddot{\mathrm{Si}}$; but we have given also the formula with $\dddot{\mathrm{Si}}$ for the more important species. In the descriptions the system of crystallization is noted, and the mineral more precisely characterized, by enumerating some of its more common forms and combinations with their characteristic angles. The physical characters of the species, its state of aggregation, cleavage, fracture, hardness (H.), and specific gravity (G.), follow; then its lustre, pellucidity, colour, and any other marked peculiarities. Next come its chemical characters, or its conduct before the blowpipe (B.B.), and the effect of acids, specially the hydrochloric (*h.*), nitric (*n.*), and sulphuric (*s.*). The chemical composition, or the amount of the different elements in 100 parts, generally deduced from the formula, but with notices of the more important variations indicated by the best analyses either from the substitution of isomorphous elements or other substances, are then noted. The principal localities where each species occurs, especially in our own country, with certain miscellaneous particulars, conclude the description.

We have also given similar characters of the orders and families, so far as this was possible. These, of course, apply chiefly to the more important and better marked or typical species (indicated by one or two asterisks [* or * *] prefixed to the name), but in many points are also descriptive of the others. The possibility of forming such general characters is the best proof that the groups are so far natural, and that the object of a scientific classification has been partially at least attained.

PART II.—DESCRIPTION OF MINERAL SPECIES.

Order I.—THE OXIDIZED STONES.

The minerals contained in this order are either simple oxides, or compounds of oxides. Oxides of the true metals are not abundant, and occur generally as isomorphous with, or replacing, the earths and alkalies which compose the greater number. They have all a stony character, non-metallic lustre and colours, and are often white and more or less translucent, except the family of the Metallic Stones, which forms a transition group to the following order.

** Family I.—Quartz.

Contains only one true species, and hence no general characteristic. Quartz is the true type or representative of the mineral kingdom.

**1.—Quartz.—$\dddot{\mathrm{Si}}$, *or* $\bar{\ddot{\mathrm{Si}}}$.

Hexagonal; the purest varieties tetartohedral. The primary pyramid P has the middle edge $= 103° 34'$, and the polar edges $= 133° 44'$, and is often perfect. Very frequently it appears as a rhombohedron R (or $\frac{1}{2}$ P), with polar edges $= 94° 15'$. Crystals often of $\infty P . P$; $\infty P . P . 4P$, the forms ∞P and $4P$ being combined in an oscillatory manner, producing striæ on the face of the prism; $\infty P . P . \frac{1}{4}(2P2)$ (fig. 101), the last face appearing as a rhomb replacing the angles between the two other forms. They are prismatic, or pyramidal, or rhombohedric when P is divided into R and $-$R; the latter very often wanting.

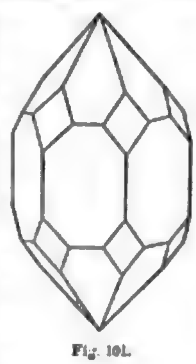


Fig. 101.

Twins or macles common, with parallel axes, and either merely in juxtaposition (see fig. 80), or interpenetrating. The crystals occur either single, attached, or imbedded, or in groups and druses. Most frequently granular, massive, fibrous, or columnar; also in pseudomorphs, petrifactions, and other forms. Cleavage, rhombohedric along R very imperfect; prismatic along ∞P still more imperfect. Fracture conchoidal, uneven, or splintery. H = 7; G = 2·5...2·8, or 2·65 in the purest varieties. Colourless, but more often white, gray, yellow, brown, red, blue, green, or even black. Lustre vitreous, inclining to resinous; transparent or translucent, sometimes almost opaque. B.B. infusible alone; with soda effervesces and melts into a clear glass; insoluble in acids, except the fluoric; when pulverized, slightly soluble in solution of potash. Chem. com. 48·04 silicium and 51·96 oxygen, but frequently a small amount of the oxides of iron or titanium, of lime, alumina, and other substances.

Varieties are,—*Rock-crystal*, highly transparent and colourless; Dauphiné, Switzerland, Tyrol, Hungary, Madagascar, and Ceylon. *Amethyst*, violet-blue (from iron peroxide or manganese), and often marked by zig-zag or undulating lines, and the colour disposed in clouds; Siberia, Persia, India, Ceylon, Brazil (white or yellow named topaz), Hungary, Siebenburg, Ireland, near Cork, and Aberdeenshire. Wine yellow, or *citrin* and *gold topaz;* the brown or *smoky quartz;* and the black or *morion;* Siberia, Bohemia, Pennsylvania, and other places. *Cairngorm stone*, brown or yellow; Aberdeenshire mountains. The above are valued as ornamental stones; less so:—

Rose-quartz, red inclining to violet-blue; Ben Macdhui, and Rabenstein in Bavaria. *Milk-quartz*, milk-white and slightly opalescent; Greenland. *Prase*, leek, and other shades of green; Saxony and Cedar Mountain in South Africa. *Cat's-eye*, greenish-white or gray, olive-green, red, brown, or yellow; Ceylon and Malabar. *Avanturine*, yellow, red, or brown; India, Spain, and Scotland. *Siderite*, indigo or Berlin blue; Golling in Salzburg.

Common quartz, crystallized or massive, white or gray, also red, brown, &c., is a frequent constituent in many rocks. Some varieties are so impure as to be properly rocks, as—

(1.) *Ferruginous quartz*, or iron-flint, red, yellow, or brown, often associated with iron ores.

(2.) *Jasper*, red, yellow, or brown, but also green, gray, white, and black alone, or in spots, veins, and bands (*Ribbon* or *Egyptian jasper*); the Ural, Tuscan Apennines, the Harz, and many parts of Scotland.

(3.) *Lydian stone*, or *flinty slate*, black, gray, or white; has a splintery or conchoidal fracture, breaks into irregular fragments, and passes by many transitions into clay slate, of which it is often merely an altered portion, as in Scotland; used as a touchstone for gold, and at Elfdal manufactured into ornaments.

(4.) *Hornstone* or *chert*, compact, conchoidal splintery fracture; translucent on the edges, and dirty gray, red, yellow, green, or brown; passes into flint, flinty slate, or common quartz; common in the mountain limestone, oolite, and greensand formations; and often contains petrifactions, as shells, madrepores, and wood.

Other siliceous minerals seem intermediate between quartz and opal, as,—*Flint*, grayish-white, gray, or grayish-black, also yellow, red, or brown; sometimes in clouds, spots, or stripes; semitransparent; lustre dull; fracture flat conchoidal; occurs chiefly in the chalk formation of England, North Ireland, Aberdeenshire, France, Germany, and other countries; sometimes in beds or vertical veins, oftener in irregular lumps or concretions, inclosing petrifactions, as sponges, echinites, shells, or siliceous infusoria. The colour is partly derived from carbon or organic matter. It is used for gun-flints, and for the manufacture of glass and pottery, and cut into cameos or other ornaments.

Calcedony, semitransparent or translucent; white, gray, blue, green, yellow, or brown; stalactitic, reniform, or botryoidal, and in pseudomorphs or petrifactions; Trevascus mine in Cornwall, Scotland, Hungary, Tyrol, Bohemia, Oberstein. *Carnelian*, chiefly blood-red, but also yellow, brown, or almost black; India, Arabia, Surinam, and Siberia; also Bohemia, Saxony, and Scotland (Perthshire). *Plasma*, leek or grass-green, and waxy lustre; Olympus, Schwarzwald, India, and China. *Chrysoprase*, apple-green; Silesia, and Vermont in North America. *Heliotrope* or *bloodstone*, dark-green, sprinkled with deep-red spots; Siberia, Bohemia, the Fassa Valley, the Island of Rum and other parts of Scotland. *Agates*, mixtures chiefly of calcedony in layers, with jasper, amethyst, or common quartz, abound in the amygdaloids of our own and other countries. *Onyx*, alternate layers of white, brown, or black, was much used in ancient times for cameos.

Some crystals are remarkable for their great size, as one in the Museum at Paris, measuring 3 feet in diameter, and weighing nearly 8 cwt. Other specimens contain cavities inclosing various substances, more than 24 known, as silver, iron pyrites, rutile, magnetite, tremolite, amianthus, mica, tourmaline, topaz; also air, water, naphtha, or other fluids.

*2. Opal.—$\dddot{Si}$, $\dot{H}$.

Amorphous; fracture conchoidal; very brittle. H. = 5·5...6·5; G. = 2...2·2. Transparent to opaque; vitreous, inclining to resinous. Colourless, but often white, yellow, red, brown, green, or gray, with a beautiful play of colours. B.B. decrepitates and becomes opaque, but is infusible; in the closed tube yields water; almost wholly soluble in solution of potash. Chem. com., silica, with 5 to 13 per cent. water; or probably a mere hardened natural gelatine of silica with water as an accidental mixture.

Varieties are,—(1.) *Hyalite, glassy-opal*, or *Muller's glass*, transparent, colourless, very glassy; small botryoidal or incrusting; Frankfort on the Maine, Kaiserstuhl in the Breisgau, Schemnitz in Hungary, in Silesia, Moravia, Mexico, and other places. (2.) *Fire-opal* or *girasol*, transparent, brilliant vitreous lustre; bright hyacinth red or yellow; Zimapan in Mexico, and the Faroe Islands. (3.) *Noble opal*, semitransparent or translucent; resinous inclining to vitreous; bluish or yellowish-white, with brilliant prismatic colours; in irregular masses or veins at Czernewitza near Eperies in Hungary, Frankfort, and Gracios a Dios in Honduras. (4.) *Common opal*, semitransparent, vitreous; white, yellow, green, red, or brown; Hungary, also Faroe, Iceland, the Giant's Causeway, and the Western Isles of Scotland. (5.) *Semi-opal*, duller and less pellucid. *Wood-opal* or *lithoxylon*, with the form and texture of wood distinctly seen; Hungary, also Bohemia, and near Hobart's Town in Tasmania. (6.) *Menilite*, compact, reniform; opaque and brown or bluish-gray; Mont Menil near Paris. (7.) *Opal jaspar*, blood-red, brown, or yellow. (8.) *Cacholong*, opaque, dull, glimmering, or pearly, and yellowish or rarely reddish-white; in veins or reniform and incrusting; Faroe, Iceland, the Giant's Causeway, and in Bucharia. One variety is named *Hydrophane*, from imbibing water and becoming translucent. (9.) *Siliceous sinter*, deposited from the Geyser and other hot springs near volcanoes; and *Pearl sinter*, incrusting volcanic tufa at Santa Fiora in Tuscany (*Fiorite*), in Italy, and in Auvergne. That from the Geyser contains 84·4 silica, 3·1 alumina, 1·9 peroxide of iron, 1·1 magnesia, 0·7 lime, 0·9 potash and soda, and 7·9 water.

2 *b*. Earthy Silica.—(*a*.) *Spongiform quartz*, coarse earthy, soft and often friable, and yellow or grayish-white; porous, and swims on water till saturated; St Ouen near Paris. (*b*.) *Tripoli*, coarse or fine earthy; white, gray, or yellow; near Tripoli in Africa, Corfu, Bohemia, Saxony, and Bavaria. (*c*.) *Polishing slate* (*Polirschiefer*), white or yellow; slaty texture, opaque, brittle, and swims on water; at Bilin

in Bohemia; consists of the siliceous remains of animals or plants (*Diatomaceæ*). (*d.*) *Adhesive slate*, from Montmartre near Paris; and (*e.*) *Mountain meal*, snow-white, pearly, gray, or greenish; have a similar origin; Santa Fiora in Tuscany, Oberohe in Hanover, Kymmenegard in Sweden (where used as food), in Bohemia, and the Isle of France.

** Family II.—Felspar.

Crystallization monoclinohedric or triclinohedric, both very similar in aspect and angles. Cleavage very distinct, especially the basal *P*; less so the clino- or brachy-diagonal *M*. G.=2·4...3·2, but mostly 2·5...2·8; H.=6, or a little more. Slightly or not at all soluble in acids. B.B. fusible, but often with difficulty. Translucent, pure varieties highly transparent. Colourless, white, or shades of red; less common, green or yellow. Chem. com. anhydrous silicates of alumina, and of an alkali or lime.

The felspars are very important constituents of the earth's crust, occurring in nearly all the igneous rocks, and in many of the stratified crystalline schists. In true strata, they are found chiefly as fragments or decomposed, and in the latter state form a large part of most soils and clays. In the older mineralogists and popular language many species are conjoined under the common name of felspar, which are now considered as distinct, each of them having not only its peculiar physical and chemical characters, but also geognostic position and associated group of minerals. Thus orthoclase, and the other more siliceous felspars with potash, abound in granite and the plutonic rocks; the less siliceous, with soda and lime, characterize the volcanic rocks—as labradorite the basaltic group, glassy felspar the trachytic. Orthoclase occurs with quartz, hornblende, and mica; glassy felspar only with hornblende and mica, or only with augite; labradorite only with augite, rarely if ever with quartz or hornblende.

The felspars are best known from similar minerals by their hardness (scarce scratch with a good knife), difficult fusibility, and unequal cleavages. The following marks may aid the student in distinguishing the more common species. If the basal cleavage plane is turned to the spectator, then in orthoclase it forms a right angle with the clinodiagonal cleavage planes M on both hands; in albite, oligoclase, and petalite it forms an obtuse angle with M on his right hand; and in labradorite and anorthite on his left hand. Orthoclase, albite, andesin, and oligoclase are insoluble in acids; ryacolite, labradorite, and anorthite more or less soluble.

S. von Waltershausen states that the felspars form a series with the oxygen of the silica, alumina, and $\dot{R} = x : 3 : 1$, in which x ranges from 24 to 4. Baulite (with 80 silica), albite (69 silica), and anorthite (44 silica), being the three true species, of which the others are mixtures, according to a peculiar law (isomorphism of groups).

** 3. Orthoclase.—$\dddot{Al}\,\dddot{Si}^3 + \dot{K}\,\dddot{Si}^3$, *or* $\bar{\ddot{A}}l\,\dddot{Si}^3 + \dot{K}\,\dddot{S}$.

Monoclinohedric; C = 65° 47′, ∞P 118° 50′, $P\infty$ 63° 53′, $(2P\infty)$ 90°, $2P\infty$ 35° 12′. Crystals often of $\infty P \,.\, 0P \,.\, P\infty$; or $(\infty P\infty)$ (*M*) . ∞P (*T, l*) . $0P$ (*P*) . $2P\infty$ (*y*), (fig. 102), are short rhombic prisms, when ∞P predominates; or tabular when $(\infty P\infty)$; or short hexagonal prismatic when ∞P and $(\infty P\infty)$; or rectangular prismatic when $0P$ and $(\infty P\infty)$ predominate; and occur single, attached, or in druses. Macles are frequent, especially with the twin axis parallel to the chief axis, and often partially interpenetrating as in fig. 103; also massive and coarse or fine granular. Cleavage, basal (*P*) very perfect; clinodiagonal (*M*) perfect (P to M = 90°); and hemiprismatic ∞P in traces. Fracture conchoidal or uneven and splintery. H. = 6; G. = 2·53...2·58. Transparent to translucent on the edges; vitreous, but often pearly on the more perfect cleavage; and also opalescent, with bluish or changing colours. Colourless, but generally red, yellow, gray, or green. B.B. fuses with difficulty to an opaque vesicular glass; not affected by acids. Chem. com. 65·4 silica, 18 alumina, and 16·6 potash, but generally 10 to 14 potash, 1 to 4 soda, 0 to 1·3 lime, 0 to 2 iron peroxide.

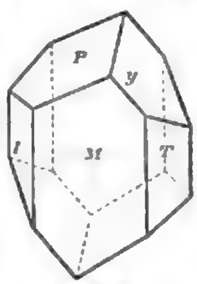


Fig. 102.

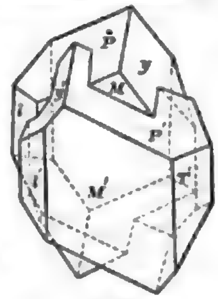


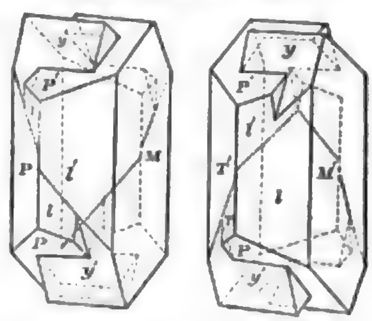
Fig. 103.

Varieties are,—(1.) *Adularia* and *Ice-spar*, transparent or translucent, splendent, and almost or wholly colourless. Some with a bluish opalescence are named *Moonstone*; St Gotthardt, Mont Blanc, Dauphiné, Arendal, Southern Norway, Greenland, and Ceylon.

(2.) *Common felspar*, less splendent and transparent, and generally white or red, especially flesh-red, is a very common constituent of many rocks. Crystals at Baveno on Lago Maggiore, Lomnitz in Silesia, Mourne Mountains and Wicklow in Ireland, Aberdeenshire (at Rubislaw, 4 or 5 inches long) in Scotland, and at Carlsbad and Elnbogen in Bohemia. *Amazon stone*, verdigris-green, from Lake Ilmen; and *Murchisonite*, golden or grayish-yellow, from Arran and Dawlish, seem varieties.

(3.) The *Glassy felspar* or *sanadine* (*C* = 63° 55′, ∞P 119° 13′), contains 3 to 12 potash, 3 to 10 soda, 0 to 3 lime, and 0 to 2 magnesia. Crystals imbedded, yellowish-white or gray; vitreous; transparent or translucent, and often much cracked;

Macles of common Felspar.



RIGHT. LEFT.

Fig. 104.

Drachenfels on the Rhine, Mont d'Or and other parts of Auvergne, Hungary, Italy, Iceland, Mexico, Chili, and other countries; also in Arran, Rum, and other parts of Scotland. *Ryacolite*, from Vesuvius and Lake Laach, is only a variety—the specimen analysed, having been impure. *Loxoclase*, from Hammond, New York, also a variety with much soda. *Baulite* and *Krablite* from Iceland, probably mixtures with quartz.

Orthoclase occurs in granite, gneiss, and porphyry in many countries. It is commonly associated with quartz, sometimes, as in the graphic granite of Portsoy and Aberdeenshire, in regular combinations. It is very liable to decomposition, when it is converted especially into kaolin, used for manufacturing porcelain and stoneware. The adularia or moonstone, and the green amazon stone are cut as ornamental stones.

Compact felspar, or *feldstein*, a mixture of orthoclase and quartz, often harder than the pure mineral. G. = 2·59 ...3, White, gray, red, or yellow, sometimes in spots or bands. The softer varieties, or *claystones*, often bluish or purplish. G. = 2·21. B.B. most melt with difficulty to a white enamel (hornstone is infusible). Common in the porphyry rocks of many countries, as in Scotland (Cheviots,

Pentland, and Ochil Hills), and Sweden (*leelite* from Grythyttan).

** 4. ALBITE.—$\dddot{\bar{Al}}\,\dddot{Si}^3 + \dot{Na}\,\dddot{Si}^3$, *or* $\dddot{\bar{Al}}\,\dddot{Si}^3 + \dot{Na}\,\dddot{Si}$.

Triclinohedric; 0P (*P*) to $\infty\breve{P}\infty$ (*M*) = 86° 24′, ∞P′ (*l*) to ∞′P (*T*) = 122° 15′. Crystals, generally like those of orthoclase, are tabular or prismatic (fig. 105). Macles very

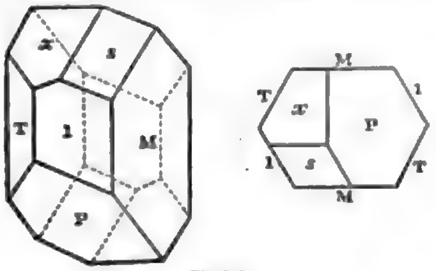


Fig. 105.

common, especially united by a face of $\infty\breve{P}\infty$ (fig. 106), the re-entering angle between the faces of 0P (*P* and *P′* = 172° 48′) being very characteristic. Fig. 107 is another macle common in pericline. Also massive and foliated or radiating. Cleavage, basal and brachydiagonal almost equally perfect, prismatic along ∞P imperfect; fracture

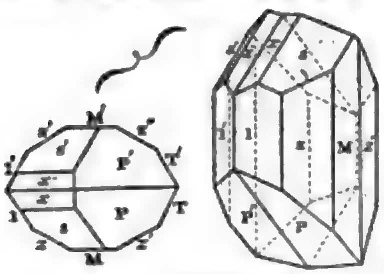


Fig. 106.

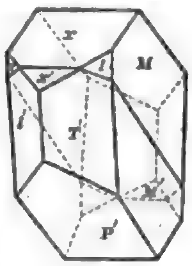


Fig. 107.

conchoidal or uneven. H.=6...6·5; G.=2·6...2·67. Rarely transparent, usually translucent or only on the edges; vitreous, inclining to pearly on the cleavage. Colourless, but generally white, gray, green, red, or yellow; streak white. B.B. difficultly fusible, tinging the flame yellow, to a white semi-opaque glass; not affected by acids. Chem. com. 69·3 silica, 19·1 alumina with 0·1 to 1 iron peroxide and 11·6 soda with 0·3 to 4 lime, 0 to 2·5 potash, and 0 to 0·5 magnesia. Hence albite and orthoclase both contain soda and potash, only in different proportions. Albite is best marked by the frequent re-entering angles, its more easy fusibility, and the obliquity (93° 36′) of its cleavage planes. *Pericline*, with G.=2·54...2·6, and slight diversity in angles, is only a variety.

Albite is a constituent of many greenstones (Edinburgh), of granite (Aberdeenshire), syenite, gneiss, porphyry, and trachyte; also in beds and veins; crystals at Barèges in the Pyrenees, Bourg d'Oisans in Dauphiné, St Gotthardt, the Tyrol, Salzburg, and Arendal. *Adinole* is a compact gray or red mixture of albite and quartz.

5. ANDESIN.—$\dddot{\bar{Al}}\,\dddot{Si}^2 + (\dot{Na}, \dot{Ca})\,\dddot{Si}$.

Triclinohedric; crystals and physical properties similar to albite, but the cleavage less distinct. G.=2·67...2·73. B.B. more easily fusible (like oligoclase) to a milky somewhat porous glass. Chem. com. 60 silica, 25 alumina, 7 soda, 6 lime, 1 potash, and 1 magnesia. Cordilleras, in andesite or diorite porphyry; Vosges Mountains, near Dresden, and Iceland.

Saccharite, compact, or fine granular; white or apple-green; Frankenstein, Silesia, and Canada; seems a variety.

** 6. LABRADORITE.—$\left\{\begin{array}{l}\dddot{\bar{Al}}\,\dddot{Si}^2 + (\dot{Ca}, \dot{Na})\,\dddot{Si}, \textit{ or} \\ \dddot{\bar{Al}}\,\dddot{Si} + \dot{R}\,\dddot{Si}.\end{array}\right.$

Triclinohedric; 0P : $\infty\breve{P}\infty$ = 86° 25′, 0P : ∞P′ = 114° 26′. Crystals rare; mostly massive and granular; macles like those of pericline (fig. 107). Cleavage basal, very perfect, brachydiagonal less so; both usually striated. H.=6; G. 2·68...2·74. Translucent, or only on the edges; vitreous, on the cleavage pearly or resinous. Gray, passing into white, green, yellow, or red. The faces of $\infty\breve{P}\infty$ often exhibit very beautiful changing colours,—blue, green, yellow, red, or brown,—sometimes in bands intersecting at certain angles. B.B. fuses more readily than orthoclase to a compact colourless glass; soluble when pulverized in h. acid. Chem. com. 53·7 silica, 29·7 alumina with 1 to 2 iron peroxide, 12·1 lime, and 4·5 soda with 0·3 to 2 potash, 0·1 to 2 magnesia, and 1 to 3 water—the latter probably not essential.

Common constituent of dolerite, greenstone, the gabbro, and hypersthene rocks. Labrador, Finland, Harz, Meissner, Tyrol, Mourne Mountains, Campsie and Milngavie near Glasgow, and Skye; also Etna and Vesuvius, and in meteoric stones.

Scolexerose, from Pargas, is a pure lime-labradorite. *Glaucolite*, from Lake Baikal, pale blue or greenish, with traces of cleavage in two directions, and G.=2·72...3·2, is not distinct. *Saussurite*, compact, dull, subtranslucent; gray, inclining to blue, green, or red; B.B. fuses to a gray or greenish-white enamel, and is not acted on by acids; is merely an impure labradorite. Alps near Geneva, Harz, Styria, Apennines, and Corsica.

7. COUZERANITE.—$2\,\dddot{\bar{Al}}\,\dddot{Si}^2 + 3\,(\dot{Ca}, \dot{K}, \dot{Na}, \dot{Mg})\,\dddot{Si}$.

Monoclinohedric; C=87°, ∞P=96°. Cleavage clinodiagonal. H.=6; G.=2·69. Opaque, vitreous, or resinous. Pitch-black, blackish-blue, or gray. B.B. melts to a white enamel; not affected by acids. Chem. com. by Dufresnoy's analysis, 52·37 silica, 24·02 alumina, 11·85 lime, 1·40 magnesia, 5·52 potash, and 3·96 soda. Couzerans in the Pyrenees.

8. ANORTHITE, Christianite.—$\left\{\begin{array}{l}\dddot{\bar{Al}}\,\dddot{Si} + \dot{Ca}\,\dddot{Si}, \textit{ or} \\ 3\,\dddot{\bar{Al}}\,\dddot{Si} + \dot{R}^3\,\dddot{Si}.\end{array}\right.$

Triclinohedric; 0P : ∞P∞ = 85° 48′; ∞P′ : ∞′P = 120° 30′. Crystals and macles like albite, with angle between *P* and *P′* = 188° 24′. Cleavage, basal and brachydiagonal perfect. H.=6; G.=2·7...2·76. Transparent or translucent; vitreous. Colourless or white. B.B. fuses to a clear glass; soluble without gelatinizing in con. h. acid. Chem. com. 43·9 silica, 36·3 alumina, and 19·8 lime with 1 to 5 magnesia, 0·3 to 8 soda, 0·2 to 1 potash, and 0·1 to 2 iron peroxide. Monte Somma, Iceland, Java.

Amphodelite has the same composition and a close resemblance in crystalline forms, cleavage, and macles; is reddish-gray, or dirty peach-blossom red. Lojo in Finland, and Tunaberg in Sweden. *Indianite* from the Carnatic; gelatinizes with acids; and B.B. is infusible.

*9. OLIGOCLASE.—$2\,\dddot{\bar{Al}}\,\dddot{Si}^2 + \dot{Na}^2\,\dddot{Si}^3$, *or* $\dddot{\bar{Al}}\,\dddot{Si}^2 + \dot{Na}\,\dddot{Si}$.

Triclinohedric; 0P : $\infty\breve{P}\infty$ = 86° 45′; ∞P′ : ∞′P about 120°. Crystals rather rare, and macles resemble albite. Cleavage, basal perfect; brachydiagonal less perfect; ∞P′ imperfect. H.=6; G.=2·64...2·68. More or less translucent; vitreous, pearly or resinous on the cleavage. White, with a tinge of green, gray, or red. B.B. melts easier than orthoclase or albite to a clear glass; not affected by acids. Chem. com. 63 silica, 23 alumina, and 14 soda; but 20 to 24 alumina, 7 to 12 soda, 1 to 4 potash, 5 to 4 lime, 0 to 1 magnesia, and 0 to 4 iron peroxide. Scotland, Scandinavia, Ural, Harz, and Morea. The *Sunstone* or *Aventurine felspar* from Tvedestrand, Norway, Lake Baikal, and Ceylon, with a fine play of colour, belongs to this species. *Hafnefiordite*, in lava, Hafnefiord, Iceland; G.=2·729; is a lime-oligoclase.

10. LATROBITE, Diploite.— $4\,\dddot{\bar{Al}}\,(\dddot{\bar{Mn}})\,\dddot{Si} + 3\,(\dot{Ca}, \dot{Mg}, \dot{K})\,\dddot{Si}^2$ (?).

Triclinohedric; crystals indistinct, prismatic; mostly

massive. Cleavage in three directions, intersecting at 91°, 93° 30′, and 98° 30′; fracture uneven. H. = 5 to 6; G = 2·7. Translucent; vitreous. Rose-red to reddish-white. B.B. becomes white, intumesces, and melts on the edges to a porous mass. Amitok Island in Labrador, and Bolton in Massachusetts.

11. PETALITE.—$4\,\ddot{\bar{A}}l\,\ddot{S}i^4 + 3\,(\dot{L}i, \dot{N}a)\,\ddot{S}i^4$.

Probably mono- or triclinohedric, but only coarse granular. Cleavage in one direction distinct, in a second less so, and mere traces of a third. H. = 6·5; G. = 2·4…2·5. Greenish, grayish, or reddish white, to pale red. Translucent; vitreous or pearly. B.B. melts easily into an obscure porous glass, colouring the flame red; not affected by acids. Chem. com. 77·1 silica, 18·4 alumina, 3·3 lithia, and 3·1 soda. Utoe, Bolton in Massachusetts, and York in Canada.

*12. SPODUMENE, Triphane. $\begin{cases} 4\,\ddot{\bar{A}}l\,\ddot{S}i^2 + 3\,(\dot{L}i, \dot{N}a, \dot{K})\,\ddot{S}i, \textit{or} \\ 4\,\ddot{\bar{A}}l\,\ddot{S}i^2 + \dot{L}i^3\,\dddot{S}i^2. \end{cases}$

Monoclinohedric; C. = 69° 40 ∞P = 87°; isomorphous with augite (diopside). Cleavage, prismatic ∞P perfect; orthodiagonal more perfect, chiefly massive or foliated. H. = 6·5…7; G. = 3·1…3·2. Translucent; vitreous or pearly. Pale greenish-gray or white to apple-green; streak white. B.B. intumesces slightly, tinging the flame momentarily purplish-red, and fuses easily to a colourless glass; not affected by acids. Chem. com. 65·0 silica, 28·7 alumina, and 6·3 lithia, with 0·1 to 2·5 soda, 0 to 4·5 potash, and 0 to 1 lime. Utoe in Sweden, Sterzing and Lisens in the Tyrol, Killiney near Dublin, Peterhead in Scotland, and crystals at Norwich in Massachusetts.

Killinite.—Crystalline foliated. Cleavage along a prism of 135°. H. = 4; G. = 2·65. Greenish-gray, yellow or brownish-green. B.B. melts difficultly to a white porous enamel. Chem. com. $2\,\ddot{\bar{A}}l\,\ddot{S}i^2 + \dot{R}\,\ddot{S}i^2 + 3\,\dot{H} - \dot{R}$, being potash, lime, magnesia, iron protoxide, and lithia. Killiney near Dublin, with spodumene.

13. KASTOR.—$2\,\ddot{\bar{A}}l\,\ddot{S}i^6 + \dot{L}i\,\ \ddot{S}i^2$.

Monoclinohedric. Cleavage distinct in two directions, meeting at 141½°. H. = 6…6·5; G. = 2·38…2·40. Transparent; splendent vitreous. Colourless. B.B. melts difficultly to a transparent colourless bead, tinging the flame deep carmine-red; not soluble in n. acid. Chem. com. 78·7 silica, 18·6 alumina, and 2·7 lithia. Elba. Probably a variety of petalite.

14. POLLUX.—$\ddot{\bar{A}}l\,\ddot{S}i^2 + \dot{K}\,\ \ddot{S}i + \dot{N}a\,\ \ddot{S}i + \dot{H}$ (?).

Massive. Traces of cleavage; fracture conchoidal. H. = 6…6·5; G. = 2·87…2·89. Transparent; splendent vitreous. Colourless; optically binaxial. B.B. melts on thin edges to an enamel-like porous glass, colouring the flame reddish-yellow. Elba, with castor. Both much resemble quartz.

15. ZYGADITE.—$\ddot{S}i$, $\ddot{\bar{A}}l$, $\dot{L}i$.

Triclinohedric, in macles like albite. H. = 5·5; G. = 2·51. Subtranslucent; vitreous. Reddish or yellowish white. Andreasberg.

16. AMORPHOUS FELSPAR.

Mineral substances, with no regular structure, and rather rocks than minerals.

*(*a*.) OBSIDIAN.—Compact in globular grains or masses. Fracture conchoidal; brittle. H. = 6…7; G. = 2·2…2·4. Semitransparent to translucent on the edges; vitreous. Black, gray, green, red, and brown, or striped and spotted. B.B. melts to a foamy mass, a glass or enamel. Chem. com. indeterminate, but 70 to 80 silica, 6 to 12 alumina, 3 to 10 soda, 3 to 6 potash, 1 to 7 lime, 1 to 2 magnesia, and 1 to 6 iron peroxide. Streams or detached masses near volcanoes, as Iceland, Lipari Islands, Milo, Santorin, Teneriffa, Mexico, and Hungary.

*(*b*.) PUMICE.—Porous, vesicular, or fibrous. Fracture conchoidal or flat; very brittle. White, gray, yellow, brown, or black. H. = 5; G. in powder = 2·19…2·2; in masses swims on water. B.B. melts more or less easily to a white enamel. Chem. com. like obsidian, of which it seems a peculiar state. Andernach on the Rhine, Lipari, and Ponza Islands. Used as a polishing material.

(*c*.) PEARLSTONE.—Roundish concentric globules imbedded in a vesicular basis. Fracture conchoidal; very brittle. H. = 6; G. = 2·2…2·4. Pearly. Reddish, bluish, or ash-gray; also yellow, red, or brown in stripes or spots. B.B. melts to a white fungus-like mass. Chem. com. indefinite, or a mixture of felspar and opal, with 2 to 4 per cent. water. Hungary, Siberia, Mexico. *Sphærulite*, small spherical concretions in pearlstone in Hungary and Mexico, and in pitchstone in Arran and Meissen.

*(*d*.) PITCHSTONE.—Compact, slaty, or in concentric scaly concretions. Fracture conchoidal; splintery. H. = 5·5…6; G. = 2·2…2·3. Subtranslucent to opaque; resinous. Gray, green, yellow, red, brown, black. B.B. melts to a porous glass or gray enamel. Chem. com. indefinite; but 64 to 76 silica, 11 to 14 alumina, 1 to 3 lime, 1 to 6 soda, 0 to 6 potash, 0 to 7 magnesia, 1 to 4 iron peroxide, and 5 to 9 water. Beds or veins at Tokai, Kremnitz, Schemnitz in Hungary, Meissen, Saxony, Newry in Ireland, and Arran in Scotland (the latter said to contain 2 per cent. of bitumen).

FAMILY III.—SCAPOLITE.

Crystallization tetragonal or hexagonal (prehnite rhombic). Cleavage more or less perfect. H. = 5…6, or a little more in prehnite; G. 2·6…3. All fusible and soluble in acids, and gelatinize. Chem. com. anhydrous silicates of alkalies or lime, and of alumina. They are generally transparent or translucent. Colourless, but often with green or yellow tinge and resinous lustre. They occur chiefly in volcanic or in plutonic rocks.

*17. SCAPOLITE, Wernerite. $\begin{cases} \ddot{\bar{A}}l^2\,\ddot{S}i + 3\,(\dot{C}a, \dot{N}a)\,\ddot{S}i, \textit{or} \\ (2\,\ddot{\bar{A}}l\,\ddot{S}i + \dot{R}^3\,\ddot{S}i^2.) \end{cases}$

Tetragonal; P 63° 32. Crystals ∞P . ∞P∞ . P, often long prismatic; also massive and granular or columnar. Cleavage, ∞P∞ rather perfect, ∞P less perfect. H. = 5…5·5; G. = 2·6…2·8. Transparent or translucent; vitreous, pearly, or resinous. Colourless, but pale gray, green, yellow, or red. B.B. melts with effervescence to a vesicular glass; in the closed tube many show traces of fluorine; with solution of cobalt become blue; soluble in h. acid. Chem. com. 49·9 silica, 27·6 alumina (with 0 to 3·8 iron peroxide), 22·5 lime and soda (but 12 to 21 lime, 1 to 7 soda, 0 to 2 magnesia, and 1 to 3 potash). Analyses differ widely, and some resemble the anarthite, others the labradorite felspars. Arendal, Tunaberg, Pargas, Bolton in Massachusetts, and Governeur in New York. Easily known by its indistinct rectangular cleavage, the resinous lustre on fracture surfaces, and its action before blowpipe.

18. MEIONITE.—$\ddot{\bar{A}}l^2\,\ddot{S}i^3 + 3\,\dot{C}a^3\,\ \ddot{S}i$.

Tetragonal; P 63° 48′. Crystals, ∞P∞ . P . ∞P, prismatic. Cleavage, ∞P∞ perfect, ∞P imperfect. Fracture conchoidal, H. = 5·5…6; G. = 2·6…2·7. Translucent and transparent; vitreous. Colourless or white. B.B. fuses with much intumescence to a vesicular glass; soluble in h. acid without gelatinizing. Chem. com. 42·5 silica, 31·5 alumina, and 26 lime (but 21 to 24 lime, 0·5 to 2 soda, 0·3 to 1 potash, and 0 to 1 magnesia.) Somma, Vesuvius.

19. The following are varieties of, or closely related to scapolite:—

Nuttalite.—Tetragonal; P 64° 40′; forms and cleavage like scapolite. H. = 5·5; G. = 2·74…2·75. Vitreous; on fracture resinous. Ash or greenish gray. B.B. like scapolite. Bolton in Massachusetts.

Barsowite.—Granular or compact, with one distinct cleavage. Translucent on the edges; pearly. Snow-white.

Gelatinizes in warm h. acid. Chem. com. about 49 silica, 34 alumina, 5·6 lime, and 1·5 magnesia. Barsowskoi in Ural. *Bytownite*, translucent; vitreous; light greenish-blue, Bytown in Upper Canada; is similar.

20. Palagonite. $\left\{ \begin{array}{l} (\dddot{\overline{Al}}{}^2, \dddot{\overline{Fe}}{}^2)\ \ddot{Si}^3 + 3\ (\dot{Ca},\ \dot{Mg},\ \dot{Na})\ \ddot{Si}^3 \\ +9\ \dot{H}. \end{array} \right.$

Amorphous; fracture conchoidal. H. nearly 5; G.=2·4. Transparent or translucent; resinous to vitreous. Wine-yellow to yellowish-brown. B.B. fuses readily to a shining magnetic bead. Easily soluble in acid. Palagonia in Sicily, Iceland, Galapagos, Nassau, and Cassel. Rather a rock.

21. Dipyr.—$3\ \dddot{\overline{Al}}\ \ddot{Si} + 4\ (\dot{Ca},\ \dot{Na})\ \ddot{Si}^2$.

Tetragonal, in rounded eight-sided prisms. Cleavage, ∞P and ∞P∞. Scratches glass. G = 2·646. Vitreous. Whitish or reddish. B.B. becomes opaque, and melts readily to a white vesicular glass. Slightly affected by acids. Chem. com. 55·7 silica, 25·1 alumina, 9·1 lime, and 10·1 soda. Mauléon, and Castillon in the Pyrenees.

* 22. Nepheline, Elæolite. $\left\{ \begin{array}{l} \dddot{\overline{Al}}{}^4\ \ddot{Si}^3 + 4\ (\dot{Na},\ K)\ \ddot{Si},\ or \\ 2\ \dddot{\overline{Al}}\ \ddot{Si} + \dot{R}^2\ \ddot{Si}. \end{array} \right.$

Hexagonal; P 88° 6. Crystals, ∞P . 0P and ∞P . 0P . P, imbedded, or in druses; also massive granular. Cleavage, basal and ∞P imperfect. Fracture conchoidal or uneven. H. = 5·5...6; G. = 2·58...2·64. Transparent or translucent; vitreous. Colourless or white (nepheline); or more opaque, dull resinous, and green, red, or brown (elæolite.) B.B. melts difficultly (nepheline), or easily with slight effervescence (elæolite), into a vesicular glass. Soluble and gelatinizes in h. acid. Chem. com. 44·84 silica, 33·04 alumina, 16·05 soda, 6·07 potash, with 0·2 to 2 lime, and 0·5 to 1·5 iron peroxide. Nepheline at Monte Somma, Capo di Bove, Katzenbuckel in the Odenwald, Aussig, and the Lausitz. Elæolite in the zircon syenite at Laurvig, Fredriksvärn, Brevig, and Miask.

Davine, $\frac{1}{2}$ P 51° 46′; long prismatic. G.=2·43. Contains a little chlorine and carbonic acid. Vesuvius and Somma.

23. Cancrinite.—$\dddot{\overline{Al}}{}^4\ \ddot{Si}^3 + 4\ \dot{Na}\ \ddot{Si} + 2\ \dot{Ca}\ \ddot{C}$.

Hexagonal; massive and columnar. Cleavage, prismatic ∞P perfect. H.=5...5·5; G.=2·42...2·46. Translucent or transparent; resinous, vitreous, or pearly on cleavage. Green, yellow, and rose-red. B.B. melts to a white vesicular glass. Soluble with effervescence in h. acid. Chem. com. one atom of a nepheline silicate with two atoms carbonate of lime = 39·3 silica, 29 alumina, 17·6 soda, and 14·1 carbonate of lime. Miask, and Litchfield in Maine; but in the latter the carbonate is $\dot{Na}\ \ddot{C} + \dot{Ca}\ \ddot{C}$. *Stroganowite* has the soda chiefly replaced by lime. Slūdānka River in Dauria.

24. Gehlenite.—$(\dddot{\overline{Al}},\ \dddot{\overline{Fe}})\ \ddot{Si} + (\dot{Ca},\ \dot{Mg},\ \dot{Fe})\ \ddot{Si}$.

Tetragonal. Crystals, 0P. ∞P, thick tabular or short prismatic. Cleavage, basal rather perfect, ∞P traces. H.=5·5...6; G.=2·9...3·1. Translucent on the edges; dull resinous. Mountain, leek, or olive green, to liver-brown. B.B. melts difficultly in thin fragments. Gelatinizes with h. acid. Chem. com. 31·4 silica, 20 to 24 alumina, 3 to 6 iron peroxide, 35 to 38 lime, 0 to 4 magnesia, 0 to 1·7 iron protoxide, and 1 to 3 water. Mount Monzoni in the Fassa Valley.

25. Humboldtilite.—$(\dddot{\overline{Al}},\ \dddot{\overline{Fe}})\ \ddot{Si} + 2(\dot{Ca},\ \dot{Mg},\ \dot{Na},\ K)\ \ddot{Si}^2$.

Tetragonal; P 66° 24′; 0P . ∞P, tabular or short prismatic. Cleavage, basal perfect. H.=5...5·5; G.=2·91...2·95. Translucent on the edges; vitreous or resinous. Yellowish-white, honey-yellow, and yellowish-brown. B.B. melts easily to a light or blackish coloured glass. Gelatinizes with h. acid. Chem. com. about 40 silica, 32 lime, 6 to 7 magnesia, 2 to 4 soda, 0·3 to 1·5 potash, 6 to 11 alumina, and 4 to 10 iron peroxide. Vesuvius and Capo di Bove. Melilite, Somervillite, and Zurlite are identical. *Sarkolite*, from Vesuvius, is similar.

*26. Prehnite, Koupholite. $\left\{ \begin{array}{l} \dddot{\overline{Al}}\ \ddot{Si} + 2\ \dot{Ca}\ \ddot{Si} + \dot{H},\ or \\ \dddot{\overline{Al}}\ \ddot{Si} + \dot{Ca}^2\ \ddot{Si} + \dot{H}. \end{array} \right.$

Rhombic, ∞P 99° 56′, 3P̆∞ 33° 0′, $\frac{4}{3}$P̄∞ 126° 40′. Crystals 0P . P, or ∞P (*m*) . 0P (*P*) . ∞P̆∞ (*l*) . 3P̆∞ (*o*) (fig. 108), tabular or short prismatic, in druses, fan-shaped or cock's-comb groups. Also granular or spherical, reniform and fibrous. Cleavage, basal rather perfect, ∞P imperfect. H. = 6...7; G.=2·8...3. Semi-transparent or translucent on the edges; vitreous, on 0P pearly. Colourless, but mostly greenish-white, olive, apple, or leek-green. When heated becomes polar-electric. B.B. melts easily, with much intumescence, to a porous enamel. Soluble in con. h. acid, but only gelatinizes perfectly when previously ignited or fused. Chem. com. 44·4 silica, 24·6 alumina, 26·7 lime, and 4·3 water (but with 0·1 to 7 peroxide of iron and manganese). Cape of Good Hope; Bourg d'Oisans in Dauphiné; Ratschinges and Fassa in Tyrol; Friskie Hall and Campsie, Dumbartonshire; Hartfield Moss, Renfrewshire; Corstorphine Hill, the Castle Rock, and Salisbury Craigs, near Edinburgh; Mull; Skye; and Dalnabo, near Glengairn, Aberdeenshire.

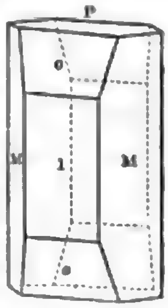


Fig. 108.

Prehnitoid, like prehnite, but scarce affected by h. acid. Wexio in Sweden.

27. Karpholite.—$\dddot{\overline{Al}}\ \ddot{Si} + \dot{Mn}\ \ddot{Si} + 2\ \dot{H}$.

Rhombic; radiating or stellated and acicular. H=5...5·5; G.=2·9...3. Translucent; silky. Straw to wax yellow. B.B. intumesces and forms an opaque brown glass, scarcely affected by acids. Chem. com. 37 silica, 30·6 alumina, 21·6 manganese protoxide, 10·8 water, with iron protoxide and fluoric acid. Schlakenwald and Wippra in the Harz.

28. The following minerals may follow prehnite:—

(*a.*) *Kirwanite.*—Spheroidal; radiating fibrous. H.=2; G.=2·9. Opaque; dark olive-green. B.B. becomes black, and partially fuses. Chem. com. 40·5 silica, 11·4 alumina, 23·9 iron protoxide, 19·8 lime, and 4·4 water. Mourne Mountains, Ireland.

(*b.*) *Huronite.*—Granular or foliated. H.=3·25; G.=2·86. Translucent; pearly or resinous. Pale yellowish-green. B.B. infusible, but grayish-white. Not affected by acids. Chem. com. 45·8 silica, 33·9 alumina, 4·3 iron protoxide, 8·1 lime, 1·7 magnesia, and 4·2 water. Lake Huron.

(*c.*) *Neurolite.*—Fine columnar. H.=4·25; G.=2·47. Translucent or opaque. Greenish-yellow. B.B. infusible, but becomes snow-white and pulverulent. Chem. com. 73 silica, 17·4 alumina, 3·3 lime, 1·5 magnesia, and 4·3 water. Stamstead in Lower Canada.

Family IV.—Haloid Stones.

These minerals are so named from their resemblance to salts. Their crystallization is rhombic or monoclinohedric. H.=4...6; G.=2·3...3·1. Soluble in acids. Generally infusible, or with difficulty. Most colour the B.B. flame bluish-green from phosphoric acid, being compounds of this acid with alumina, in some also with magnesia or iron protoxide. Are brightly-coloured minerals, of blue, green, or yellow tints. Most contain water, and do not form constituents of rocks.

29. Lazulite, Azurite.—$\dddot{\overline{Al}}{}^2\ \ddot{\ddot{\overline{P}}} + (\dot{Mg},\ \dot{Fe})^3\ \ddot{\ddot{\overline{P}}} + 2\ \dot{H}$.

Monoclinohedric. C.=88° 2′, ∞P 91° 30′, P 99° 40′, −P 100° 20′, P∞ 30° 2′; crystals pyramidal, tabular or prismatic, but rare; usually massive or granular. Cleavage, prismatic ∞P imperfect; fracture uneven, splintery. H. =5...6; G.=3...3·1. Translucent on the edges; vitreous.

Mineralogy.

Indigo, smalt, or other shades of blue inclining to green or white; streak white. In closed tube yields water and loses its colour. B.B. intumesces, but does not melt. With cobalt solution assumes a fine blue colour. Scarcely affected by acids till after ignition, when almost wholly soluble. Chem. com. 44·1 phosphoric acid, 31·7 alumina, 9 to 12 magnesia, 2 to 10 iron protoxide, 1 to 4 lime, and 5·7 water. Werfen in Salzburg, Vorau (*Voraulite*) and Krieglach in Styria, Tijuco in Brazil, and Lincoln county in North Carolina.

30. Calaite, Turquois.—$\dddot{\bar{Al}}^2\,\dddot{\bar{P}} + 5\,\dot{H}$.

Reniform; stalactitic or incrusting. Fracture conchoidal. H.=6; G.=2·6...2·8. Opaque or translucent on the edges; dull or waxy. Sky-blue, greenish-blue, rarely green; streak greenish-white. In the closed tube yields water, decrepitates violently, and becomes black. B.B. infusible, but colours the flame green. Soluble in acids. Chem. com. 46·89 alumina, 32·57 phosphoric acid, and 20·54 water, but mixed with phosphate of iron and copper. Silesia, Lausitz, and Voigtland. Oriental turquoise, in veins, at Meschid near Herat; in pebbles in Khorazan, Bucharia, and Syrian desert. Takes a fine polish, and is valued as an ornamental stone.

31. Fischerite.—$\dddot{\bar{Al}}\,\dddot{\bar{P}} + 8\,\dot{H}$.

Rhombic; ∞P 118° 32′, mostly in crusts or indistinct six-sided prisms. H.=5; G.=2·46. Transparent; vitreous; green. Slightly soluble in h. or n., wholly in s. acid, and on heating becomes white or partly black. Chem. com. 42 alumina, 29 phosphoric acid, 29 water, with a little lime and copper oxide. Nischnei Tagilsk.

Peganite.—Probably rhombic, ∞P 127° nearly; in very small prismatic crystals or thin crusts. Emerald, grass-green, or white. H.=3...4; G.=2·49...2·54. Chem. com. like Fischerite, but 6 $\dot{H}$. Strigis in Saxony.

Variscite.—Reniform; incrusting; weak resinous; greasy feel; green. G.=2·34...2·38; H.=5. In the closed tube it yields much water, and assumes a rose-red colour. Chem. com. chiefly phosphate of alumina, with water, magnesia, protoxide of iron, and chrome-oxide. Plauen in the Voigtland.

•32. Wavellite, Lasionite.—$\dddot{\bar{Al}}^3\,\dddot{\bar{P}}^2 + 12\,\dot{H}$.

Rhombic, ∞P 126° 25′, $\bar{P}\infty$ 106° 46′; crystals $\infty\bar{P}\infty$ (*P*). ∞P (*d*). $\bar{P}\infty$ (*o*) (fig. 109); but generally small, acicular, and in hemispherical radiated fibrous masses. Cleavage, along ∞P and $\bar{P}\infty$ rather perfect. H.=3·5...4; G.=2·3...2·5. Translucent; vitreous. Colourless, but generally yellowish or grayish, sometimes green or blue. In closed tube yields water. B.B. in the forceps colours the flame weak bluish-green; on charcoal intumesces, and becomes snow-white. Soluble in acids. Chem. com. 38·0 alumina, 35·3 phosphoric acid, and 26·7 water; but generally traces of fluoric acid (2 per cent.). Beraun in Bohemia, Amberg in Bavaria, Frankenberg in Saxony, Tanne in the Harz, Barnstaple in Devonshire, St Austle in Cornwall, near Clonmel, Cork, and Portrush, Ireland, and in the Shiant Isles in Scotland; also in New Hampshire and Tennessee.

Fig. 109.

33. Wagnerite.—$\dot{M}g^3\,\dddot{\bar{P}} + Mg\,F$.

Monoclinohedric; C=63° 25′, ∞P 57° 35′, P∞ 71° 53′. Cleavage, prismatic and orthodiagonal imperfect. Fracture conchoidal or splintery. H.=5...5·5; G=3·0...3·1. Translucent or transparent; resinous. Wine-yellow, honey-yellow, and white. B.B. fuses with great difficulty in thin splinters to a dark greenish-gray glass. Chem. com. 43·32 phosphoric acid, 11·35 fluorine, 37·64 magnesia, and 7·69 magnesium; but with 3 to 4·5 iron protoxide, and 1 to 4 lime. Very rare; Werfen in Salzburg.

34. Amblygonite. $\left\{\begin{array}{l}\dddot{\bar{Al}}^3\,\dddot{\bar{P}}^3 + (\dot{L}i, \dot{N}a)^3\,\dddot{\bar{P}} + Al\,F^3\\ + (Li, Na)\,F.\end{array}\right.$

Rhombic; coarse granular. Cleavage, ∞P 106° 10′, tolerably perfect. Fracture uneven and splintery. H.=6; G.=3...3·1. Translucent; vitreous; pearly on ∞P. Grayish or greenish-white to pale mountain-green. In closed tube yields water, sometimes corroding the glass. B.B. fuses very readily to a transparent glass, opaque when cold. Finely pulverized it is slowly soluble in acids. Chem. com. 47·9 phosphoric acid, 34·5 alumina, 6·9 lithia, 6 soda, and 8·3 fluorine. Penig in Saxony.

Family V.—Leucite.

Tesseral. H.=5...6; G.=2·2...2·5. All fusible except leucite, and all soluble and mostly gelatinize in hydrochloric acid. They are mostly silicates of alumina and of alkalies (or lime), often with chlorine, sulphur, or sulphuric acid. Their colours are white, gray, or often blue. They are mostly found imbedded in volcanic rocks.

35. Leucite.—($\dddot{\bar{Al}}\,\dddot{S}i^3 + \dot{K}\,\dddot{S}i$, *or* 3 $\dddot{\bar{Al}}\,\dddot{S}i^3 + \dot{K}^3\,\dddot{S}i^2$.)

Tesseral; only 202 (fig. 6). The crystals generally single. Cleavage, hexahedral very imperfect. Fracture conchoidal. H.=5·5...6; G.=2·4...2·5. Transparent to translucent on the edges; vitreous, inclining to resinous. Colourless, but grayish, yellowish, or reddish-white, or gray; streak white. B.B. infusible; with cobalt solution becomes blue. Soluble in h. acid, without gelatinizing. Chem. com. 55·7 silica, 23·1 alumina, and 21·2 potash. Abundant in the lavas of Vesuvius, the tufas near Rome, and the peperino of Albano; also at the Kaiserstuhl, and near Lake Laach. Readily distinguished from Analcime by its infusibility and by never showing faces of the cube.

36. Porcelain Spar.—3 $\dddot{\bar{Al}}\,\dddot{S}i^2 + (\dot{C}a\,\dot{N}a)^4\,\dddot{S}i^3 + \frac{1}{2}K\,Cl$.

Rhombic; ∞P 92° nearly. Massive and coarse granular. Fracture uneven. H.=5·5; G.=2·67...2·68. Translucent, or only on the edges; vitreous or pearly. Yellowish or bluish-white, or pale gray. B.B. fuses easily with intumescence to a colourless vesicular glass. Soluble without gelatinizing in con. h. acid. Chem. com. 49·55 silica, 27·40 alumina, 15·62 lime, 4·75 soda, 1·39 potassium, and 1·29 chlorine. Obernzell near Passau (*Passauite*), forming porcelain earth when decomposed.

37. Sodalite.—3 ($\dddot{\bar{Al}}\,\dddot{S}i + \dot{N}a\,\dddot{S}i$) + Na Cl.

Tesseral; ∞O (fig. 3); massive and granular. Cleavage, ∞O more or less perfect. Fracture conchoidal or uneven. H.=5·5; G.=2·28...2·29. Translucent; vitreous, inclining to resinous. White, gray, green, and rarely blue. B.B. becomes white and fuses easily alone, sometimes intumescing to a clear glass; with difficulty in borax. Gelatinizes with acids. Chem. com. 37·8 silica, 31·3 alumina, 25·3 soda, and 5·6 chlorine. Greenland, Vesuvius, Valle di Noto in Sicily, Lake Laach, Ilmen Hills, Fredriksvärn in Norway, and Litchfield in Maine.

•38. Hauyne.—3 ($\dddot{\bar{Al}}\,\dddot{S}i + \dot{N}a\,\dddot{S}i$) + 2 $\dot{C}a\,\dddot{S}$.

Tesseral chiefly ∞O, but more common in grains. Cleavage ∞O more or less perfect. H.=5...5·5; G.=2·4...2·5. Semi-transparent or translucent; vitreous or resinous. Azure or sky blue; streak bluish-white. B.B. decrepitates violently, and melts to a bluish-green vesicular glass. Soluble, and gelatinizes in h. acid. Chem. com. 32·5 silica, 27·1 alumina, 16·4 soda, 9·9 lime, and 14·1 sulphuric acid. Vesuvius, Mount Vultur near Melfi, the Campagna of Rome, and Niedermendig near Andernach.

39. Nosean.—3 ($\dddot{\bar{Al}}\,\dddot{S}i + \dot{N}a\,\dddot{S}i$) + $\dot{N}a\,\dddot{S}$.

Tesseral, like Hauyne, but oftener granular. H.=5·5; G.=2·25...2·27. Translucent; vitreous to resinous. Ash or yellowish gray, sometimes blue, brown, or black. B.B. becomes paler, and melts to a vesicular glass. Soluble in acids. Chem. com. 36·65 silica, 30·59 alumina, 24·82 soda,

and 7·94 sulphuric acid; but with 1 to 1·5 lime and 0·6 chlorine. Lake Laach and Rieden, near Andernach, on the Rhine. ***Skolopsite***, granular, smoke-gray and reddish-white; G.=2·53; is very similar. Kaiserstuhl in the Breisgau.

40. ITTNERITE.—$\dddot{Al}\,\dddot{Si}+(\dot{Na},\dot{Ca})\,\dddot{Si}+2\,\dot{H}$.

Tesseral, but only coarse granular. Cleavage, dodecahedral distinct; fracture imperfect conchoidal. H.=5·5; G.=2·37...2·40. Translucent; resinous. Smoke, ash or dark bluish-gray. In the closed tube yields much water. B.B. fuses, with much effervescence and sulphureous smell, to a vesicular opaque glass. Soluble, and gelatinizes in con. h. acid. Chem. com. by Whitney's analysis, 35·69 silica, 29·14 alumina, 5·64 lime, 12·57 soda, 1·20 potash, 4·62 sulphuric acid, 1·25 chlorine, 9·83 water and loss. Kaiserstuhl near Freiburg.

*41. LAPIS-LAZULI, Lasurstein.

Tesseral; ∞O, but rarely distinct; generally massive and fine granular. Imperfect dodecahedral cleavage. H.=5·5; G.=2·38...2·42. Translucent on the edges; dull resinous or vitreous. Ultra-marine or azure blue; streak light-blue. B.B. fuses readily to a white porous glass. In h. acid the powder is dissolved and gelatinizes, evolving sulphuretted hydrogen. Chem. com. by Varrentrapp's analysis, 45·50 silica, 5·89 sulphuric acid, 31·76 alumina, 9·09 soda, 3·52 lime, 0·86 iron, 0·42 chlorine, 0·95 sulphur, 0·12 water. Near Lake Baikal, China, Thibet, and Tartary. It is used for ornamental purposes, and the preparation of ultramarine-blue. The colour both in it and the Hauyne seems caused by some compound of sulphur, probably with iron. A mode of preparing the artificial colour was discovered by Chr. Gmelin.

42. EUDIALITE.—$[\dot{Zr}\,\dddot{Si}+2\,(\dot{Na},\dot{Ca},\dot{Fe})\,\dddot{Si}]$, Na Cl.

Rhombohedric; R 73° 30′; also massive and granular. Cleavage, basal distinct. H.=5...5·5; G.=2·84...2·95. Semitranslucent or opaque; vitreous. Peach-blossom to brownish-red; streak white. B.B. fuses easily to a light-green opaque glass. Gelatinizes in hydrochloric acid. Chem. com. by Rammelsberg's analysis, 49·92 silica, 16·88 zirconia, 11·11 lime, 12·28 soda, 6·97 iron protoxide, 1·15 manganese protoxide, 1·19 chlorine, with 0·65 potash, and 0·3 water. Greenland.

**FAMILY VI.—ZEOLITES.

Crystallization chiefly rhombic and monoclinohedric; also tetragonal and tesseral. H.=3·5...6, or mostly scratched by steel; G.=2...3. Mostly hyaline, and white or red, gray or yellow coloured. Cleavage generally distinct. All yield water in closed tube; all fusible B.B.; all soluble in acids, and mostly gelatinize or deposit silica. They are hydrated silicates of alkalies, or alkaline earths, mostly with silicates of alumina, but rarely contain magnesia. They are generally found in amygdaloidal cavities or fissures of trap or plutonic rocks, apparently as deposits from water percolating through them. Also in veins, but rare.

*43. ANALCIME. $\left\{\begin{array}{l}\dddot{Al}\,\dddot{Si}^2+\dot{Na}\,\dddot{Si}+2\,\dot{H},\ or\\ 3\,\dddot{Al}\,\dddot{Si}^2+\dot{Na}^3\,\dddot{Si}^2+6\,\dot{H}.\end{array}\right.$

Tesseral; crystals 2O2, seldomer ∞O∞ . 2O2 (fig. 110), in druses; also granular. Cleavage hexahedral, very imperfect; fracture uneven. H.=5·5; G.=2·1...2·25. Transparent to translucent on the edges; vitreous. White, grayish, greenish, yellowish, or reddish white; also flesh-red, and very rarely leek-green. B.B. melts quietly to a clear glass. Completely soluble and gelatinizes in h. acid. Chem. com. 55·2 silica, 22·9 alumina, 13·9 soda, and 8 water, with occasionally a little potash or lime. Seisser Alp in Tyrol, Dumbarton in Scotland, and in Siebenburg; Cyclopean Islands, Sicily; the Vicentine, Norway, Faroe, Iceland, Nova Scotia; also Giant's Causeway; and the Hebrides, Glenfarg, Salisbury Crags, and other parts of Scotland. ***Sarcolite***, ***Cuboit***, and the ***Cluthalite***, from near Dumbarton, are varieties.

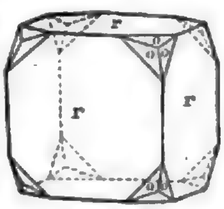


Fig. 110.

*44. NATROLITE, Mesotype. $\left\{\begin{array}{l}\dddot{Al}\,\dddot{Si}^2+\dot{Na}\,\dddot{Si}+2\,\dot{H},\ or\\ \dddot{Al}\,\dddot{Si}+\dot{Na}\,\dddot{Si}+2\,\dot{H}.\end{array}\right.$

Rhombic; ∞P 91°, P polar edges 143° 20′, and 142° 40′, middle edges 53° 20′; crystals, ∞P . P (fig. 111), fine prismatic, acicular or fibrous, and radiating. Cleavage, ∞P perfect. H.=5...5·5; G.=2·17...2·26. Pellucid; vitreous. Colourless or grayish-white, but sometimes bluish or yellow, seldom red or brown. Is *not* pyroelectric. B.B. becomes obscure and melts quietly to a clear glass. Gelatinizes in h. acid. Chem. com. 48 silica, 26·6 alumina, 16·1 soda, and 9·3 water, with a little lime and iron oxides. Clermont in Auvergne, Alpstein in Hessia, Hohentwiel in Swabia, Norway; in Scotland, as in Mull, Canna, and near Tantallan Castle; and in Ireland, Nova Scotia, and other countries. ***Bergmannite*** and ***Radiolite*** are varieties. ***Galactite***, H.=4·5, with 4 lime and 10·5 water. Glenfarg, Kilpatrick, and Bishopstown, probably distinct.


Fig. 111.

*45. SCOLEZITE, Needlestone. $\left\{\begin{array}{l}\dddot{Al}\,\dddot{Si}^2+\dot{Ca}\,\dddot{Si}+3\,\dot{H},\ or\\ \dddot{Al}\,\dddot{Si}+\dot{Ca}\,\dddot{Si}+3\,\dot{H}.\end{array}\right.$

Monoclinohedric; C=89° 6′, ∞P 91° 35′, P 144° 20′; crystals, ∞P . P . −P, prismatic or acicular. Twin crystals very common, united by a face of ∞P∞, and one face with feathery striæ (fig. 112); also massive and radiating. Cleavage, ∞P rather perfect. H.=5...5·5; G.=2·2...2·3. Pellucid; vitreous, fibrous varieties silky. Snow-white, grayish, yellowish, and reddish white. Distinctly pyro-electric. B.B. bends and twists in a vermicular manner, and melts easily to a porous glass. In h. acid dissolves and gelatinizes. Chem. com. 46·6 silica, 25·8 alumina, 14 lime, and 13·6 water. Very fine on Staffa; at Berufiord in Iceland; in Faroe, Greenland; and the Vendyah Mountains in India; also in Tyrol, Ireland, &c.

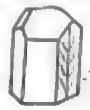


Fig. 112.

The following are either varieties of, or closely allied to, Scolezite or Natrolite:—

Mesolite, with 4 to 5 soda; Staffa, Antrim, and Iceland. ***Caporcianite***, reddish-gray, radiating fibrous; Caporciano, Tuscany. ***Lehuntite***, fine scaly, flesh-red. G.=1·953; H.=3·75. Glenarm, Ireland. ***Poonahlite***, rhombic prisms of 92° 20′, otherwise like Scolezite, from Poonah in Hindustan. ***Brevicite***, radiated, massive, white, reddish-gray, or dark-red; Brevig. ***Harringtonite***, compact, earthy, snow-white; Portrush in Ireland. ***Antrimolite***, white, fibrous, and opaque. G.=2·096; H.=3·75. Antrim. ***Stellite***, fine rhombic prisms grouped in concentric stars. White, translucent, silky. H.=3...3·5; G.=2·612. Kilsyth, Scotland. ***Mesole*** or ***Faröelite***, radiating, fibrous; transparent, pearly; white, yellow, or gray. H. 3·5. Chem. com. 41·3 silica, 28·4 alumina, 11·5 lime, 5·7 soda, and 13·2 water. Faroe, Schonen; Storr, Uig, and Portree, in Skye. The last is perhaps a distinct species.

*46. THOMSONITE, Comptonite. $\left\{\begin{array}{l}3\,\dddot{Al}\,\dddot{Si}+3\,\dot{Ca}\,\dddot{Si}+7\,\dot{H},\ or\\ 3\,\dddot{Al}\,\dddot{Si}+\dot{R}^3\,\dddot{Si}+7\,\dot{H}.\end{array}\right.$

Rhombic; ∞P 90° 40′, usually like fig. 113, terminating in an extremely obtuse dome of 177° 35′, like the basis with the plane broken. In druses, fan-shaped or radiated. Cleavage, macrodiagonal and brachydiagonal equally perfect. H.=5...5·5; G.=2·3...2·4. Translucent, but often obscure; vitreous, sometimes pearly. White. B.B. intumesces, becomes opaque, and fuses with difficulty to a white enamel.

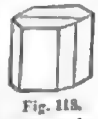


Fig. 113.

Soluble, and gelatinizes in h. acid. Chem. com. 38·2 silica, 31·6 alumina, 17·2 lime, with 1 to 8 soda, and 13 water. Vesuvius, Sicily, Bohemia, Tyrol, Iceland, Faroe, Scotland (Lochwinnoch, Kilpatrick Hills), and Nova Scotia. *Chalilite*, a compact variety; Antrim.

*47. STILBITE, Desmine. $\left\{\begin{array}{l}\dddot{Al}\ \ddot{Si}^3+\dot{Ca}\ \ddot{Si}^3+6\ \dot{H},\ or\\ \dddot{Al}\ \ddot{Si}^3+\dot{Ca}\ \ddot{Si}+6\ \dot{H}.\end{array}\right.$

Rhombic; P polar edges, 119° 16′, and 114°; crystals, $\infty\bar{P}\infty$ (*M*) . $\infty\breve{P}\infty$ (*T*) . P (*r*) . 0P (*P*), (fig. 114), broad pyramidal, very often fascicular or diverging; also radiating or broad columnar, or macled. Cleavage, macrodiagonal very perfect. H. = 3·5...4; G. = 2·1...2·2. Translucent, or only on the edges; vitreous; pearly on $\infty\bar{P}\infty$. White, red, gray, yellow, and brown. B.B. intumesces greatly, and melts with difficulty to a white enamel. Decomposed by c. h. acid, leaving slimy silica. Chem. com. 58·2 silica, 16 alumina, 8·8 lime, with 1 to 3 soda or potash, and 17 water. Andreasberg in the Harz, Kongsberg and Arendal, Iceland, Faroe, and the Vendayah Mountains in Hindostan; in Scotland, in Skye, Kilpatrick, Kilmalcolm, and Arran. *Sphærostilbite* and *Hypostilbite* are related species. *Ædelforsite*; fibrous or columnar; H. = 6; G. = 2·6; is a stilbite with two atoms less water, or a laumonite mixed with quartz. Ædelfors in Sweden.

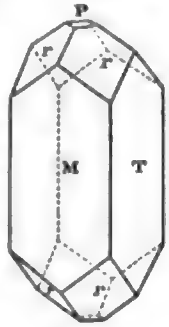


Fig. 114.

*48. HEULANDITE. $\left\{\begin{array}{l}\dddot{Al}\ \ddot{Si}^3+\dot{Ca}\ \ddot{Si}^3+5\ \dot{H},\ or\\ \dddot{Al}\ \ddot{Si}^3+\dot{Ca}\ \ddot{Si}+5\ \dot{H}.\end{array}\right.$

Monoclinohedric; C = 63° 40′, $P\infty$ 50° 20′; crystals ($\infty P\infty$) . $\infty P\infty$. $P\infty$. 0P (fig. 115); mostly tabular, rarely prismatic in druses or radiated lamellar. Cleavage, clinodiagonal very perfect; brittle. H. = 3·5...4; G. = 2·1...2·2. Transparent to translucent on the edges; vitreous or pearly. White, but often flesh or brick-red, and yellowish or hair-brown. B.B. exfoliates, intumesces, and melts to a white enamel. Soluble in h. acid, leaving slimy silica. Chem. com. 59·9 silica, 16·7 alumina, 9 lime, and 14·5 water. Arendal, Kongsberg, Andreasberg, Fassa Valley, Iceland, Faroe, Nova Scotia, New Jersey, and the Vendayah Mountains, Hindostan; at Campsie, in Skye, and other parts of Scotland. *Beaumontite* is the same; Baltimore.


Fig. 115.

49. BREWSTERITE.—$\dddot{Al}\ \ddot{Si}^3+(\frac{2}{3}\ \dot{Sr}+\frac{1}{3}\dot{Ba})\ddot{Si}^3+5\ \dot{H}.$

Monoclinohedric; C. = 86° 20′; crystals short prismatic, of several vertical prisms, bounded by an extremely obtuse clinodome (172°) (fig. 116), are mostly small. Cleavage, clinodiagonal very perfect. H. = 5...5·5; G. = 2·12...2·2. Pellucid; vitreous or pearly. White, gray, yellow, brown, or green. B.B. froths, intumesces, and fuses to a porous glass. Soluble in h. acid, and gelatinizes. Chem. com. 54·3 silica, 15·0 alumina, 10·1 strontia, 7·4 baryta with 1·3 lime, and 13·1 water; and thus with all the three alkaline earths. Strontian in Scotland, Giants' Causeway, Freiburg in the Breisgau, and the Pyrenees.


Fig. 116.

50. EPISTILBITE.—$\dddot{Al}\ \ddot{Si}^3+\dot{Ca}\ \ddot{Si}^3+5\ \dot{H}.$

Rhombic; ∞P 135° 10′, $\bar{P}\infty$ 109° 46′, $P\infty$ 147° 40′; in long prismatic crystals (fig. 117). Macles united by a face of ∞P are more common; also massive and granular. Cleavage, brachydiagonal very perfect. H. = 3·5...4; G. = 2·3...2·4. Pellucid; vitreous or pearly. Colourless or white. B.B. melts with intumescence to a porous enamel. Soluble without gelatinizing, but after ignition is insoluble. Chem. com. 59 silica, 17·5 alumina, 9 lime, with 1·5 soda, and 14·5 water, or like Heulandite. Iceland and Faroe; also, it is said, in Skye, and at Portrush in Ireland.

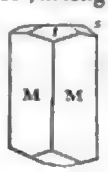


Fig. 117.

*51. APOPHYLLITE.—$4\ \dot{Ca}^3\ \ddot{Si}^2+\dot{K}\ \ddot{Si}^3+16\ \dot{H}.$

Tetragonal; P 121° 4′; crystals, P . $\infty P\infty$ (*m*) (fig. 118) and 0P, are pyramidal, or short prismatic, or tabular; usually in druses or lamellar. Cleavage, basal perfect; $\infty P\infty$ imperfect; brittle. H. = 4·5...5; G. = 2·3...2·4. Pellucid; vitreous; on 0P pearly (*ichthyophthalm*). Colourless, but yellowish, grayish, or reddish white, to rose or flesh red. B.B. exfoliates, intumesces, and melts easily to a white enamel. Powder readily soluble in h. acid, leaving slimy silica. Chem. com. 52·8 silica, 25·4 lime, 5·3 potash, and 16·5 water; in some with 0·24 to 1·54 fluorine. Occurs at Utoe in Sweden, Aussig in Bohemia, the Seisser Alp in Tyrol, St Andreasberg in the Harz, Nertschinsk in Siberia, in Greenland, Iceland, Faroe, and Raith in Fife.

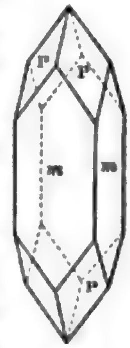


Fig. 118.

Gyrolite, spherical radiated concretions, with 50·7 silica, 1·48 alumina, 33·24 lime, 0·18 magnesia, and 14·18 water, seems a variety; Storr in Skye. Also *Xylochor*, from Iceland.

52. OKENITE, Dysclasite.—$\dot{Ca}\ \ddot{Si}^2+2\ \dot{H}.$

Rhombic; ∞P 122° 19′; usually fine columnar or fibrous. H. = 5; G. = 2·28...2·36. Pellucid; slightly pearly. Yellowish to bluish-white. B.B. froths up and melts to an enamel. In powder easily soluble in h. acid, leaving gelatinous flakes; after ignition insoluble. Chem. com. 57 silica, 26 lime, and 17 water. On Disco Island, Greenland, Faroe, and Iceland.

53. PECTOLITE.—$3\ \dot{Ca}\ \ddot{Si}+\dot{Na}^2\ \ddot{Si}^3+3\ \dot{H},\ or\ 6\ \dot{R}\ \ \ddot{Si}+\dot{H}.$

Monoclinohedric (?), but only spheroidal, radiating, and columnar. H. = 5; G. = 2·69...2·74. Translucent on the edges; slightly pearly. Grayish-white or yellowish. B.B. melts easily to a white enamel-like glass. Soluble in h. acid, leaving flaky silica; after ignition gelatinizes perfectly. Chem. com. 52·1 silica, 34·2 lime, 9·5 soda, with 0·6 to 1·6 potash and 4·2 water. Monte Baldo, Monte Monzoni in Tyrol, Kilsyth (*Wollastonite*), Ratho, Corstorphine near Edinburgh, and Storr in Skye.

54. LEVYNE.—$\dddot{Al}\ \ddot{Si}^2+\dot{Ca}\ (\dot{K},\ \dot{Na})\ \ddot{Si}+4\ \dot{H}.$

Rhombohedric; R 79° 29′; crystals, 0R. R. $-\frac{1}{2}$R, thick tabular, in perfect intersecting macles (fig. 119). H. = 4; G. = 2·1...2·2. Chem. com. 44·5 silica, 23·8 alumina, 10·7 lime, 1·6 potash, 1·4 soda, and 17·4 water. Otherwise like chabasite. Faroe, Glenarm, Skye, and Hartfield Moss in Renfrewshire.

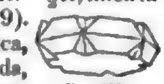


Fig. 119.

55. CHABASITE, Lime-Ch.—$\dddot{Al}\ \ddot{Si}^2+\dot{Ca}\ (\dot{Na},\ \dot{K})\ \ddot{Si}+6\ \dot{H}.$

Rhombohedric; R 94° 46′; R mostly alone, but also with $-\frac{1}{2}$R and -2R. Intersecting macles very common; crystals in druses and striated. Cleavage, R rather perfect. H. = 4...4·5; G. = 2...2·2. Transparent to translucent; vitreous. Colourless, grayish, yellowish, reddish to flesh-red. B.B. fuses to a finely porous enamel. Soluble in h. acid, leaving slimy silica. Chem. com. 48·2 silica, 20 alumina, 10·8 lime, with 0 to 2·5 soda, and 0·2 to 3 potash, and 21 water. Faroe, Iceland, Greenland, Aussig in Bohemia, Giants' Causeway, Kilmacolm in Renfrewshire, in Skye, and other places in Scotland. *Phacolite*, with rather less silica and more alumina, is a variety; Leipa in Bohemia.

56. GMELINITE, Soda-Chabasite. $\}$ $\dddot{Al}\ \ddot{Si}^2+\dot{Na}\ (\dot{Ca},\ \dot{K})\ \ddot{Si}+6\ \dot{H}.$

Hexagonal; P 80° 8′; crystals P . 0P . ∞P (fig. 120). The faces of P striated parallel to their polar edge;

those of the prism horizontally. Cleavage, ∞P distinct. Gelatinizes with h. acid; otherwise like chabasite. Chem. com. 47·6 silica, 19·7 alumina, 12 soda, with 3 to 5 lime, and 0·4 to 2 potash, and 20·7 water. Glenarm in Antrim, Vicenza (*Sarcolite*). *Lederite*, with only 9 per cent. water, seems a variety; Cape Blomidon, Nova Scotia.

Fig. 120.

57. Faujasite.—$2\,\dddot{\overline{Al}}\,\dddot{Si}^2+(\dot{Ca},\ \dot{Na})^3\,\dddot{Si}^2+18\,\dot{H}$.
Tetragonal; P 105° 30′. Fracture uneven; brittle. Scratches glass. G. = 1·923. Transparent; vitreous or adamantine. White or brown. B.B. intumesces and fuses to a white enamel. Soluble in h. acid. Chem. com. 46 silica, 17 alumina, 5 lime, 5 soda, and 27 water. Kaiserstuhl.

58. Edingtonite.—$4\,\dddot{\overline{Al}}\,\dddot{Si}^2+3\,\dot{Ba}\,\dddot{Si}+12\,\dot{H}$.
Tetragonal, hemihedric; P 87° 9′; formed as a sphenoid (*P*), with polar edges 92° 51′; also $\frac{1}{2}P$ (*n*), polar edges 129° 8′, and $\infty P(m)$ (fig. 121). Cleavage, ∞P, perfect. H. = 4...4·5; G. = 2·7...2·75. Translucent; vitreous. Grayish-white. B.B. fuses difficultly to a colourless glass. Chem. com. 37·3 silica, 23·7 alumina, 26·5 baryta, and 12·5 water (*analysis*). Kilpatrick Hills, Dumbartonshire.

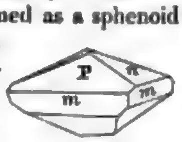


Fig. 121.

*59. Harmotome, Cross-stone.—$\dddot{\overline{Al}}\,\dddot{Si}^2+\dot{Ba}\,\dddot{Si}^2+5\,\dot{H}$.
Rhombic; P polar edges 119° 4′, and 121° 6′, and ∞P 88° 14′; crystals, $\infty\breve{P}\infty$ (*q*) . $\infty\bar{P}\infty$ (*o*) . P . $\breve{P}\infty$, short prismatic. Generally in perfectly intersecting macles (fig. 122). Cleavage, brachydiagonal imperfect, macrodiagonal less distinct; brittle; fracture uneven. H. = 4·5; G. = 2·3...2·5. Translucent; vitreous. Colourless, but white, gray, yellow, brown, or red. B.B. fuses rather difficultly but quietly to a clear glass. Soluble, but not readily, in h. acid, with deposition of silica. Chem. com. 47·25 silica, 15·67 alumina, 23·39 baryta (with 1 to 3 lime and 1 to 2·5 potash), and 13·76 water. Andreasberg, Kongsberg, Oberstein; Dumbartonshire and Strontian (*Morvenite*), Scotland.

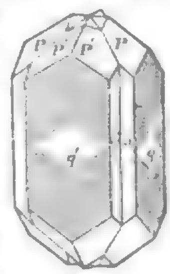


Fig. 122.

60. Phillipsite.—$\dddot{\overline{Al}}\,\dddot{Si}^2+(\dot{Ca},\ \dot{K}.)\,\dddot{Si}+5\,\dot{H}$.
Rhombic; P polar edges 119° 18′ and 120° 42′. Forms, macles, and other characters like harmotome. G. = 2·15...2·20. B.B. fuses easily with slight intumescence; gelatinizes in h. acid. Chem. com. 48·6 silica, 20·2 alumina, 7·3 lime, 6·2 potash, and 17·7 water. Giessen, Marburg, Cassel, Iceland, and the Giants' Causeway.

61. Herschelite.—$\dddot{\overline{Al}}\,\dddot{Si}^2+(\dot{Na},\ \dot{K},\ \dot{Ca})\,\dddot{Si}+3\,\dot{H}$.
Hexagonal; P polar edges, 124° 45′; crystals ∞P . 0P. H. = 4·5; G. = 2·06. Translucent; pearly; white. B.B. fuses readily to a white enamel. Chem. com. 48·5 silica, 20·1 alumina, 9·2 soda, 4·6 potash (with 0·2 to 5 lime), and 17·6 water. Aci Reale and Palagonia in Sicily.

62. Zeagonite.—$2\,\dddot{\overline{Al}}\,\dddot{Si}^2+2\,(\dot{Ca},\dot{K})\,\dddot{Si}+7\,\dot{H}$.
Rhombic; P polar edges 120° 37′ and 121° 44′; crystals single or in groups. H. = 5, on angles and edges = 7 or more; G. = 2·213. Transparent; vitreous. Colourless, white, or bluish. B.B. becomes white, falls down, shines, and melts to a clear glass. Capo di Bove. Variety of Phillipsite (?).

63. Gismondine, Abrazite.—$\dddot{\overline{Al}}\,\dddot{Si}^2+\dot{Ca}\,(\dot{K})\,\dddot{Si}+4\,\dot{H}$.
Tetragonal (or rhombic?); P 92° 30′; crystals, P or with $\infty P\infty$, in groups. Cleavage, P imperfect. H. = 5, on edges and angles = 6; G. = 2·265. Semitransparent to translucent; vitreous. Grayish-white to pale-red. B.B. intumesces, shines, and melts to a white enamel. Chem. com. 35 silica, 29 alumina, 15·7 lime (with 2·8 potash), and 20·3 water. Vesuvius, Aci Castello, and Capo di Bove.

64. Laumonite.—$\dddot{\overline{Al}}\,\dddot{Si}^2+\dot{Ca}\,\dddot{Si}+4\,\dot{H}$.
Monoclinohedric; C = 68° 40′, ∞P 86° 15′, $\infty P : 2\,P\infty$ 113° 30′; crystals prismatic, also columnar. Cleavage, prismatic perfect; clinodiagonal in traces; rather brittle. H. = 3...3·5 (when fresh = 5...6?); G. = 2·2...2·3. Pellucid; vitreous; on cleavage pearly. White, grayish, yellowish, and reddish. In the air soon decomposed. B.B. intumesces and melts easily to a white enamel, which becomes clear in a stronger heat. Soluble and gelatinizes in h. acid. Chem. com. 51·8 silica, 21·5 alumina, 11·3 lime, and 15·4 water. Huelgoët in Brittany, Eule near Prague, Fahlun, Iceland, Faroe, Snizort and Storr in Skye, Dumbarton, and other parts of Scotland, and in North America.

65. Leonhardite.—$4\,\dddot{\overline{Al}}\,\dddot{Si}^2+3\,\dot{Ca}\,\dddot{Si}+12\,\dot{H}$.
Monoclinohedric; ∞P 83° 30′, $\infty P : 0P$ 114°; crystals, ∞P . 0P, prismatic, and grouped in bundles; also granular or columnar. Cleavage, ∞P very perfect, basal imperfect. Very friable. H. = 3...3·5; G. = 2·25. Translucent on the edges; pearly; yellowish-white. B.B. exfoliates, froths, and melts easily to a white enamel. Becomes opaque, and decomposes quickly in the air. Chem. com. 53·9 silica, 23·8 alumina, 9·8 lime, and 12·5 water. Schemnitz.

66. Glottalite—$\dddot{\overline{Al}}\,\dddot{Si}+3\,\dot{Ca}\,\dddot{Si}+8\,\dot{H}$.
Tesseral; O and $\infty O\infty$; in druses. H. = 3...4; G. = 2·18. Highly translucent; vitreous. Colourless or white. B.B. melts with intumescence to a white enamel. Chem. com. 37·4 silica, 15·6 alumina, 25·3 lime, and 21·7 water. Near Port-Glasgow. Probably chabasite.

Family VII.—Mica.

Crystallization monoclinohedric or rhombic, and hexagonal or rhombohedric. Cleavage mostly very perfect in one direction (basal), and thin laminæ flexible. Pellucid, with a strong, often semimetallic lustre. H. = 2...3, more rarely 1...6; G. = 2·5...3. B.B. mostly fusible. Are silicates of alumina, with silicates of potash, magnesia, lithia, and protoxides of iron and manganese, with or without water. They are mostly constituents of the plutonic or volcanic rocks.[1]

**67. Potash-mica, Muscovite, Phengite, Binaxial-Mica. $\left\{\begin{array}{l}3\,\dddot{\overline{Al}}\,\dddot{Si}+\dot{K}\,\dddot{Si}^2,\ or\\ 3\,\dddot{\overline{Al}}\,\dddot{Si}+\dot{K}\,\dddot{Si}.\end{array}\right.$
Monoclinohedric, or probably rhombic. Crystals chiefly rhombic or six-sided tables, with ∞P 120° and 60° nearly. Imbedded, or in druses; also scaly, foliated, or lamellar. Macles rather rare. Cleavage, basal highly perfect; sectile, and in thin laminæ elastic. H. = 2...3; G. = 2·8...3·1. Pellucid in various degrees; optically binaxial; metallic-pearly, on some faces vitreous. Colourless, but white, gray, green, red, brown, black, and rarely yellow. In closed tube usually yields water, with traces of fluorine. B.B. loses its transparency, and fuses to an obscure glass or white enamel. Not affected by h. or s. acids. Chem. com. very variable, but nearly 48 silica, 39·8 alumina, and 12·2 potash; but analyses give 40 to 48 silica, 32 to 37 (rarely 9 to 10) alumina, 3 to 9 (or 36) peroxide of iron, 1 to 2 peroxide of manganese, 5 to 10 potash, 1 to 3 protoxide of iron (with traces of lime, magnesia, and soda), and most 1 to 4 water and 1 to 3 fluorine. The green micas (*Fuchsite*) also 4 to 6 chrome oxide. Abundant as a constituent of granite, gneiss, mica-slate, and other rocks. Large plates in Norway, Sweden, and especially in

[1] Neither the optical nor crystallographical characters of the micas, Nos. 67 to 71, are well determined. The magnesia micas were formerly regarded as monoaxial and hexagonal, but now appear to be binaxial, with the angle between the axes small; in biotite under 5°, often 0° to 1° or 2°; in phlogopite, 5° to 20°. The crystallization of the potash mica and lepidolite is more probably rhombic. The chem. com. also cannot be represented by any general formula.

Siberia, often a yard in diameter, and used for windows, but become white on exposure. Fine crystals, Vesuvius, St Gotthardt, Pargas, Arendal, Utoe, Fahlun, Kimito, Cornwall, and Aberdeenshire.

68. DAMOURITE.—$3\,\overline{\ddot{A}l}\,\ddot{Si} + \dot{K}\,\ddot{Si}^2 + 2\,\dot{H}$.

Fine foliated. H.$=$1·5; G$=$2·7...28. Translucent on the edges; pearly; yellowish-white. B.B. yields water, intumesces, becomes milk-white, and melts with difficulty to a white enamel. Soluble in sulphuric (not in h.) acid, leaving silica. Chem. com. 45·7 silica, 38·1 alumina, 11·7 potash, and 4·5 water. Pontivy in Brittany. The mica slate of St Gotthardt (*Paragonite*) is similar externally, but contains 50·20 silica, 35·90 alumina, 2·36 iron peroxide, 8·45 soda, and 2·45 water; and is infusible B.B. *Didrimite* from Zillerthal, and *Margarodite* from Connecticut, are similar hydrous micas.

*69. LITHIA-MICA, Lepidolite. } $3\,\overline{\ddot{A}l}\,\ddot{Si}^3 + 2\,\dot{L}i\,\ddot{Si} + (KF, Si\,F^3)$.

Crystallization and physical characters like potash-mica, but colour often rose or peach-blossom red. In the closed tube shows evident fluorine reaction. B.B. melts *very easily* with effervescence to a colourless, brown, or rarely black magnetic glass, colouring the flame *red*. Imperfectly soluble in acids, wholly so after fusion. Chem. com. 51·6 silica, 28·5 alumina, 8·7 potash, 5·3 lithia, and 5·9 fluoric acid; analyses give 46 to 52 silica, 20 to 29 alumina, 0 to 18 iron peroxide, 0 to 5 manganese peroxide, 5 to 10 potash, 2 to 6 lithia, 4 to 6 fluorine, and 0 to 15 soda. Cornwall, Bohemia, Saxony; and also at Portsoy (serpentine), Loch Fine, and Ballahulish (limestone), in Scotland. It is sometimes used as an ornamental stone.

**70. BIOTITE, Magnesia-Mica. $\left\{\begin{array}{l}\overline{\ddot{A}l}\;\ddot{Si} + (\dot{M}g, \dot{K}, \dot{F}e)^3\,\ddot{Si}, \textit{ or} \\ \overline{\ddot{A}l}\;\ddot{Si} + \dot{R}^3\,\ddot{Si}.\end{array}\right.$

Rhombohedric; R 71° 4′ to about 73° (but perhaps rhombic); crystals mostly tabular, rarely short prisms. Cleavage, basal very perfect; sectile; in thin plates elastic. H.$=$2·5...3; G.$=$2·85...2·9. Transparent, but often only in very thin plates (and generally monoaxial?); metallic pearly. Usually dark-green, brown, or black; streak greenish-gray or white. B.B. difficultly fusible to a gray or black glass. Completely soluble in con. s. acid, leaving white pearly plates of silica. Chem. com. very variable, but analyses give 40 to 42 silica, 13 to 16 alumina, 0 to 20 iron peroxide, 0 to 20 iron protoxide, 10 to 25 magnesia, 4 to 10 potash, 0 to 2 fluorine, and 1 to 3 water. Pargas, Bodenmais, Monroe in New York, Greenland, near Aberdeen, and in other parts of Scotland. *Rubellan*, brownish-red, Bohemia and Saxony, seems a variety.

71. PHLOGOPITE.—$\overline{\ddot{A}l}\;\ddot{Si} + (\dot{M}g, \dot{K}, \dot{N}a)^3\,\ddot{Si}^2$.

Rhombic (or rhombohedric?), in rhombic or hexagonal prisms. Cleavage, basal. Yellow or copper-red; also colourless, white, and brown. B.B. fuses to a white enamel. Chem. com. 38 to 42 silica, 13 to 20 alumina, 2 to 7 iron oxides, 25 to 30 magnesia, 6 to 10 potash, 1 to 5 soda, and 0·2 to 4 fluorine. In limestones, New York, Vosges Mountains, Sala.

72. LEPIDOMELANE.—$(\overline{\ddot{A}l}, \overline{\ddot{F}e})\;\ddot{Si} + (\dot{F}e, \dot{K})\;\ddot{Si}$.

Hexagonal, small six-sided tables. Cleavage, basal perfect; rather brittle. H.$=$3; G.$=$3·0. Highly vitreous; opaque and raven-black; or translucent and leek-green; streak mountain-green. B.B. becomes brown, and fuses to a black magnetic bead. Soluble in h. acid, leaving pearly scales of silica. Chem. com. 37·4 silica, 11·6 alumina, 27·7 iron peroxide, 12·4 iron protoxide, 9·2 potash, with 0·6 magnesia and lime. Persberg, Sweden.

73. CHLORITOID.—$\overline{\ddot{A}l}^2\,\ddot{Si} + (\dot{F}e, \dot{M}g)\;\ddot{Si}$.

Granular, foliated. Cleavage, in one direction perfect; brittle. H.$=$5·5...6; G$=$3·55. Opaque; weak pearly. Blackish-green; streak greenish-white. B.B. infusible, but becomes darker and magnetic. Not affected by acids. Chem. com. 26·2 silica, 43·4 alumina, and 30·4 iron protoxide, with 0 to 4 magnesia, and mostly 6 to 7 water. Kosoibrod in the Ural, Tyrol. *Sismondine*, St Marcel in Piedmont, is similar; and *Masonite*, from Rhode Island.

74. OTTRELITE.—$\overline{\ddot{A}l}^2\,\ddot{Si}^3 + 3\,(\dot{F}e, \dot{M}n)\;\ddot{Si} + 3\,\dot{H}$.

Thin hexagonal tables. Cleavage, parallel to the lateral faces, rather perfect. Scratches glass. G.$=$4·4. Translucent; vitreous. Greenish or blackish-gray. B.B. melts difficultly on the edges to a black magnetic globule. Powder soluble in warm s. acid. Chem. com. 43·9 silica, 24·3 alumina, 17·0 iron protoxide, 8·5 manganese protoxide, and 6·3 water. In gray clay-slate at Ottrez in Belgium.

**75. CHLORITE (Ripidolite, *G. Rose.*) $\left\{\begin{array}{l}2\,\dot{R}\,\ddot{Si} + \dot{R}^3\,\overline{\ddot{A}l} + 3\,\dot{H}, \textit{ or} \\ 3\,\dot{R}^3\,Si + \dddot{R}^2\,\ddot{Si} + 9\,\dot{H}\ (\textit{Rams.})\end{array}\right.$

Hexagonal; P 106° 50′; crystals tabular of 0P. ∞P, or 0P. P, (fig. 123), often in comb-like or other groups; generally foliated and scaly. Cleavage, basal perfect; laminæ flexible, but not elastic. H.$=$1...1·5; G.$=$2·78...2·96. Thin plates transparent or translucent; pearly. Leek to blackish green, often red transverse to the chief axis; streak greenish-gray. In the closed tube yields water. B.B. difficultly fusible on thin edges; soluble in con. sul. acid. Chem. com. when 4 $\dot{R}$

Fig. 123.

$=$3 Mg$+\dot{F}e$, $=$26·3 sil., 21·8 al., 25·5 mag., 15·0 $\dot{F}e$, and 11·5 water.
$=$2 $\dot{M}g$$+2\dot{F}$, $=$24·6 ... 20·1 ... 15·9 ... 28·5 ... 10·9 ...

but the analyses variable. Common in the Alps, Scandinavia, the Ural, the Harz, Cornwall, and many parts of Scotland.

76. RIPIDOLITE, Pennine (Chlorite, *G. Rose*). $\left\{\begin{array}{l}3\,\dot{M}g\,\ddot{Si} + \dot{M}g^3\,\overline{\ddot{A}l} + 4\,\dot{H}, \textit{ or} \\ 3\,\dot{R}^3\,\ddot{Si} + \dddot{R}^2\,\ddot{Si} + 9\,\dot{H}\ (\textit{Rams.})\end{array}\right.$

Rhombohedric (?); R 63° 15′; crystals chiefly tabular, in comb-like or fan-shaped groups. Cleavage, basal very perfect; sectile and flexible, but not elastic. H.$=$2...3; G.$=$2·6...2·77. Translucent, in thin leaves transparent; pearly. Green, but red by light transmitted transverse to the axis; streak greenish-white. B.B. exfoliates, becomes white, and fuses on the edges to a white enamel. Completely soluble in warm s. acid. Chem. com. 33·2 silica, 18·3 alumina, 35·7 magnesia, and 13·8 water, but with 1 to 7 peroxide, and 1 to 6 protoxide of iron. Zermatt in Valais, Schwarzenstein in Tyrol, and Mauleon in the Pyrenees. *Leuchtenbergite*, yellowish-white, from Slatoust, is the same.

N.B.—Chlorite and Ripidolite may be regarded as one species, with the formula $\dot{R}^3\,(\ddot{Si}, \overline{\ddot{A}l})^2 + 3\,\dot{H}$ (*Rams.*)

77. CLINOCHLORE.

Monoclinohedric; C$=$76° 4′; 0P : P 113° 59′, 0P : ∞P 102° 8′. Macles common; also in groups and druses. Other characters and chem. com. like ripidolite, and the two probably identical. West Chester in Pennsylvania, Achmatowsk in Ural, and Leugast in Bavaria (massive).

Epichlorite, *Metachlorite*, *Helminth*, *Delessite*, and *Grengesite* are other chlorite-like minerals.

**78. TALC.—$\dot{M}g^4\,\ddot{Si}^3 + \dot{H}$, *or* $\dot{M}g^6\,\ddot{Si}^5 + 2\,\dot{H}$.

Monoclinohedric; ∞P2$=$105° 50′. Rarely found in six-sided or rhombic tables. Generally massive, granular, or scaly. Cleavage, basal very perfect. Soft, sectile, and flexible, in thin plates. H.$=$1; G.$=$2·68...2·80. Transparent in thin plates, and optically binaxial; pearly or resinous. Colourless, but generally greenish or yellowish-white, to apple, leek, or olive green. Feels very greasy. B.B. emits a bright light, exfoliates, and hardens (H.$=$6), but is infusible. Not soluble in h. or s. acid before or after ignition. Chem. com. 62·5 silica, 33·9 magnesia, and 3·6 water; but analyses give 57 to 63 silica, 0 to 4·7 alumina, 30 to 35 magnesia, 0 to 2·3 iron protoxide, with traces of lime and nickel oxide, and 2 to 6 water. Greiner in Tyrol, Sala, Fahlun, the Pyrenees, Unst in Zetland, and many parts

of the Scottish Highlands (talc-slate). Used as crayons; also for forming crucibles and porcelain.

Steatite.—Massive. Gray, red, yellow, or green. B.B. melts in fine splinters to a white enamel; but in other respects acts like talc, of which it seems only a compact variety. Briançon, Wunsiedel, the Lizard Point, Cornwall, and near Kirkcaldy, Scotland. Savage nations cut the steatite into culinary utensils. *Potstone* is a mixture of talc, chlorite, and other minerals. Steatite and talc are apparently altered forms of other minerals, chiefly augite and hornblende.

79. Schillerspar.—$\dot{M}g\,(\dot{F}e, \dot{C}a), \ddot{S}i\,(\ddot{\bar{A}}l, \ddot{\bar{C}}r, \ddot{\bar{F}}e) + \dot{H}$.

Mono- or tri-clinohedric; only granular and foliated. Cleavage very perfect in one direction, less so in another, meeting at 87°; fracture uneven, splintery. H.=3·5...4; G.=2·6...2·8. Translucent on thin edges; metallic pearly. Olive or pistacio green, yellow, brown, or black; streak greenish white. Imperfectly soluble in h., wholly in s. acid. B.B. becomes magnetic, and fuses in thin splinters on the edges. With borax traces of iron when hot, of chrome when cold. Chem. com. 43 silica, 26 magnesia, 2·7 lime, 7·4 iron protoxide, 3·3 iron peroxide, 2·4 chrome-oxide, 1·7 alumina, and 12·4 water. Baste in the Harz; other localities uncertain. Probably an altered augite.

Metaxite, massive, asbestiform, weak pearly, and greenish-white; H.=2...2·5 nearly; G.=2·52; Schwarzenberg; is closely related.

80. Pyrosmalite. $\left\{ \begin{array}{l} 15\,\dot{F}e\,\ddot{S}i + 15\,\dot{M}n\,\ddot{S}i + 3\,\ddot{\bar{F}}e\,\dot{H} \\ + Fe^2\,Cl^3 \end{array}\right.$

Hexagonal; P 101° 34′; crystals ∞P . 0P, tabular; also granular. Cleavage, basal perfect, ∞P imperfect; brittle. H.=4...4·5; G.=3·0...3·2. Translucent to opaque; resinous, or metallic pearly. Liver-brown to olive-green. B.B. fuses to a black magnetic globule. Wholly soluble in c. n. acid. Chem. com. 38·5 silica, 22 iron protoxide, 22 manganese protoxide, 13 iron peroxide, 3·4 hydrochloric acid, and 1·1 water. Nordmark in Sweden.

81. Cronstedtite, Chloromelan. $\Big\}$ $\ddot{\bar{F}}e^2\,\ddot{S}i + 2\,(\dot{F}e, \dot{M}g)^3\,\ddot{S}i + 5\,\dot{H}$.

Rhombohedric, chiefly radiated, columnar. Cleavage, basal perfect; thin laminæ elastic. H.=2·5; G.=3·3...3·5. Opaque or translucent; highly vitreous. Raven-black; streak dark-green. B.B. intumesces, and melts on the edges slowly to a steel-gray globule. Gelatinizes with h. or s. acid. Chem. com. 21·8 silica, 37·6 iron peroxide (with 2·9 manganese peroxide), 25·4 iron protoxide, 4·7 magnesia, and 10·5 water. Przibram in Bohemia; Huel Maudlin, Cornwall; and Conghonas do Campo in Brazil (*Sideroschisolite*).

82. Stilpnomelan.—$(\dot{F}e, \dot{M}g)^3\,(\ddot{S}i, \ddot{\bar{A}}l)^2 + 2\,\dot{H}$.

Massive or radiating-foliated. Cleavage in one direction very perfect; rather brittle. H.=3...4; G.=3...3·4. Opaque; vitreous, inclining to pearly. Greenish-black; streak greenish. B.B. fuses with difficulty to a black shining globule. Imperfectly decomposed by acids. Chem. com. 45·3 silica, 6·9 alumina, 38·3 iron protoxide (with 2 to 3 magnesia), and 9·5 water. Zuckmantel in Silesia, and Wielburg in Nassau.

83. Clintonite, Seybertite, Holmesite, Xanthophylite, Chrysophane. $\left\{ \begin{array}{l} \ddot{S}i, \ddot{\bar{A}}l, \dot{M}g, \dot{C}a, \\ \dot{F}e, \dot{N}a, \dot{H}. \end{array}\right.$

Hexagonal tables, or massive and foliated. Cleavage very perfect in one direction, traces in another. H.=4·5...6; G.=3 to 3·16. Translucent; pearly on the cleavage planes. Wax-yellow, yellowish, or reddish-brown. Soluble in concentrated acids. B.B. infusible alone, but some become white and colour the flame yellow. Chem. com. uncertain. Amity, New York; Slatoust in the Ural.

Disterrite, Brandisite, from Monzoni, in Tyrol; H.=5 on basis, 6...6·5 on the prism; when fresh blackish-green, but reddish-brown after exposure; is closely allied.

Groppite.—Coarse foliated. H.=2·5, G.=2·73. Rose or brown-red. Gropptorp in Sweden.

84. Margarite, Pearl-Mica, Emerylite. $\Big\}$ $\ddot{\bar{A}}l^2\,\ddot{S}i + (\dot{C}a, \dot{N}a, \dot{M}g)\,\ddot{S}i + \dot{H}$.

Rhombic; rarely in six-sided tables; generally granular foliated. Cleavage, basal very perfect. Thin plates slightly elastic. H.=3·5...4·5; G.=3·032. Translucent; vitreous, or pearly. Snow-white, reddish-white, or pearl-gray. B.B. intumesces and difficultly fusible. Soluble in acids. Chem. com. 30·1 silica, 51·2 alumina, 11·6 lime, 2·6 soda, 0·5 to 3 magnesia, and 4·5 water. Sterzing in Tyrol; Asia Minor and Greece, with emery; and in Pennsylvania. *Diphanite*, in hexagonal prisms, bluish-white; B.B. fuses to an enamel; from the Ural; is nearly allied.

Euphyllite.—Like mica, but less readily cleavable. H.=4; G.=3. Pellucid; bright pearly; colourless. B.B. exfoliates with a bright light, and fuses on the edges. Contains 40 silica, 42 alumina, 1·4 iron peroxide, 1·4 lime, 3·3 potash, 5 soda, and 5·5 water. Unionville, Pennsylvania.

85. Pyrophyllite.—$\ddot{\bar{A}}l\,\ddot{S}i^4 + \dot{H}$.

Rhombic(?), but radiated, columnar, or foliated. Cleavage very perfect; flexible; sectile. H.=1; G.=2·7...2·8. Translucent; pearly. Light verdigris-green to yellowish-white. B.B. swells up with many twistings to a white infusible mass. Partially soluble in sulphuric acid. Chem. com. 67 silica, 28·1 alumina, and 4·9 water, with 0·1 to 4 magnesia and lime. Ural, Spaa, Morbihan, and Westana in Sweden.

86. Anauxite.

Granular, with a very perfect cleavage in one direction. H.=2...3; G.=2·26. Translucent on the edges; pearly. Greenish-white. B.B. becomes white and fuses on thin edges. Chem. com. 55·7 silica, much alumina, a little magnesia, iron protoxide, and 11·5 water. Bilin in Bohemia.

87. Pholerite, Nacrite.—$\ddot{\bar{A}}l^3\,\ddot{S}i^2 + 4\,\dot{H}$.

Fine scaly. H.=0·5...1; G.=2·35...2·57. Glimmering or pearly. Snow or yellowish white. B.B. infusible. Chem. com. 40 silica, 44·4 alumina, and 15·6 water. Fins in the Allier dept., Mons, Freiberg, and Naxos.

88. Rosellan, Polyargite, Rosite. $\Big\}$ $\ddot{\bar{A}}l^3\,\ddot{S}i^3 + (\dot{K}, \dot{C}a, \dot{M}g)\,\ddot{S}i + 2\,\dot{H}$.

Small grains, with perfect cleavage. H.=2·5; G.=2·72. Translucent; splendent; fine rose-red. B.B. fuses with difficulty to a white slag. Chem. com. 45 silica, 35 alumina, 6·6 potash, 3·6 lime, 2·45 magnesia, and 6·5 water. Aker and Tunaberg in Sweden.

** Family VIII.—Serpentine.

Massive or rhombic. H.=1...4, rarely more; G.=2·3...3. Often compact or fibrous. B.B. infusible or difficultly. Mostly soluble in acids. Colour often green. Chem. com. generally hydrated silicates of magnesia, partly replaced by protoxide of iron or lime, occasionally also with silicate of alumina or iron peroxide. Occur in plutonic or altered rocks; the serpentine often in large masses or beds.

**89. Serpentine. — $\dot{M}g^3\,\ddot{S}i^2 + 2\,\dot{H}$, *or* $\dot{M}g^9\,\ddot{S}i^4 + 6\,\dot{H}$.

Crystallization uncertain; generally massive, and granular or fibrous. Fracture flat-conchoidal, uneven, or splintery. Sectile and slightly brittle. H.=3...3·5; G.=2·5...2·6. Translucent to opaque; dull resinous. Green, gray, yellow, red, or brown, often in spots, stripes, or veins; streak white, shining. Feels greasy. In the closed tube yields water and becomes black. B.B. becomes white, and fuses with much difficulty on thin edges. Soluble in h. or easier in s. acid. Chem. com. 43·35 silica, 43·78 magnesia, and 12·87 water, but with 1 to 8 iron protoxide, and also carbonic acid, bitumen, and chrome oxide.

Varieties are,—1*st*, Noble Serpentine; 2*d*, Marmolite or foliated; 3*d*, Picrolite or fibrous (H.=3·5...4·5); 4*th*, Common or compact Serpentine; 5*th*, *Chrysotile* (*Baltimorite*, *Metaxite*), in fine asbestiform fibres, easily separated, with a metallic or silky lustre. G.=2·219. Common in Norway, Sweden, North America, the Lizard Point in Cornwall, in Shetland, Portsoy, and many parts of Scotland. The chrysotile, at Reichenstein in Silesia, the Vosges Mountains, and North America.

90. ANTIGORITE.—$(\dot{Mg}, \dot{Fe})^4 \ddot{Si}^3 + \dot{H}$ (?).

Very thin, straight, slaty laminæ. H.=2·5; G.=2·62. Transparent or translucent. Dull or blackish leek-green, in some parts with brown spots; streak white. B.B. very thin edges fuse to a yellowish-brown enamel. Chem. com. 46 silica, 2 alumina, 13 iron protoxide, 35 magnesia, and 3·7 water (but others 13 water). Antigorio in Piedmont.

91. HYDROPHITE.—$(\dot{Mg}, \dot{Fe})^4 \ddot{Si}^2 + 4\,\dot{H}$.

Massive or fibrous. Fracture uneven. H.=3...4; G.=2·65. Mountain-green; streak lighter. B.B. infusible. Chem. com. 36·19 silica, 22·73 iron protoxide, 1·66 manganese protoxide, 21·08 magnesia, 2·89 alumina, 0·12 vanadic acid, 16·08 water. Taberg in Sweden, and New York.

92. PICROSMINE.—$2\,\dot{Mg}\,\ddot{Si} + \dot{H}$.

Rhombic, but massive. Cleavage, $\infty\breve{P}\infty$ perfect; less so in other directions. Very sectile. H.=2·5...3; G.=2·5...2·7. Translucent or opaque; vitreous, but pearly on $\infty\breve{P}\infty$. Greenish-white, gray, or blackish-green; streak colourless. Yields a bitter odour when breathed on (hence the name). In closed tube gives water and blackens. B.B. becomes white, and hard (=5). Chem. com. 55·8 silica, 36·1 magnesia, and 8·1 water. Presnitz in Bohemia, and the Greiner in Tyrol.

Monradite.—Massive, foliated, translucent, and yellowish-gray. H.=6; G.=3·267. Has nearly the same composition, but with half the water. B.B. infusible. Bergen, Norway.

Picrophyll.—Dark-green, foliated. G.=2·73; H.=2·5. B.B. infusible, but becoming white. Is also nearly related. Sala.

93. VILLARSITE.—$2\,\dot{Mg}^2\,\ddot{Si} + \dot{H}$.

Rhombic; crystals $\infty P . \breve{P} . 0P$, with $\infty P = 119° 59'$ (?); also granular. Fracture uneven. H.=3; G.=2·9...3. Translucent. Greenish or grayish-yellow. B.B. infusible; decomposed by acids. Chem. com. 41 silica, 53 magnesia, with 34 iron protoxide and 23 manganese protoxide, and 6 water. Probably a pseudomorph of Olivine. Traversella in Piemont.

94. SPADAITE.—$\dot{Mg}^5\,\ddot{Si}^4 + 4\,\dot{H}$.

Only massive, with splintery fracture. Sectile. H.=2·5. Translucent; weak resinous. Red; streak white. B.B. fuses to an enamel-like glass; soluble in con. h. acid, leaving slimy silica. Chem. com. 57 silica, 32 magnesia, and 11 water. Capo di Bove, near Rome.

95. GYMNITE, Deweylite.—$\dot{Mg}^4\,\ddot{Si}^3 + 5\,\dot{H}$.

Only massive. H.=2...3; G.=2·2...2·4. Semi-translucent; resinous. Pale or dirty orange-yellow. B.B. becomes dark-brown, and fuses on very thin edges. Chem. com. 42·1 silica, 37 magnesia, and 20·9 water. Bare Hills near Baltimore, and Tyrol.

96. CHONIKRITE.—$3\,(\dot{Mg}, \dot{Ca}, \dot{Fe})\,(\ddot{Si}, \dddot{Al}) + 2\,\dot{H}$.

Massive. Fracture uneven. Sectile. H.=2·5...3; G.=2·91. Translucent; dull or glimmering. Snow, yellowish, or grayish-white. B.B. melts with ebullition to a grayish-white glass; soluble with deposition of silica in h. acid. Chem. com. 35·7 silica, 17·1 alumina, 22·5 magnesia, 12·6 lime, 1·5 iron protoxide, and 9 water. Elba.

97. PYROSCLERITE.—$3\,\dot{Mg}^3\,\ddot{Si} + \dddot{Al}\,\ddot{Si} + 4\,\dot{H}$.

Massive. Cleavage, in two directions at right angles, the one perfect, the other imperfect; fracture uneven, splintery. Sectile. H.=3; G.=2·7...2·8. Translucent; dull, or weak pearly. Apple, emerald, or grayish green. B.B. fuses with difficulty to a gray glass. With borax forms a chrome-green glass. The powder soluble in c. h. acid, leaving silica. Chem. com. 36·8 silica, 15·2 alumina (with 1·5 chrome-oxide), 33·7 magnesia, 3·5 iron protoxide, and 10·7 water. Elba, Aker in Södermanland.

98. KAMMERERITE.—$3\,\dot{Mg}^3\,\ddot{Si} + \dddot{Al}\,\ddot{Si} + 5\,\dot{H}$.

Hexagonal; $0P . \infty P$ tabular and prismatic; but usually massive and foliated. Cleavage, basal perfect. Sectile; flexible. H.=1·5...2; G.=2·76. Translucent; pearly. Violet-blue, reddish, or greenish. Feels greasy. B.B. exfoliates without fusing. Chem. com. 37·0 silica, 14·2 alumina, 1·0 chrome-oxide, 31·5 magnesia, 1·5 lime, 1·5 iron protoxide, and 13·0 water. Bissersk in Siberia.

Rhodochrome.—Massive, fine scaly, splintery fracture. H.=2·5...3; G.=2·668. Greenish-black, in fine splinters peach-blossom red. Tino in Greece, the Ural, Styria, and near Baltimore.

Tabergite, from Taberg; *Vermiculite*, in fine scales, twisting up, B.B., from Millbury, Mass.; and *Loganite*, from Canada, are closely allied.

99. BRUCITE, Nemalite.—$\dot{Mg}\,\dot{H}$.

Rhombohedric; R. 82° 15′; crystals 0R, ∞R; also foliated or columnar. Cleavage, basal very perfect. Sectile; fine laminæ flexible. H.=2; G.=2·3...2·4. Translucent; pearly. Colourless, or grayish and greenish-white. B.B. infusible; easily soluble in acids. Chem. com. 69 magnesia, and 31 water, but after exposure often contains carbonic acid and effervesces. *Nemalite* is the fine fibrous varieties with silky lustre. Swinaness in Unst, Hoboken in New Jersey, and Beresowsk in the Ural.

** FAMILY IX.—HORNBLENDE.

Monoclinohedric mostly. Distinct cleavage in several directions. H.=4...6, but generally 5, or scratch with knife; G.=2·5...4, but mostly high. Mostly coloured, ranging from white, through green (rarely brown), to black. Lustre sometimes silky or metallic pearly. Soluble, but not very readily, in acids; and more or less easily fusible. Chem. com. anhydrous silicates and aluminates of lime, magnesia, iron protoxide, more sparingly of soda, yttria, and manganese protoxide. The chief species are essential constituents of the igneous rocks, and form by their decomposition highly fertile soils.

N.B.—Hornblende and Augite rather represent groups of mineral substances than single species.

**100. HORNBLENDE, Amphibole. $\left\{ \begin{array}{l} \dot{R}^4\,\ddot{Si}^3 = (\dot{Mg}, \dot{Ca}, \dot{Fe})^3\,(\ddot{Si}\,\dddot{Al})^4, or \\ \dot{R}^4\,\ddot{Si}^3 . \end{array} \right.$

Monoclinohedric; C=75° 10′, ∞P 124° 30′, P 148° 30′. The crystals short and thick, or long and thin prismatic, formed especially by ∞P (*M*) and (∞P∞) (*x*), and bounded on the ends chiefly by 0P and P (*r*) (fig. 123). Macles common, with the chief axis the twin axis. Very often radiated, fibrous or columnar, or granular. Cleavage, prismatic along ∞P 124½° very perfect, orthodiagonal and clinodiagonal very imperfect. H.=5...6; G.=2·9...3·4. Pellucid in all degrees; vitreous, but sometimes pearly or silky. Colourless; often white, but usually some shade of gray, yellow, green, brown, or black. B.B. fuses, generally intumescing and boiling, to a gray, green, or black glass. Those containing most iron are most fusible, and are also partially soluble in hydrochloric acid, which scarcely affects the others. Chem. com. very variable, and hardly reducible to any general formula. Analyses range from 40 to 60 per cent. silica, 0 to 17 alumina, 0 to 30 lime, 0 to 36 iron protoxide (or peroxide), 0 to 4 manganese protoxide, 0 to 8 soda, 0 to 3 potash, and 0 to 1·5 fluorine, with a little water.

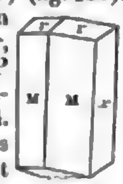


Fig. 124.

Mineralogy.

The more remarkable varieties are,—

1. *Tremolite*, *Grammatite*, or *Calamite*.—$3\,\dot{M}g^3\,\ddot{S}i^4 + \dot{C}a^3\,\ddot{S}i^4 + \dot{C}a\,F^1$, with 60·85 silica, 24·53 magnesia, 13·74 lime, and 0·88 fluoric acid. White, gray, green, rarely yellowish or blue; in long prismatic crystals, often bent and striated longitudinally. Pearly or silky; semitransparent or translucent. B.B. fuses readily to a white or nearly colourless glass. Lapland, Sweden, Arendal, Campo Longo, St Gotthardt, and other parts of the Alps; in the Pyrenees, Silesia, Siberia, North America; Glen Tilt, Glenelg, Tiree, and many parts of Scotland.

2. *Actinolite*, *Actinote*, or *Strahlstein*.—Colour green, inclining to black, gray, or brown. Translucent, or only on the edges. Long prismatic crystals, or radiated columnar masses. B.B. melts to a greenish or blackish enamel. Sweden, Tyrol, North America, Glenelg, Isle Oronsay, and Aberdeenshire.

3. *Asbestus*, *Amianthus*, and *Byssolite*.—Fine fibrous. White, gray, or green. The fibres often easily separable, elastic, and flexible. Savoy, Tyrol, and Corsica. *Rock-cork*, felt-like, and swims on water; Saxony, Sweden, Portsoy and Leadhills in Scotland. *Rock-leather*, flat and flexible; Leadhills, Aberdeenshire, and Strontian; and *Rock-wood*, near Sterzing in the Tyrol.

4. *Anthophyllite*.—Clove-brown to leek-green; translucent, radiating, and columnar; pearly on cleavage planes. B.B. very difficultly fusible. In it the lime is chiefly replaced by protoxide of iron. Kongsberg and near Brevig in Norway, Greenland, and the United States.

5. *Hornblende*.—Green or black, seldomer brown or gray. G.=3·3...4. B.B. fuses rather easily to a yellow, greenish, or black enamel. $(\dot{M}g^3 + \dot{C}a^3)\,\ddot{S}i^4 + \dot{F}e\,\bar{\bar{A}}l$, with 47·9 silica, 13·2 alumina, 15·5 magnesia, 14·4 lime, and 9·0 iron protoxide in the black variety. Three varieties are distinguished. (*a*.) The Noble or *Pargasite*, pale celadine or olive-green, and strong pearly or vitreous lustre; at Pargas in Finland, Tyrie in Scotland. (*b*.) Common Hornblende, dark leek or blackish green, opaque; a constituent of many rocks, as in Norway, the Alps, and Scottish Highlands (Ben Lair, East Rona). Streak greenish-gray. (*c*.) Basaltic, velvet-black, foliated, opaque; streak gray or brown, in basalt and volcanic rock. Ural, Arendal, Bohemia.

Arfvedsonite.—$3\,\dot{F}e^3\,\ddot{S}i^2 + \dot{N}a^3\,\ddot{S}i^4$, with 52·3 silica (2 alumina), 36·9 iron protoxide, 8·6 soda, and 2 lime. Pure black, opaque; streak grayish-green. Cleavage, very perfect along a prism of 123° 55′. G.=3·44; H.=6. Fusible in fine splinters in the flame of a candle. B.B. intumesces much, and melts to a black magnetic globule. Not soluble in acids. Greenland, Frederiksvärn in Norway, and Arendal.

The *Raphilite*, from Upper Canada, seems only tremolite.

Uralite.—Dark-green or greenish-black, with the outward form of augite, the internal structure and composition of hornblende. The Ural. Is probably a pseudomorph.

**101. Augite, Pyroxene. $\begin{cases} \dot{C}a\ \ddot{S}i + (\dot{M}g,\ \dot{F}e)\ \ddot{S}i, \textit{ or} \\ \dot{C}a^3\ \dddot{S}i^2 + (\dot{M}g,\ \dot{F}e)^3\ \ddot{S}i^2. \end{cases}$

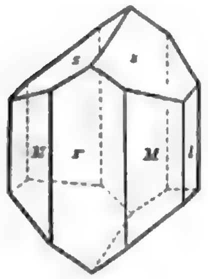


Fig. 125.

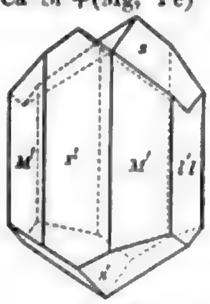


Fig. 126.

Monoclinohedric; C.=74°, ∞P 87° 6′, P 120° 39′, —P 131° 29′, 2P 96° 36′. Crystals, ∞P (M). ∞P∞ (r). (∞P∞) (l). P (s). (fig. 125) ∞P . 2P . 0P . 3 P. ∞P∞, and ∞P∞. (∞P∞) . P∞ . ∞P, almost always prismatic, imbedded, or attached; also granular, columnar, and scaly. Macles (fig. 126) common. Cleavage, prismatic along ∞P (with angles of 87° 6′ and 92° 54′), generally rather imperfect: orthodiagonal and clinodiagonal imperfect. H.=5...6; G.=3·2...3·5. Pellucid in all degrees; vitreous; in some pearly on ∞P∞. Colourless, and white, but usually gray, green, or black. B.B. generally fusible; imperfectly soluble in acids. Chem. com. generally

	Silica.	Lime.	Magnesia.	Iron.
a. Magnesia-augite	56·36	25·46	18·18	...
b. Magnesia-iron-augite	52·72	23·81	8·50	14·97
c. Iron-augite	49·52	22·37	...	28·11

Analysis gives 47 to 56 silica, 20 to 25 lime, 5 to 15 magnesia, 1 to 20 iron protoxide, with 0 to 3 manganese protoxide, and 0 to 8 alumina. The alumina, chiefly found in very dark green or black augites, may replace part of the silica.

The more important varieties are—

1. *Diopside*.—Grayish or greenish-white, to pearl-gray or leek-green; streak white. Crystallized or broad-columnar, or concentric lamellar. Transparent to translucent on the edges. Not affected by acids. B.B. fuses to a whitish semitransparent glass. Mussa Alpe (*Mussite*) and Ala (*Alalite*) in Piedmont, Swarzenstein in the Tyrol; also the Alps, Scandinavia, Finnland, Ural, and North America.

2. *Sahlite*, *Malacolite*.—Green, rarely yellow, brown or red; streak white. Translucent, or only on the edges; vitreous, inclining to pearly. Seldom crystallized (*Baikalite*), mostly columnar or lamellar. B.B. melts to a dark-coloured glass. Fassathal (*Fassaite*), Piedmont, Arendal, Philipstadt in Sweden; in the vicinity of Lake Baikal (*Baikalite*); near Lake Lherz in the Pyrenees (*Lherzolite*); Sahla, Sweden; Glentilt, Glenelg, Tiree, in Scotland; Tyrol, and North America. *Coccolite* is a distinct granular sahlite or augite.

3. *Augite*.—Leek-green, greenish-black, or velvet-black, rarely brown; streak greenish-gray. Vitreous to resinous; translucent or opaque. Only slightly affected by acids. B.B. fuses to a black, often magnetic glass. An essential component of many rocks, basalt, dolerite, clinkstone, and augite porphyry, in Germany, Auvergne, Vesuvius, and in many parts of Scotland; associated chiefly with labradorite, also with olivine, leucite, or nepheline; rarely if ever with quartz.

4. *Hedenbergite*.—Black or blackish-green; opaque or translucent on the edges. B.B. melts to a black magnetic glass. Seems a lime-iron augite. Tunaberg. *Jeffersonite*, from Sparta, New Jersey; *Hudsonite*, from the Hudson River; and *Polylite*, are related.

5. *Amianthus*.—Some asbestiform minerals are probably augite, but the greater number are rather hornblende.

6. *Breislackite*.—Fine yellowish or brown woolly crystals. Vesuvius, and Capo di Bove near Rome.

Hornblende and augite agree so closely in crystalline forms and chemical composition, that it has sometimes been proposed to unite them in one species. They, however, differ too widely to justify their union. Thus, hornblende contains more silica, and a half to one per cent. of fluoric acid, which does not appear in augite. Hornblende, too, is more fusible, and ranges lower in specific gravity (hornblende from 2·931 to 3·445; augite, 3·195 to 3·525). Though both possess a cleavage parallel to their vertical prisms, yet these differ in angular dimensions. They also occur in distinct geognostic positions. Hornblende in rocks containing quartz or free silica, and mostly with minerals that are neutral compounds of silica, as orthoclase and albite; augite in rocks that do not contain free silica, and mostly with minerals that are not neutral silicates, as labradorite, olivine, and leucite. Hence there are two distinct series of massive or igneous rocks; the hornblende

series, including granite, syenite, diorite, diorite-porphyry, and red porphyry; and the augite series or hypersthene rock, gabbro, dolerite, nepheline rock, augite-porphyry, and leucite-porphyry.

102. NEPHRITE, Jade. $\begin{cases} 2\ \dot{Mg}\ \ddot{Si} + \dot{Ca}\ \ddot{Si}, \text{ or} \\ 3\ \dot{Mg}\ \ddot{Si} + \dot{Ca}\ \ddot{Si}. \end{cases}$

Compact; fracture coarse splintery. Very tenacious. H. = 6...6·5; G. = 2·9...3. Translucent, dull, or resinous. Leek-green, to greenish-white or blackish-green. Feels slightly greasy. B.B. become white and melt with difficulty to a gray mass. Chem. com. 57·7 silica, 24·8 magnesia, 17·4 lime; or 58·5 silica, 28·3 magnesia, and 13·2 lime, but with 1 to 3 protoxide of iron and 1 to 2·5 water. China and the East, also in New Zealand. Seem varieties of hornblende or augite. Cut into ring-stones or amulets.

103. BOLTONITE.—$(\dot{Mg}, \dot{Fe}, \dot{Ca})^5\ \ddot{Si}^2$.

Granular; cleavage, one perfect, two others in traces. Translucent. Bluish-gray changing to yellowish-gray on exposure. B.B infusible. Chem. com. 46 to 47 silica, 43 to 44 magnesia, 6 iron protoxide, and 3·5 lime. Bolton, Massachusetts.

104. HYPERSTHENE, Paulite.—$(\dot{Mg}, \dot{Fe})\ \ddot{Si}$.

Isomorphous with augite, ∞P 87°. Crystalline and granular, or disseminated. Cleavage, orthodiagonal very perfect, prismatic ∞P distinct, clinodiagonal very imperfect. H. = 6; G. = 3·3...3·4. Opaque or translucent on thin edges; vitreous or resinous, but metallic pearly on the cleavage planes, of which one is copper-coloured, two silvery. Pinchbeck-brown, inclining to copper-red, pitch-black, and grayish-black; streak greenish-gray. Not affected by acids. B.B. melts more or less easily to a greenish-black glass, often magnetic. Chem. com. generally 46 to 58 silica, 0 to 4 alumina, 11 to 26 magnesia, 1 to 5 lime, 13 to 34 iron protoxide, 0 to 6 manganese protoxide. Paul's Island (*Paulite*), Labrador, and Greenland. Hypersthene rock in Norway, Elfdal in Sweden, Skye and Ardnamurchan in Scotland. Also Cornwall; the Harz, and other parts of Germany.

*105. BRONZITE.—$(7\ \dot{Mg} + \dot{Fe})\ \ddot{Si}^2$.

Monoclinohedric, like augite; C. = 72°, ∞P 86°; indistinct crystals or granular. Cleavage, orthodiagonal very perfect, ∞P imperfect, clinodiagonal in traces. H. = 4·5...5; G. = 3·2...3·5. Translucent, or only on the edges; resinous or vitreous; on the more perfect cleavage planes, which are often slightly curved and fibrous; metallic-pearly or silky. Clove-brown to pinchbeck-brown, sometimes greenish or yellowish; streak white. Not affected by acids. B.B. very difficultly fusible to a dark-brown or blackish-green glass. Chem. com. 58·6 silica, 33·0 magnesia, and 8·4 iron protoxide; but also 1 to 2 alumina, 0 to 2·2 lime, and 0 to 3 manganese protoxide. Kraubat in Styria, Kupferberg in Baireuth, Ullenthal in Tyrol, and near Marburg.

*106. DIALLAGE.—$(\dot{Ca}, \dot{Mg}, \dot{Fe})\ \ddot{Si}$.

Like augite, and only a variety, with very perfect cleavage in the clinodiagonal, a metallic-pearly lustre, and gray or pinchbeck-brown colour. B.B. melts easily to a grayish or greenish enamel. Chem. com. 50 to 53 silica, 1 to 5 alumina, 15 to 23 magnesia, 11 to 20 lime, and 5 to 12 manganese protoxide. Constituent of the Gabbro. Baste in the Harz, Silesia, the Alps, Apennines, and Ural. *Vanadine-bronzite*, containing soda and vanadic acid, and *Diaclasite*, seem merely diallage.

107. RHODONITE, Manganese-spar.—$\dot{Mn}\ \ddot{Si}$.

Monoclinohedric, crystalline, or granular. Cleavage, ∞P 87° 5′ imperfect, (∞P∞) perfect, also ∞P∞. Brittle. H. = 5...5·5; G. = 3·5...3·6. Translucent; vitreous or partly pearly. Dark rose-red, bluish-red, or reddish-brown. Not affected by acids. B.B. fusible. Chem. com. 45·33 silica, and 53·67 manganese protoxide, with 3 to 5 lime, and 0 to 6 iron protoxide. Langbanshytta, Katharinenburg, the Harz, and New Jersey. The *Bustamite*, pale-greenish or reddish-gray, with 14 lime, Mexico; *Fowlerite*, New Jersey, with 7 to 11 iron protoxide, and *Paisbergite*, Sweden, are varieties. *Hydropite*, *Photicite*, *Allagite*, and *Hornmanganese*, mere mixtures.

108. WOLLASTONITE, Tabular-spar.—$\dot{Ca}\ \ddot{Si}$.

Monoclinohedric; C. = 84° 40′, ∞P 140°, or C. = 69° 48′, ∞P. 87°, 28′. Very rarely crystallized, mostly broad prismatic or laminar. Cleavage, along 0P and ∞P∞ perfect, but planes uneven or rough; meet at 95° 23′. H. = 5; G. = 2·7...2·9. Translucent; vitreous, or pearly on cleavage. White, inclining to gray, yellow, red, or brown; streak white. Phosphoresces with heat or friction; gelatinizes in hydrochloric acid. B.B. difficultly fusible to a semitransparent glass. Chem. com. 52·5 silica and 47·5 lime, but with 0 to 2 magnesia, and 0 to 2 iron protoxide. Bannat, Finnland, Sweden, North America, Ceylon, Capo di Bove, Monaltrie in Aberdeenshire, and the Castle Rock at Edinburgh.

110. ACMITE.—$2\ \dddot{Fe}\ \ddot{Si}^2 + \dot{Na}^2\ \ddot{Si}^3$.

Monoclinohedric. Crystals long acute-pointed prisms. Cleavage like augite, ∞P (86° 56′). H. = 6...6·5; G. = 3·4...3·6. Nearly opaque; vitreous. Brownish or greenish-black; streak greenish-gray. Imperfectly soluble in acids. B.B. fuses easily to a black magnetic glass. Chem. com. 55·6 silica, 32 iron peroxide, and 12·4 soda, but with 1 to 3 manganese peroxide, and also 3 to 4 titanic acid. Eger and Porsgrund in Norway.

111. BABINGTONITE.—$\dot{R}^4\ \ddot{Si}^3$, *or* $\dot{Ca}^2\ \ddot{Si}^3 + 2\ \dot{Fe}\ \ddot{Si}$.

Triclinohedric; $\infty\bar{P}\infty\ (M) : \infty\breve{P}\infty\ (t) = 112°\ 30'$; $\infty P'\ (h) : \infty' P\ (g) = 90°\ 40'$; $0P\ (P) : \infty\bar{P}\infty = 92°\ 34'$, $0P : \infty\breve{P}\infty = 88°\ 0'$; crystals very low eight-sided prisms (fig. 127), small, attached. Cleavage, basal and brachydiagonal perfect. H. = 5...5·5; G. = 3·4...3·5. Thin laminæ translucent, greenish, and brownish. Splendent vitreous; black. Slowly soluble in boiling h. acid. B.B. fuses easily with effervescence to a black magnetic bead. Chem. com. 54·7 silica, 20·3 lime, and 25·0 iron protoxide, but with 0·3 to 6 alumina, 2·2 magnesia, and 2 to 10 manganese protoxide. Arendal, Zetland, and Governeur, New York.

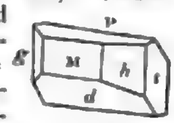


Fig. 127.

112. SORDAWALITE.—$\dddot{Al}\ \ddot{Si}^2 + 4\ (\dot{Mg}, \dot{Fe})\ \ddot{Si} + 2\dot{H}$.

Massive. Fracture conchoidal; brittle. H. = 4...4·5. G. = 2·55...2·62. Opaque; resinous or vitreous. Brownish-black or blackish-green; streak liver-brown. B.B. fuses to a black globule. Chem. com. 50·7 silica (with 2·68 phosphoric acid), 14 alumina, 19·6 iron protoxide, 10·9 magnesia, and 4·8 water. Sordawala in Finnland.

113. KROKYDOLITE.—$3\ \dot{Fe}\ \ddot{Si} + (\dot{Na}, \dot{Mg})\ \ddot{Si}^2 + 2\dot{H}$.

Very fine, easily separable, but tough elastic fibres. H. = 4; G. = 3·2...3·3. Translucent; silky, or dull. Indigo blue; streak lavender-blue. B.B. fuses easily to a black magnetic glass. Chem. com. 50·3 silica, 35·0 iron protoxide, 2·2 magnesia, 6·7 soda, and 5·8 water. Orange River in South Africa, Stavern in Norway, and Greenland.

114. PYRALLOLITE.

Triclinohedric; prismatic; usually columnar or granular. Cleavage, ∞P′ to ∞′P = 94° 36′ distinct. Fracture uneven, splintery; rather brittle. H. = 3·5...4; G. = 2·55...2·60. Opaque, or translucent on the edges; resinous, or pearly. Greenish-white, asparagus-green, and yellowish-gray. B.B. becomes black, then white, and fuses with very much difficulty. Chem. com. silicate of magnesia with a little silicate of lime, water, and bituminous matter. Storgard, Finnland. Probably decomposed augite.

115. ISOPYRE.—$(\dddot{Al}, \dddot{Fe})^2\ \ddot{Si}^3 + 3\ \dot{Ca}\ \ddot{Si}$ (?).

Brittle; fracture conchoidal. H.=5·5...6; G.=2·90...2·95. Opaque; vitreous. Grayish or velvet-black, sometimes with red spots; streak pale greenish-gray. Imperfectly soluble in acids. B.B. fuses to a magnetic globule. Chem. com., by Turner's analysis, 47·09 silica, 13·91 alumina, 15·43 lime, 20·07 iron peroxide, 1·94 copper oxide. St Just near Penzance, Calton Hill, Edinburgh (?).

116. TACHYLITE.—$\dddot{\bar{Al}}\,\dddot{Si}^2+3(\dot{Fe}, \dot{Ca}, \dot{Mg}, \dot{Mn}, \dot{Na}, \dot{K})\dddot{Si}$.

Conchoidal. H.=6·5; G.=2·52. Opaque; vitreous or resinous. Velvet, brownish, or greenish black; streak dark-gray. B.B. fuses very easily to an opaque glass; soluble in h. acid. Vogelsberg (*Hyalomelan*) near Dransfeld, Munden, and Iceland. Seems a vitreous basalt.

FAMILY X.—CLAYS.

Amorphous, earthy, variously-coloured masses. H.=1...5, but generally low or 1...3; G.=1...3, but often about 2. Many have a shining streak, adhere to the tongue, feel greasy, and fall down in water. Some then form a ductile paste and are used for pottery. These are slightly affected by acids (under 25 per cent. of mass, soluble.) They are chiefly silicates of alumina, with about 10 to 12 per cent. water. Others with 20 to 25 per cent. water, and almost entirely soluble in acids, do not become plastic, and in the fire become misshapen or fuse; but often combine with grease or oil to an earthy soap. Many are thus of great economic importance. They rarely form true species, and are mostly indefinite mixtures or mere products of the decomposition of rocks and minerals.

*117. KAOLIN, Porcelain-earth.—$\dddot{\bar{Al}}\,\dddot{Si}^2+2\dot{H}$.

Massive in beds and veins. Fracture uneven; fine-earthy, very soft, sectile, and friable. H.=1; G.=2·2. Opaque, dull. White or gray, inclining to blue, green, yellow, or red. Feels meagre when dry, and plastic when wet. B.B. infusible. Not affected by h. acid, but decomposed by warm s. acid, leaving silica. Chem. com. very variable, but approximates to 47·2 silica, 39·1 alumina, and 13·7 water. Chiefly a product of the decomposition of orthoclase, or of granite, porphyry, and other rocks containing this mineral. Cornwall and Devonshire in Britain, Limoges in France, Meissen in Saxony, are the chief localities for the kaolin used in manufacturing porcelain.

*118. CLAY.

Clays are merely varieties of kaolin, mixed with quartz-sand, carbonate of lime, magnesia, the oxyhydrates of iron and manganese, or other substances. Generally they are compact and friable, of white, yellow, red, blue, gray, or brown colours. Their spec. gr. varies from 1·8 to 2·7. Varieties are,—*Pipe-clay*, grayish or yellowish-white, with a greasy feel; adheres strongly to the tongue; and when wet is very plastic and tenacious, and in the fire burns white. Abundant in Devonshire, and in the Trough of Poole in Dorsetshire; in France, Belgium, and Germany. Used for manufacturing tobacco-pipes and similar articles. *Potter's clay*, red, yellow, green, or blue, becoming yellow or red when burnt; more easily fused than the former, and often effervesces with acids. That used in the potteries in England comes chiefly from Devonshire. *Loam*, coarser and more impure, with more sand, and consequently less plastic. *Shale* or *Slate-clay*, grayish-black, and much mixed with bituminous or carbonaceous matter. *Bituminous shale*, known by its shining, resinous streak. *Black chalk*, with more carbon, leaves a black mark on paper. *Iron-clay* contains much peroxide of iron, is reddish-brown, and forms the basis of many amygdaloids and porphyries.

119. ROCK-SOAP, Bergseife.

Compact. Fracture earthy or conchoidal; sectile. H.=1...2. Streak resinous. Colour pitch-black and bluish-black. Feels very greasy; writes, but does not soil. Adheres strongly to the tongue, and falls to pieces in water. Chem. com. 44 to 46 silica, 17 to 26 alumina, 6 to 10 iron peroxide, 13 to 25 water. Arnstedt, Cassel, Bilin, and Isle of Skye. Used for crayons by painters, and for washing cloth.

120. PLINTHITE.

Compact; earthy. H.=2...3; G.=2·34. Brick-red or brownish-red. Does not adhere to the tongue. B.B. becomes black, but is infusible. Chem. com. 30·9 silica, 20·8 alumina, 26·1 iron peroxide, 2·6 lime, and 10·6 water. Antrim in Ireland. *Erinite*, from the same place, is similar.

121. GREEN-EARTH.—$\dddot{Si}$, $\dddot{\bar{Al}}$, $\dot{Fe}$, $\dot{Mg}$ $\dot{K}$, $\dot{H}$.

Massive, forming crusts. Fracture, fine earthy; sectile. H.=1...2; G.=2·8. Opaque; streak shining. Green. Feels greasy. B.B. fuses to a black magnetic glass; not affected by acids. Common in the trap rocks of Faroe, Iceland, Scotland, and other countries; that used in the arts chiefly from Monte Baldo near Verona, and Cyprus. *Glauconite*, small round green grains, in the greensand of England, France, Germany, and North America, is essentially a hydrous silicate of iron protoxide and potash, but with 43 to 57 silica, 5 to 17 alumina, 19 to 27 iron protoxide, 5 to 15 potash, 1 to 4 magnesia, 0 to 3 lime, and 7 to 13 water. In New Jersey forms a valuable manure.

122. YELLOW-EARTH.—$(\dddot{\bar{Fe}}, \dddot{\bar{Al}})^2\,\dddot{Si}^3+4\dot{H}$.

Fracture fine earthy or slaty. H.=1...2; G.=2·2. Ochre-yellow. Greasy; adheres slightly to the tongue, and pulverizes in water. B.B. infusible, but becomes red; partially soluble in h. acid. A mixture of silicate of alumina, peroxide of iron, and water. Harz, France, and Scotland. Used as a coarse pigment.

123. HALLOYSITE.—$\dddot{\bar{Al}}\,\dddot{Si}+4\dot{H}$.

Reniform. H.=1·5...2·5; G.=1·9...2·1. Semitranslucent, and more so when moist. White, inclining to blue, green, or yellow. Adheres slightly to the tongue. B.B. infusible; soluble in c. s. acid. Chem. com. nearly 41·5 silica, 34·4 alumina, and 24·1 water. Liege, Tarnowitz, Thiviers in France; Eifel (*Lenzinite*); Scotland (*Tuesite*).

*124. FULLER'S-EARTH, Walkerde.

Fracture uneven, slaty, or earthy. H.=1...1·5; G.=1·8...2·0. Opaque; dull, but streak resinous. Green, gray, or white. Very greasy; scarcely adheres to the tongue. Falls down in water, but does not become plastic. That from Reigate in Surrey contained 53 silica, 10 alumina, 9·75 iron peroxide, 1·25 magnesia, 0·5 lime, and 24 water. It is used in preparing cloth,—the best for this purpose being found in England, as at Reigate, Maidstone in Kent, Woburn in Bedfordshire, &c.; also near Maxton in Scotland, in Saxony, Bohemia, and Styria.

125. ALLOPHANE.—$\dddot{\bar{Al}}\,\dddot{Si}+5\dot{H}$.

Botryoidal and reniform. Fracture conchoidal, brittle. H.=3; G.=1·8...2. Pellucid; vitreous. Pale-blue, white, green, or brown. B.B. intumesces and becomes white, but does not fuse; gelatinizes in acids. Chem. com. often near 24·3 silica, 40·4 alumina, and 35·3 water; occasionally with 2 to 3 oxides of iron or copper and 2 to 4 carbonate of lime or magnesia. Charlton near Woolwich, Baden, Bonn, and Saal-field.

126. SCHRÖTTERITE.—$\dddot{\bar{Al}}^3\,\dddot{Si}^2+20\dot{H}$.

Amorphous. Conchoidal. H.=3...3·5; G.=2. Greenish, yellowish, or with brown spots. B.B. infusible, but burns white; gelatinizes in h. acid. Freienstein in Styria.

127. BOLE.

Earthy, in nests and veins. Conchoidal. H.=1...2; G.=2·2...2·5. Opaque, or translucent on the edges; dull resinous; streak shining. Brown, yellow, or red. Feels greasy; some adhere strongly to the tongue, others not at all. In water crackle and fall to pieces. B.B. harden, and generally fuse to an enamel; in acids are more or less soluble. Chem. com. hydrous silicates of alumina and iron peroxide in various proportions. Dransfield, Stolpen, Cler

mont, Auvergne, the trap rocks of the Hebrides and other parts of Scotland, and Ireland. *Sinopite*, red, from Asia Minor, is supposed to be the Sinopian earth of antiquity. *Fettbol*, from Freiberg, and *Ochran*, of a yellow colour, are infusible B.B.

128. Teratolite.

Fracture uneven, or earthy. H.=2·5...3; G.=2·5. Opaque; dull. Lavender-blue to plum-blue, often with reddish-white veins and spots. Feels rough and meagre. B.B. infusible. Schuler's analysis gave 41·66 silica, 22·85 alumina, 12·98 iron peroxide, 3·04 lime, 2·55 magnesia, 0·93 potash, 1·68 manganese peroxide, 14·20 water (=99·89). Planitz near Zwickau; the *Terra miraculosa Saxoniæ* of old authors.

129. Kollyrite.—$\dddot{Al}^2\, \dddot{Si} + 10\, \dot{H}$.

Fine-earthy. Fracture even or conchoidal. H.=1...2; G.=2·0...2·15. Semitranslucent or opaque; dull or glimmering. Snow-white, rarely reddish, greenish, or yellowish. Feels greasy, and adheres strongly to the tongue. B.B. infusible; gelatinizes imperfectly with acids. Chem. com. 14 silica, 46 alumina, and 40 water. Schemnitz, Pyrenees, and Saxony. *Scarbroite*, from Scarborough, is similar, but with more (48) water.

130. Lithomarge, Steinmark.

Kaolin substances; in general compact, earthy, or pseudomorphous. H.=2·5...3·0; G.=2·4...2·6. Opaque, or dimly translucent; dull. White, yellow, or red. Feel greasy, and adhere more or less to the tongue. Landshut, Clausthal, and the Harz. Similar are *Carnat*, fine red; and *Myelin*, pale yellow or red, and reniform; both from Rochlitz in Saxony: also *Melopsite*, yellowish or greenish-white, from Neudeck in Bohemia.

131. Miloschin, Serbian.—$(\dddot{Al}, \dddot{Cr})\, \dddot{Si} + 3\, \dot{H}$.

Fracture conchoidal, or earthy. H.=2; G.=2·13. Indigo-blue to celadine-green. Adheres to the tongue, and crackles in water. B.B. infusible; partially soluble in h. acid. Contains 3·6 chrome oxide. Rudnaik in Servia.

132. Kerolite.—$4\, \dot{Mg}\, \dddot{Si} + \dddot{Al}\, \dddot{Si} + 15\, \dot{H}$.

Reniform. Uneven, conchoidal, or splintery; rather brittle. H.=2...3; G.=2·3...2·4. Translucent; dull resinous. White, inclining to gray, yellow, green, or red. Feels greasy, but does not adhere to the tongue. B.B. infusible. Frankenstein in Silesia.

133. Agalmatolite, Figure-stone, Pagodite. $\Big\}\; 4\, \dddot{Al}\, \dddot{Si}^2 + \dot{K}\, \dddot{Si}^3 + 3\, \dot{H}$.

Massive or slaty. Fracture splintery; rather sectile. H.=2...3; G.=2·8...2·9. Translucent, or only on the edges; dull or glimmering. Green, gray, red, and yellow. Feels somewhat greasy, but does not adhere to the tongue. B.B. burns white and fuses slightly on very thin edges; soluble in warm s. acid. Chem. com. 55 silica, 33·1 alumina, 7·6 potash, and 4·4 water, with 0·5 to 3 iron peroxide, and 0 to 3 lime. China, where it is cut into various works of art; also Nagyag in Hungary, and Saxony. *Cimolite*, pure white clay from Argentiera and Milo, used for cleaning cloth, is similar.

134. Soapstone, Saponite.—$6\, \dot{Mg}\, \dddot{Si} + \dddot{Al}\, \dddot{Si} + 5\, \dot{H}$.

Massive; sectile and very soft. H.=1·5; G.=2·26. White, or light-gray, yellow, and reddish-brown; streak shining. Feels greasy, and writes feebly; does not adhere to the tongue. B.B. fuses to a colourless porous glass; soluble in s. acid. Chem. com. 50 silica, 11·8 alumina, 27·8 magnesia, and 10·4 water. Lizard Point and St Clear in Cornwall, and Dalarne in Sweden (*Piotine*).

135. Onkosin.—$2\, \dddot{Al}\, \dddot{Si}^2 + (\dot{K}, \dot{Mg})\, \dddot{Si}^2 + 2\, \dot{H}$.

Fracture uneven or splintery; sectile. H.=2; G.=2·8. Translucent; slightly resinous. Apple-green or brown. B.B. intumesces and fuses; soluble in s. not in h. acid. Salzburg.

136. Pipestone.—$(\dddot{Al}, \dddot{Fe})\, \dddot{Si}^3 + (\dot{Na}, \dot{Ca}, \dot{Mg})\, \dddot{Si} + \dot{H}$.

Compact; fracture earthy; sectile. H.=1·5; G.=2·6. Opaque, dull. Grayish-blue, black, or red (*Catlinite*). B.B. infusible. Used by the North American Indians for pipes.

137. Meerschaum.—$2\, \dot{Mg}^3\, \dddot{Si}^2 + 3\, \dot{H}$.

Fracture fine earthy; sectile. H.=2...2·5; G.=0·8...1·0 (when moist nearly 2). Opaque, dull. Streak slightly shining. Yellowish and grayish-white. Feels rather greasy, and adheres strongly to the tongue. B.B. contracts, becomes hard, and fuses on the edges; soluble in h. acid, leaving silica. Chem. com. 62·6 silica, 28·3 magnesia, and 9·1 water; but others give also 0·7 to 2·7 carbonic acid, and 14 hygroscopic water. Asia Minor, Greece, near Madrid and Toledo; Moravia and Wermeland (*Aphrodite*, G.=2·21). Chiefly used in forming heads for tobacco pipes.

138. Pimelite.—$(\dot{Ni}, \dot{Mg})^3\, \dddot{Si}^2 + \dot{H}$.

Fracture conchoidal. H.=2·5; G.=1·4 (*Alizite*)...2·3. Translucent; dull resinous. Colour apple-green; streak yellowish-white. Feels greasy. B.B. fuses to a slag only on thin edges. With borax shows reaction for nickel (32·66 nickel oxide). Silesia. *Razoumoffskin* is by some united to pimelite, but the variety from Kosemutz in Silesia contained no nickel.

139. Dermatin.—$(\dot{Mg}, \dot{Fe})\, \dddot{Si} + 2\, \dot{H}$.

Reniform. H.=2·5; G.=2·136. Resinous. Colour blackish-green; streak yellowish-white. Does not adhere to the tongue. B.B. cracks and becomes black. Waldheim in Saxony.

*Family XI.—Garnet.

Chiefly tesseral. H.=6...7·5; G.=3·1...3·8. All fusible and soluble in acids, but not readily, or only after ignition. Mostly highly coloured, and often with fine gem-like lustre; but rarely transparent, mostly translucent or opaque. Are mostly anhydrous silicates of alumina and the earths, coloured by oxides of iron, manganese, and chrome.

Occur imbedded, or in veins and druses, in the older crystalline rocks, but rarely as essential constituents.

**140. Garnet.—$\dot{R}^3\, \dddot{Si}^2 + \dddot{R}\, \dddot{Si}$, *or* $\dot{R}^3\, \dddot{Si} + \dddot{R}\, \dddot{Si}$.

Tesseral; most common forms ∞O (fig. 3), and 2O2 (fig. 6). These are often combined (figs. 18 and 19). Also granular or compact. Cleavage dodecahedral, but very imperfect; fracture conchoidal, or uneven and splintery. H.=6·5...7·5; G.=3·5...4·3. Pellucid in all degrees; vitreous or resinous. Rarely colourless or white; generally red, brown, black, green, or yellow. B.B. in general fuse easily to a glass, black or gray, in those containing much iron, green or brown in the others, and often magnetic; imperfectly soluble in h. acid, some wholly, after long digestion, leaving the silica in powder. Chem. com. exceedingly variable, but generally form two series, according as $\dddot{R}$ is chiefly alumina or chiefly iron peroxide; and these are again divided according as $\dot{R}$ is more especially lime, iron protoxide, magnesia, or similar bases.

The more important varieties are:—

(1.) *Almandine, or Noble Garnet.*—Columbine-red inclining to violet, blood-red, or reddish-brown; streak white; transparent or translucent; sometimes magnetic. Is an iron-alumina garnet, $\dot{Fe}^3\, \dddot{Si}^2 + \dddot{Al}\, \dddot{Si}$, with 37 silica, 20·1 alumina, and 42·9 iron protoxide. Common in the primary rocks, in crystals, or rarely forming beds and veins. The finest are from Pegu, Ceylon, and the East. Large crystals at Fahlun, Arendal, Kongsberg, the Tyrol, the Ural, and in North America. It is common in the mica-slates of Perth, Inverness, and Zetland; in granite at Rubislaw, Aberdeen. Used as an ornamental stone.

(2.) *Manganese-alumina Garnet*; $\dot{R} = \dot{Mn}$; reddish-brown; Spessart, Sweden.

(3.) *Lime-alumina Garnets.*—$\dot{Ca}^3\,\dddot{Si}^2 + \dddot{\bar{Al}}\,\dddot{Si}$, with 40·7 silica, 22·5 alumina, and 36·8 lime. To these belong—

(*a.*) *Grossular.*—White to olive-green, and translucent. Wilui River, Siberia, the Ural, and Tellemark in Norway.

(*b.*) *Cinnamon-stone, Hessonite,* or *Kaneelstein.*—Hyacinth-red to honey or orange-yellow, and transparent or translucent. Ceylon and Wermeland. *Romanzowite,* Kimito in Finnland, is similar. When polished, this variety is often named Hyacinth.

(*c.*) *Common Lime-garnet.*—Red, brown, yellow, or green, and with part at least of the alumina replaced by iron peroxide. Abundant in Piedmont, Vesuvius, the Ural, and North America.

(4.) *Magnesia-garnet.*—$\dot{R}$, chiefly magnesia; opaque, resinous; coal-black. G.=3·157. Arendal.

(5.) *Iron-garnets.*—$\dot{Ca}^3\,\dddot{Si}^2 + \dddot{\bar{Fe}}\,\dddot{Si}$, with 36·2 silica, 31·1 iron peroxide, and 33·6 lime. G.=3·7...4. More difficultly fusible and more easily soluble in h. acid than the others.

(*a.*) *Common Iron-garnet, Rothoffite, Allochroite.*—Subtranslucent or opaque. Green, brown, yellow, or black, with white, gray, or yellow streak. Sweden and Arendal.

(*b.*) *Melanite.*—Black; opaque; in thin splinters translucent. Streak gray; slightly magnetic. Albano near Frascati, Vesuvius, France, Lappmark. *Pyreneite,* near Barèges in the Pyrenees.

(*c.*) *Colophonite.*—Yellowish-brown to pitch-black, also yellow or red; resinous; streak white. G.=3·43. Arendal.

(6.) *Uwarowite,* or *Chrome-garnet.*—Emerald-green; vitreous; streak greenish-white. Translucent or only on the edges. G.=3·4; H.=7·5. B.B. infusible. Bissersk and Kyschtimsk in the Ural.

141. Pyrope.—$(\dot{Mg}, \dot{Fe}, \dot{Ca}, \dot{Mn})^3\,\dddot{Si}^2 + \dddot{\bar{Al}}\,\dddot{Si}$.

Tesseral, but crystals (cubes) rare and indistinct; generally in roundish grains. Cleavage not perceptible; fracture conchoidal. H.=7·5; G.=3·7...3·8. Transparent or translucent; vitreous. Dark-hyacinth to blood-red. B.B. becomes black and opaque, but regains its colour and transparency on cooling; fuses with difficulty to a black glass; not soluble in acids, partially after fusion. Chem. com. 41·35 silica, 22·35 alumina, 15 magnesia, 9·94 iron protoxide, 5·29 lime, 4·17 chrome-protoxide, and 2·58 manganese-protoxide (*Moberg*). The chrome has also been considered as the oxide or acid. Zöblitz in Saxony, Meronitz and Mittelgebirge in Bohemia, and Elie in Fife (Elie rubies). Valued as a gem.

142. Helvine. $\begin{cases} Mn\,S + 3\,\dot{R}^2\,\dddot{Si}, \textit{ or} \\ Mn\,S,\ Mn\,O + (\dot{Mn}, \dot{Fe})^3\,\dddot{Si}^2 + \dot{G}\,\dddot{Si}. \end{cases}$

Tesseral, and tetrahedral; $\frac{O}{2}$ or $\frac{O}{2} \cdot -\frac{O}{2}$ (fig. 128). Imbedded or attached. Cleavage, octahedral imperfect. H.=6...6·5; G.=3·1...3·3. Translucent on the edges; vitreous to resinous. Wax-yellow, siskin-green, or yellowish-brown. B.B. in the red. flame fuses with intumescence to a yellow obscure pearl; soluble in h. acid, evolving sulphuretted hydrogen, and gelatinizes. Chem. com. 34 silica, 10 glucina, 8 iron protoxide, 43 manganese protoxide, and 5 sulphur. Schwarzenberg in Saxony, and near Modum in Norway.

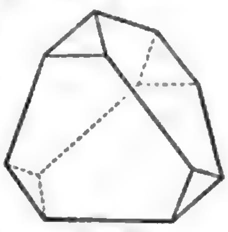


Fig. 128.

143. Idocrase, Vesuvian. $\begin{cases} 3\,(\dot{Ca}, \dot{Mg}, \dot{Fe})^3\,\dddot{Si} + 2\,\dddot{\bar{Al}}\,\dddot{Si}^2, \textit{ or} \\ 3\,(\dot{Ca}, \dot{Mg}, \dot{Fe})^3\,\dddot{Si} + 2\,(\dddot{\bar{Al}}, \dddot{\bar{Fe}})\,\dddot{Si}. \end{cases}$

Tetragonal; P 74° 27′. Crystals of ∞P, ∞P∞, 0P, P, P∞ (56° 29′), ∞P3. Columnar; more rarely tabular or pyramidal (figs. 129, 130). Also columnar or granular. Cleavage, prismatic along ∞P∞ and ∞P, but imperfect; fracture uneven, splintery. H.=6·5; G.=3·35...3·45 (or 4). Pellucid; vitreous or resinous. Yellow, green, brown, almost black, rarely azure-blue; streak white. B.B. fuses easily with intumescence to a yellowish-green or brown glass; partially soluble in h. acid, after fusion wholly, and gelatinizes. Chem. com. 39 silica, 22 alumina, 32 lime, 5 iron protoxide, and 2 magnesia. Vesuvius, Wilui River in Siberia, Mussa-alp in Piedmont, Egg in Norway, Wicklow in Ireland, Monaltrie in Aberdeenshire, and near Broadford in Skye, in Scotland.

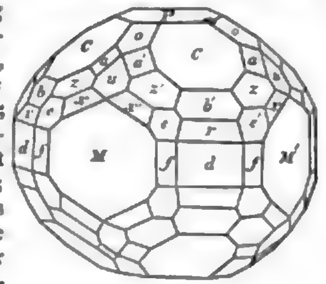


Fig. 129.

Fig. 130.

Gahnite, Loboite, Gökumite, from Gökum; *Frugardite,* from Finnland; *Egeran,* from near Eger; *Cyprine,* from Tellemark, Norway (azure-blue or green, contains copper, and B.B. melts easily in the inner flame to a red pearl); *Xanthite,* from Amity in New York—seem only idocrase.

Used as an ornamental stone, the brown being named hyacinth, the green chrysolite, but it is not highly valued.

*144. Epidote. $\begin{cases} (\dot{Ca}, \dot{Mg}, \dot{Fe})^3\,\dddot{Si}^2 + 2\,(\dddot{\bar{Al}}, \dddot{\bar{Fe}}, \dddot{\bar{Mn}})\,\dddot{Si} \\ \textit{or } \dot{R}^3\,\dddot{Si} + 2\,\dddot{\bar{R}}\,\dddot{Si}. \quad (\textit{Rams.}) \end{cases}$

Monochlinohedric; C=89° 27′, ∞P2 63° 8′, P∞ 64° 36′, $-$P∞ 63° 43′, P 70° 9′. $-$P 70° 33′. Crystals horizontal-prismatic, as in fig. 131, where ∞P∞ (*M*). P∞ (*T*) $-$P∞ (*r*) $-$P (*n*). Generally in druses; the surface often horizontally striated. Macles united by a face of P∞; also columnar, granular, or compact. Cleavage, orthodiagonal very perfect, along P∞ rather perfect. Fracture conchoidal, uneven, or splintery. H.=6...7; G.=3·2...3·5. Pellucid in all degrees; vitreous, on cleavage adamantine. Especially green, yellow, and gray; rarely red and black. B.B. fusible; strongly ignited, or after fusion all are soluble in h. acid, and gelatinize. Varieties are,—

Fig. 131.

(1.) *Zoisite.*—White, yellowish, or brownish-gray; chiefly large imbedded crystals, or foliated and columnar. B.B. intumesces and forms a white or yellow porous mass, and on the edges fuses to a clear glass. Is a lime-alumina epidote, =42·4 silica, 31·4 alumina, 26·2 lime, with very little iron oxide or magnesia. Sau Alpe in Carinthia, the Ural, and Connecticut. *Thulite,* rose or peach-blossom red, from Souland in Norway, is similar.

(2.) *Pistazite, Thallite.*—Pistacio-green to blackish-green and black, also yellow or brown. Crystallized, granular, or earthy, also in crusts. B.B. fuses on the edges, and swells into a dark-brown slag. Is an iron-epidote, with 10 to 16 peroxide and 2 to 6 protoxide of iron. Arendal, the Ural, the Alps (Mont Blanc), Pyrenees, the Harz, Finnland, Greenland, and North America. In Scotland, in syenite in Zetland, in gneiss in Sutherland, in trap in Mull and Skye, in quartz in Rona, in clay-slate in Arran, and in porphyry in Arran and Glencoe. *Puschkinite,* from the Ural, *Withamite,* from Glencoe, in minute bright-red crystals; and *Bucklandite,* in small black crystals, from Lake Laach and Siberia, are this variety.

(3.) *Manganese-epidote.*—With much manganese-peroxide (14 to 20). Dark violet-blue or reddish-black; streak cherry-red. H.=6·5; G.=3·4. B.B. melts easily to a black glass. St Marcel in Piedmont.

*145. Axinite. $\left\{\begin{array}{l}2(\dot{Ca},\dot{Mg})^2\dddot{Si}^3+3(\dddot{Al},\dddot{Fe},\dddot{Mn})\dddot{Si}+\\(\dot{Ca},\dot{Mg})\dddot{B}, \textit{ or}\\2[2\dddot{R}\dddot{Si}+\dot{R}^3\dddot{Si}]+\dddot{B}\dddot{Si}.\end{array}\right.$

Triclinohedric. Crystals usually very unsymmetrical (figs. 132 and 133), with u to $P=135°\ 24'$, u to $r=115°\ 39'$,

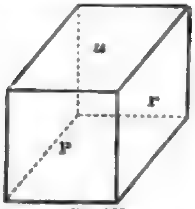


Fig. 132.

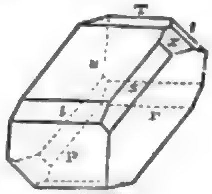


Fig. 133.

P to $r=134°\ 48'$; attached singly, or in druses. Also laminar or broadly radiated. Cleavage, imperfect along a plane truncating the sharp edge between P and u. H.= 6·5...7; G.= 3...3·3. Pellucid; vitreous. Clove-brown, inclining to smoke-gray or plum-blue, but often cinnamon-brown in one direction, dark violet-blue in a second, and pale olive-green in a third. B.B. intumesces and fuses easily to a dark-green glass, becoming black in the ox. flame; not soluble in h. acid till after ignition, when it gelatinizes. Chem. com. about 44 silica, 5 boracic acid, 16 alumina, 11 iron peroxide, 1·5 manganese-peroxide, 2·5 magnesia, and 20 lime. Bourg d'Oisans in Dauphiné, and the Botallack mine in Cornwall, Kongsberg in Norway, Arendal, Nordmark in Sweden, Pyrenees, Savoy, Tyrol, Thum in Saxony (*Thummerstein*), the Ural, and North America.

146. Glaucophane. $\left\{\begin{array}{l}2\dddot{Al}\dddot{Si}^3+9(\dot{Fe},\dot{Na},\dot{Mg},\dot{Ca},\\\dot{Mn})\dddot{Si}.\end{array}\right.$

Rhombic or monoclinohedric, only indistinct; thin four or six-sided prismatic crystals, or granular. Cleavage, prismatic distinct; fracture conchoidal. H.=5·5; G.=3·1. Translucent or opaque; vitreous or pearly. Gray, indigo-blue, or bluish-black. B.B. becomes yellowish-brown, and fuses readily to an olive-green glass; partly soluble in acids. Island of Syra. Similar are,—

Wichtyne.—Massive; black. B.B. fuses to a black enamel; not affected by acids. Wichtis in Finnland. *Violan.*—Massive; opaque, resinous. Dark violet-blue. B.B. fuses easily to a clear glass. St Marcel in Piedmont.

Family XII.—Cyanite.

Triclinohedric or rhombic, often in long prismatic forms. H.=5...7·5; G.=2·9...3·8. B.B. infusible; insoluble in acids. Some show fine colours and high vitreous lustre. They are chiefly anhydrous silicates of alumina. Occur especially in the crystalline strata.

*147. Cyanite, Disthene.—$\dddot{Al}\dddot{Si}$, *or* $\dddot{Al}^3\dddot{Si}^2$.

Triclinohedric. Generally broad prismatic lengthened crystals formed by two faces meeting at 106° 16'. Macles are common, united by $\infty P\infty$. Also even, curved, or radiated. Cleavage, along the prisms very (or less) perfect; brittle. H.=5 on cleavage planes, on other faces=7; G.=3·5 to 3·7. Pellucid, vitreous; on cleavage pearly. Colourless, or blue, gray, green, yellow, or red. Not affected by acids. B.B. infusible. Chem. com. 37·6 silica, and 62·4 alumina. St Gotthardt, Tyrol (*Rhætizite*), Pontivy in France, Bohemia, Nigg near Aberdeen, Botriphny in Banffshire, and Hillswick in Zetland.

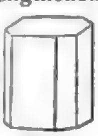


Fig. 134.

148. Sillimanite.—$\dddot{Al}\dddot{Si}$.

Triclinohedric, with $\infty P' : \infty' P=98°$, $P' : \infty P'=105°$. Crystals long and slender; also fibrous or parallel. Cleavage, macrodiagonal highly perfect. H.=7...7·5; G.=3·2 ...3·26. Translucent; vitreous, inclining to pearly. Grayish-brown, clove, or hair-brown. B.B. infusible; not affected by acids. Chem. com. like cyanite, from which it is scarcely distinct. Chester and Norwich in Connecticut, Tvedestrand in Norway. The *Xenolite*, Finnland; *Bucholzite*, *Fibrolite*, and *Bamlite*, from Bamle in Norway, seem also cyanite; *Wörthite*, an altered variety.

*149. Andalusite.—$\dddot{Al}\dddot{Si}$, *or* $\dddot{Al}^4\dddot{Si}^3=\dddot{Al}^4\dddot{Si}^3$.

Rhombic; $\infty P\ 90°\ 44'$, $\bar{P}\infty\ 109°\ 6'$. Crystals $\infty P\cdot 0P$, or this with $\bar{P}\infty$ (fig. 135); prismatic, attached or imbedded; also columnar, or granular. Cleavage, ∞P rather indistinct; traces along $\infty\breve{P}\infty$, $\infty\bar{P}\infty$ and $\bar{P}\infty$. Fracture uneven, splintery. H.=7...7·5; G.=3·1...3·3. Pellucid; vitreous. Gray, green, red, or blue. B.B. infusible; not affected by acids. Chem. com. 40·4 silica and 59·6 alumina, with 1 to 2 iron peroxide. Andalusia, Lisens in Tyrol, Penig in Saxony, Westford in Massachusetts, Litchfield in Connecticut; and Botriphny in Banffshire, Tyrie in Aberdeenshire, and Killiney Bay in Wicklow.

Fig. 135.

Chiastolite.—H.=5...5·5; G.=3. Dirty or pale gray, yellow, or red. Occurs imbedded in clay-slate, and often appears like four crystals separated by a black cross (fig. 136). Fichtelgebirge, Brittany, the Pyrenees, Sierra Morena, Wolfscrag near Keswick, and on Skiddaw in Cumberland; near Balahulish in Argyleshire, Boharm in Banffshire, and in Wicklow.

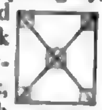


Fig. 136.

*150. Staurolite, Staurotide. $\left\{\begin{array}{l}(\dddot{Al},\dddot{Fe})^4\dddot{Si}^3=\dddot{R}^2\dddot{Si}, \textit{or}\\(\dddot{Al},\dddot{Fe})^3\dddot{Si}^4.\end{array}\right.$

Rhombic; $\infty P\ 128°\ 42'$, $\bar{P}\infty\ 70°\ 46'$. Crystals $\infty P\ (M)$. $\infty\breve{P}\infty\ (o)$. $0P\ (p)$. Macles very common, like figs. 137 or 138. Cleavage, brachydiagonal perfect, traces along ∞P;

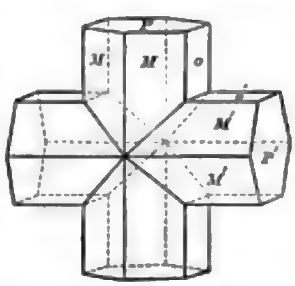


Fig. 137.

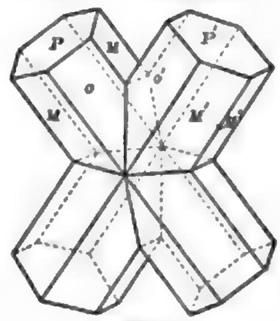


Fig. 138.

fracture conchoidal, or uneven and splintery. H.=7; G. =3·5...3·8. Translucent or opaque; vitreous, inclining to resinous. Reddish to blackish-brown; streak white. B.B. infusible; not affected by h. partially by s. acid. Chem. com. ranges from 28 to 40 silica, 45 to 55 alumina, 15 to 18 iron peroxide, with 0·2 to 2·5 magnesia. St Gotthardt and Greiner in Tyrol, Finisterre, Pyrenees, Spain, the Ural, and in North America; in Scotland, Bixter Voe in Zetland, in Aberdeenshire, and the Hebrides.

151. Diaspore.—$\dddot{Al}\dot{H}$.

Rhombic; $\infty P=130°$, broad indistinct prisms, chiefly of $\infty\breve{P}\infty$, bounded by the curved faces of P (fig. 139). Usually thin foliated or broad radiated. Cleavage, brachydiagonal highly perfect; very brittle. H. =6; G.=3·3...3·4. Pellucid; vitreous; pearly on $\infty\breve{P}\infty$. Colourless, but generally yellowish or greenish-white; also violet-blue. Insoluble in acids. B.B. infusible, but some decrepitate into small white scales. Chem. com. 85 alumina and 15 water. Rare. Ural and Schemnitz, Broddbo and St Gotthard.

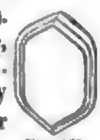


Fig. 139.

152. Hydrargillite.—$\dddot{Al}\dot{H}^3$.

Hexagonal; 0P. ∞P. $\infty P2$, or granular scaly. Cleavage, basal very perfect. H.=2·5...3; G.=2·3...2·4. Translucent; vitreous; pearly on 0P. Colourless or reddish-white.

Mineralogy.

Slowly soluble in warm acids. B.B. exfoliates, and gives out a strong light, but is infusible. Chem. com. 65·5 alumina and 34·5 water. Near Slatoust in the Ural. Stalactitic, greenish or grayish-white (*Gibbsite*); Richmond, Massachusetts, Villa Rica in Brazil.

153. PERICLASE.—$\dot{Mg}$.

Tesseral, only in octahedrons. Cleavage, hexahedral perfect. H.=6; G.=3·75. Transparent; vitreous. Dark-green. B.B. infusible; powder soluble in acids. Chem. com. magnesia, with 5 to 8 protoxide of iron. Monte Somma.

FAMILY XIII.—GEMS.

All very hard, H.=7...9, or scratch quartz, except a few =6, which are scarcely true gems; G.=2·6...4·7, but mostly high in the finest. Insoluble in acids, and infusible B.B. in the true gems. These have a high lustre, brilliant colours, and take a fine polish, and are therefore much valued. They are, however, rare, and generally small. Chem. com. variable, but mostly simple. Chiefly occur in the older igneous or metamorphic rocks.

*154. ZIRCON.—$\dot{Zr}^3\,\ddot{Si}$, *or* $\dot{Zr}^3\,\dddot{Si}$, *or* $\dddot{Zr}\,\dddot{Si}$.

Tetragonal; P 84° 20′. Crystals, ∞P. P, often with 3 P 3; also ∞P∞. P, or ∞P∞ (*s*). ∞P (*l*). P (*P*). 3 P 3 (*x*). P∞ (*t*). 4 P 4 (*y*). 5 P 5 (*z*) (fig. 140), chiefly prismatic or pyramidal, and in rounded grains. Cleavage, along P and ∞P, both rather imperfect; fracture conchoidal or uneven. H.=7·5; G.=2...4·7. Transparent to opaque; vitreous, often adamantine. Rarely white, generally gray, yellow, green, or frequently red and brown. B.B. loses its colour, but is infusible; not affected by any acid except con. s. acid, after long digestion. Chem. com. 66·23 zirconia (and noria, *Svanberg*), and 33·77 silica, with 0 to 2 iron peroxide as colouring matter. Southern Norway, Ilmen Mountains, Arendal, Sweden, Carinthia, Tyrol, Ceylon, and North America; in Scotland, at Scalpay in Harris, and Criffel.

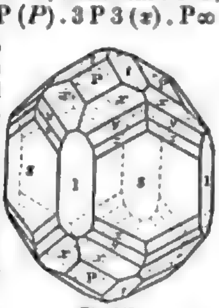


Fig. 140.

The colourless varieties are often sold for diamonds. The more brilliantly coloured are named hyacinth.

155. MALAKON.—$3\,\dot{Zr}^3\,\ddot{Si} + \dot{H}$.

Tetragonal; P. 82°. Crystals, like zircon. H.=6; G.=3·9. Opaque; resinous or vitreous. Internally bluish-white, but on the surface mostly brownish, reddish, yellowish, or blackish. Chem. com. zircon, with 3 per cent. water. Hitterö in Norway, Malakon. *Œrstedtite* from Arendal, *Tachyaphaltite* from Krageroe, and *Calyptolite*, are probably altered zircon.

*156. SPINEL.—$\dot{Mg}\,\dddot{\bar{Al}}$, *or* $(\dot{Mg}, \dot{Fe})\,(\dddot{\bar{Al}}, \dddot{\bar{Fe}})$.

Tesseral; O alone or predominating, ∞O and 3O3. Macles united by a face of O (fig. 141); also in grains or fragments. Cleavage, octahedral imperfect; fracture conchoidal. H.=8; G.=3·4...3·8. Transparent to opaque; vitreous. Red, blue, green, and black; streak white. B.B. infusible and unchanged. Chem. com. 71 alumina and 29 magnesia; but some 1 to 5 silica, 3 to 20 iron protoxide, 0 to 6 iron peroxide, and the red varieties 1 to 5 chrome. The varieties are:—*Spinel* or *Spinel-ruby*, rose-red (*Balas ruby*), yellow or orange-red (*Rubicelle*), violet (*Almandine ruby*) or brown; G.=3·52; from Ceylon, Ava, and the East. Much prized as ornamental stones. *Sapphirine*.—Pale sapphire-blue to greenish or reddish blue; G.=3·4...3·7; with 4 per cent. iron protoxide; Aker in Sweden, Greenland, and North America. *Pleonaste*, opaque or translucent, black; G.=3·65...3·8; with 8 to 20 iron protoxide; Candy in Ceylon (*Candite*, or *Zeilanite*), Monte Somma, Monzoni, Arendal, Bohemia (*Hercinite*), the Ural, and New York. *Chlorospinel*, grass-green, with a yellowish-white streak; G.=3·59; Slatoust in the Ural.

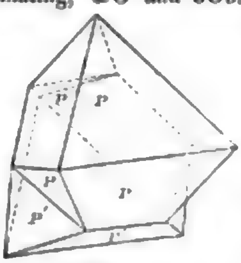


Fig. 141.

157. AUTOMOLITE, Gahnite.—$\dot{Zn}\,\dddot{\bar{Al}}$.

Tesseral; O, alone or macled. Cleavage, O perfect; brittle, with conchoidal or splintery fracture. H.=8; G.=4·3...4·6. Opaque or translucent on the edges; vitreous, inclining to resinous. Dark leek-green to blackish-green and blue; streak gray. B.B. unchanged; not affected by acids or alkalis. Chem. com. 56 alumina and 44 zinc oxide, but with 4 to 6 protoxide of iron, and 2 to 5 magnesia. Fahlun, Broddbo, Haddam in Connecticut, and Franklin in New Jersey. *Dysluite*, yellowish-brown, with manganese, from Sterling, Massachusetts; and *Kreittonite*, brown, from Bodenmais, are similar.

*158. CORUNDUM.—$\dddot{\bar{Al}}$.

Rhombohedric; isomorphous with peroxide of iron and chrome; R 86° 4′. Crystals chiefly of ∞P2 (*s*), 0R (*o*), R (*P*), are pyramidal (fig. 142), prismatic (fig. 143), or rhombohedral. Macles common, united by a face of R. Cleavage, rhombohedral along R, or basal. Extremely tough, and difficultly frangible. H.=9; G.=3·9...4·2. Transparent or translucent; vitreous, or pearly on 0R. Colourless and white, but generally blue, red, yellow, brown, or gray. B.B. unchanged. Chem. com. alumina, with a minute proportion of peroxide of iron or other colouring matter.

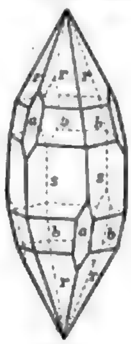


Fig. 142.

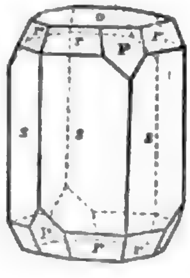


Fig. 143.

Varieties are:—(1.) *Sapphire*, highly transparent, very imperfect cleavage and conchoidal fracture; colourless, blue (*Salamstein*), seldomer green, yellow, red (*Oriental rubies*), or brown; Ceylon, Ava, Pegu, Miask, Slatoust, Bilin in Bohemia, and Expailly in Auvergne. (2.) *Corundum*, rough crystals or foliated, less transparent and duller colours; Malabar, Ceylon, Ava, Canton in China, Siberia, St Gotthardt, and Piedmont. Some (*Asteria* or *star sapphire*) show a bright opalescent star of six rays. (3.) *Adamantine spar*, with distinct cleavage, hair-brown, and adamantine; Gellivara, Ural, Malabar, and North America. (4.) *Emery*, compact, dimly translucent, and gray or indigo-blue; Asia Minor near Smyrna, Naxos, Spain, Saxony, and Greenland. Sapphire and rubies are highly valued as ornamental stones; emery as a polishing material.

159. CHRYSOBERYL, Cymophane.—$\dot{G}\,\dddot{\bar{Al}}^3$.

Rhombic; P with polar edges 86° 16′ and 139° 53′. Crystals of ∞P∞ (*M*). ∞P̆∞ (*T*). P̆∞ (*i*), or this with ∞P3 (*s*), and also with P (*o*) (fig. 144), are short and broadly columnar, or thick tabular with vertical striæ. Macles very common, united by a face of P∞. Cleavage,

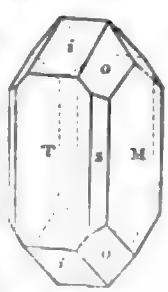


Fig. 144.

Mineralogy.

brachydiagonal imperfect, macrodiagonal more so; fracture conchoidal. H.=8·5; G.=3·68...3·8. Transparent or translucent; vitreous, sometimes resinous. Greenish-white, leek-green, olive-green, and greenish-gray; sometimes with a bluish opalescence, or beautiful dichroism. B.B. infusible; not affected by acids. Chem. com. 80·25 alumina and 19·75 glucina, with 3 to 4 protoxide of iron. Brazil, Ceylon, India, Haddam in Connecticut, and Ural.

*160. TOPAZ. $\begin{cases} 6\,\dddot{Al}\,\dddot{Si} + (Al\,F^3 + Si\,F^3), \text{ or} \\ 6\,\dddot{Al}^2\,\dddot{Si}^3 + (3\,Al\,F^3 + 2\,Si\,F^3). \end{cases}$

Rhombic; ∞P (*M*) 124° 19′, $2\breve{P}\infty$ (*n*) 93°, $\infty\breve{P}2$ (*l*) 93° 8′, P (*o*), and numerous other forms. Crystals always prismatic (fig. 145), often hemimorphic, and the prisms finely striated; also granular. Cleavage, basal very perfect, traces in other directions, especially *M* and *l* in the Scottish varieties; fracture conchoidal or uneven. H.=8; G.=3·4...3·6. Transparent to translucent on the edges; vitreous. Colourless, but yellowish, reddish, or greenish-white, honey-yellow, hyacinth-red, violet-blue, and asparagus-green. Becomes electric from heat or friction. B.B. infusible. Not affected by h. acid, but by long digestion in s. acid gives traces of fluorine. Chem. com. 35·52 silica, 53·33 alumina, and 17·49 fluorine (=108·33). Brazil, Siberia, Ceylon, New Holland, Peru, Connecticut, Bohemia, Saxony, and Cornwall (St Michael's Mount), Mourne Mountains in Ireland, Cairngorum Mountains in Aberdeenshire (one crystal nineteen ounces). The common or coarse columnar named *Pyrophysalite*, at Finbo, and Broddbo near Fahlun. Topaz is valued as an ornamental stone. The purest from Brazil, when cut in facets like the diamond, closely resemble it in lustre and brilliance, but are easily known by their electricity.

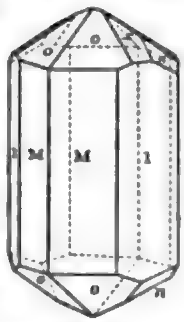


Fig. 145.

161. PYCNITE, Schorlite.—$\dddot{Al}^3\,\dddot{Si}^4 + (Al\,F^3 + Si\,F^3)$.

Massive; like topaz. H.=7·5; G.=3·49...3·54. Translucent; vitreous. Straw-yellow to reddish-white. Chem. com. 39·04 silica, 51·25 alumina, 18·48 fluorine. Altenberg in Saxony, and Schlackenwald and Zinnwald in Bohemia.

162. LEUCOPHANE.—3 $\dot{Ca}\,\dddot{Si} + \dddot{G}\,\dddot{Si}^2$ + Na F.

Triclinohedric; but crystals rare. Cleavage in three directions, intersecting at 53° 25′ and 65°. H.=3·5...4; G.=2·974. In thin splinters pellucid and almost colourless; in thicker pieces wine-yellow or olive-green; vitreous or resinous. B.B. fuses to a pale violet-blue bead. Near Brevig in Norway.

163. EUCLASE.—3 $\dddot{Al}\,\dddot{Si} + \dddot{G}^2\,\dddot{Si}^4$.

Monoclinohedric; C.=71° 7′; ∞P 115°, P 105° 49′. Crystals ∞P (*s*) . (∞P∞) (*T*) . P (*f*) (fig. 146). Cleavage, clinodiagonal highly perfect, along P∞ less so; ∞P∞ in traces. Very brittle and fragile; fracture conchoidal. H.=7·5; G.=3...3·1. Transparent; splendent vitreous. Pale mountain-green, passing into yellow, blue, or white. B.B. intumesces, becomes white, and melts in thin splinters to a white enamel. Not affected by acids. Chem. com. 44·7 silica, 31·8 alumina, and 23·5 glucina, with 1 to 2·2 iron peroxide and 0·4 to 0·7 tin oxide. Peru and Brazil, but very rare.

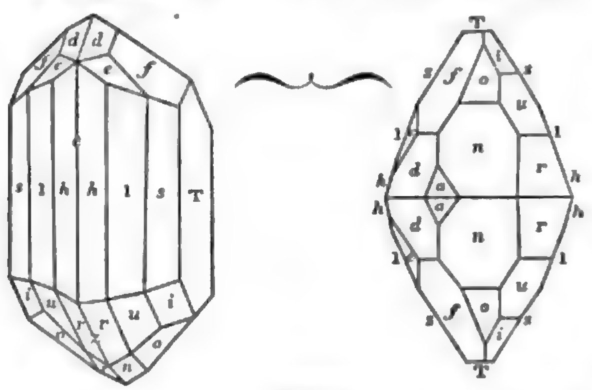


Fig. 146.

*164. EMERALD, BERYL. $\begin{cases} \dddot{Al}\,\dddot{Si}^2 + \dddot{G}\,\dddot{Si}^2, \text{ or} \\ \dddot{Al}\,\dddot{Si}^2 + \dddot{G}\,\dddot{Si}^2. \end{cases}$

Hexagonal; P 59° 53. Crystals of ∞P . 0P, and ∞P . ∞P2 . 0P (fig. 147), are prismatic, generally with vertical striæ. Cleavage, basal rather perfect, ∞P imperfect. H.=7·5...8; G.=2·6...2·8. Transparent or translucent; vitreous. Colourless or white, but generally green, sometimes very brilliant, also yellow, and smalt-blue. B.B. melts with difficulty on the edges to an obscure vesicular glass. Not affected by acids. Chem. com. 67·5 silica, 18·7 alumina, and 13·8 glucina, with 0·3 to 3 iron peroxide, and 0·3 to 3·5 chrome oxide in the rich green emerald. *Emerald*, bright green; G.=2·710...2·759; occurs in Muso Valley near Bogota, also in Salzburg and the Ural. *Beryl*, or *Aquamarine*, colourless, or less brilliant; G.=2·577...2·725; near Mursinsk, and Nertschinsk in Siberia, Salzburg and Brazil; in the United States, at Ackworth in New Hampshire, Royalston in Massachusetts, Haddam in Connecticut; Mourne Mountains in Ireland, and Cairngorum Mountains in Aberdeenshire. *Common beryl* at Fahlun in Sweden, Fossum in Norway, Limoges in France, Rabenstein in Bavaria, Rubislaw near Aberdeen (*Davidsonite*). Emerald and beryl are much valued as precious stones.


Fig. 147.

165. PHENAKITE.—$\dddot{G}^2\,\dddot{Si}^3$.

Rhombohedric; R 116° 40′. Crystals R . ∞P2, or ∞P2 . ⅔P2 . R. (fig. 148). Macles with parallel axes and intersecting. Cleavage, R and ∞P2 not very distinct; fracture conchoidal. H.=7·5...8; G=2·97. Transparent or translucent; vitreous. Colourless, and wine-yellow or brown. B.B. infusible; not affected by acids. Chem. com. 55 silica, and 45 glucina. Ural, Ilmen Mountains, Framont in Alsace.

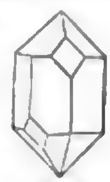


Fig. 148.

*166. CORDIERITE, Iolite, Dichroite. $\begin{cases} \dddot{Al}^3\,\dddot{Si}^2 + 2\,(\dot{Mg}, \dot{Fe})\,\dddot{Si}, \text{ or} \\ 3\,\dddot{Al}\,\dddot{Si} + \dot{R}^3\,\dddot{Si}^2. \end{cases}$

Rhombic; ∞P 119° 10′, middle edge of P 95° 36. Crystals ∞P (*T*) . $\infty\breve{P}\infty$ (*l*) . 0P (*M*), and this with $\infty\bar{P}\infty$ (*k*), $\infty\breve{P}3$ (*d*), $\breve{P}\infty$ (*n*), and ½P (*s*) (fig. 149); short, prismatic. Cleavage, $\infty\breve{P}\infty$ rather distinct, traces along $\bar{P}\infty$; fracture conchoidal or uneven. H.=7...7·5; G.=2·5...2·7. Transparent or translucent; vitreous, inclining to resinous. Colourless, but chiefly blue, green, brown, yellow, and gray, often with distinct pleochroism. B.B. fuses slowly to a clear glass; slightly affected by acids. Chem. com. 48 to 51 silica, 29 to 33 alumina, 8 to 13 magnesia, 1 to 12 iron protoxide, and 0 to 1·5 manganese protoxide. Cabo de Gata in Spain, Bodenmais (*Pelioms*), Orrijerfvi (*Steinheilite*), Norway, Sweden, Greenland, North America, and Siberia. Small rolled masses of an intense blue colour and transparent, found in Ceylon, are the *Sapphire d'Eau* or *Luchssapphir* of the jewellers.

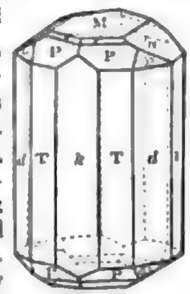


Fig. 149.

The following substances seem cordierite altered, or with 2 to 4 atoms water:—

(*a*.) *Bonsdorfite*, *Hydrous Iolite*, greenish brown, or dark olive-green, near Åbo. (*b*.) *Esmarkite*, *Chlorophyl-*

Mineralogy.

lite, large prisms or foliated, green or brownish; near Brevig in Norway, Unity in Maine, and Haddam in Connecticut. (*c*.) ***Fahlunite***, ***Triclasite***, compact, greenish-brown or black foliated; H. = 2·5…3; G. = 2·5…2·8; Fahlun. (*d*.) ***Weissite***, kidney-shaped and ash-gray or brown; Fahlun and Lower Canada. (*e*.) ***Pyrargillite***, indistinct imbedded crystals, black passing into brown or red, dull resinous lustre; H. = 3·5; G. = 2·5; Helsingfors. (*f*.) ***Pinite***, crystallized, or massive and laminar, with imperfect cleavage; H. = 2…3; G. = 2·7…2.9; semitranslucent or opaque, dull or resinous, and dirty-gray, green, or brown; B.B. fuses to a glass, sometimes clear, at other times dark-coloured; Auvergne, Schneeberg, Penig in Saxony, in the Harz, Cornwall, Aberdeenshire, the United States, and Greenland (*Gieseckite*). *Oosite* from Geroldsau in Baden, snow-white, opaque, fragile, is similar. (*g*.) ***Gigantolite***; H. = 3·5; G. = 2·8…2·9; opaque, dull resinous, and greenish-gray or brown; B.B. intumesces slightly, and fuses easily to a greenish slag; Tammela in Finnland. (*h*.) ***Praseolite***, lamellar and green; Brevig in Norway.

** 167. TOURMALINE, Schorl.

Rhombohedric; R 133° 10′. Crystals of 0R (*k*′), $-\frac{1}{2}$R (155°) (*n*), R (*P*), −2R (103° 3′) (*o*), ∞P2 (*s*), and ∞R (*l*), usually long prismatic, striated, and remarkable for hemimorphism, ∞R appearing as a trigonal prism (figs. 150,

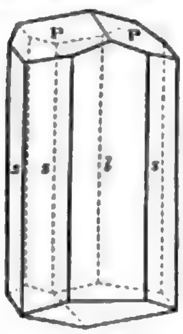


Fig. 150.

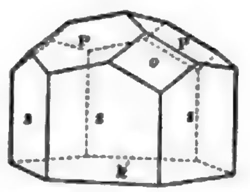


Fig. 151.

151); also radiating, columnar, or fibrous. Cleavage, R and ∞P 2 both imperfect; fracture conchoidal or uneven. H. = 6·5…7·5; G. = 3…3·3. The black opaque, the others pellucid; vitreous. Colourless, but gray, yellow, green, blue, red, brown, and most frequently black. Often several colours in layers perpendicular, or parallel to the axis. By friction acquires positive, by heat polar electricity; powder white, often magnetic. B.B. some fuse, others only intumesce, and some both fuse and intumesce. Powder not soluble in h., only imperfectly in s. acid. Chem. com. very complex, with 36 to 41 silica, 5 to 10 boracic acid, 1·3 to 2·7 fluorine, 0 to 0·3 phosphoric acid, 30 to 45 alumina, 0 to 13 iron peroxide, 0 to 5 manganese peroxide, 0 to 10 iron protoxide, 0·5 to 15 magnesia, 0 to 2 lime, 1 to 2·6 soda, 0·1 to 2 potash, and 0 to 1·5 lithia. Rammelsberg makes five groups in two divisions:—

A. Tourmalines with no lithia, and little or no manganese:—

(1.) Magnesia Tourm. – $\dot{R}^3 \dddot{Si}^2 + 3 \bar{R} \dddot{Si}$; yellow and brown, with much magnesia and little iron.

(2.) Magnesia-iron T. – $\dot{R}^3 \dddot{Si}^2 + 4 \bar{R} \dddot{Si}$; apparently black; with an average amount of magnesia and iron.

(3.) Iron T. – $\dot{R}^3 \dddot{Si}^2 + 6 \bar{R} \dddot{Si}$; deep black with most iron and least magnesia.

B. Tourmalines with lithia and little magnesia:—

(4.) Iron-manganese T. – $\dot{R} \dddot{Si} + 3 \bar{R} \dddot{Si}$; blue (or violet) and green T., with iron.

(5.) Manganese T. – $\dot{R} \dddot{Si} + 4 \bar{R} \dddot{Si}$; red or colourless, with no iron.

Groups 2 and 3 are the most common, and known as *Schorl*, the red varieties as *Rubellite*, the colourless as *Achroite*.

The finest transparent varieties or noble tourmalines come from Ceylon, Siberia, and Brazil. The dark-blue or *Indicollite* occurs chiefly in Utoe. Large crystals of the dark opaque varieties occur in Greenland, Arendal, the Tyrol, and various parts of North America. In England, Bovey in Devonshire and St Just in Cornwall, are well-known localities; and in Scotland large prisms, often curved or broken, abound in the granite of Aberdeenshire.

Tourmaline is not much valued as a gem, the colours being rarely pure. *Zeuxite* seems only Tourmaline.

*168. CHRYSOLITE, Olivine, Peridot.—$(\dot{Mg}, \dot{Fe})^3 \ddot{Si}$.

Rhombic; ∞P (*n*) 130° 2′, $\bar{P}\infty$ (*d*) 76° 54′, 2$\breve{P}\infty$ (*k*) 80° 53′; also ∞$\bar{P}\infty$ (*M*), ∞$\breve{P}\infty$ with P (*p*), 0P (fig. 152). The crystals are frequently prismatic and imbedded; also massive and granular. Cleavage, ∞$\breve{P}\infty$ rather distinct; fracture conchoidal. H. = 6·5…7; G. = 3·3…3·5. Transparent or translucent; vitreous. Olive-green, also yellow and brown, rarely colourless. B.B. infusible; soluble and gelatinizing in acids. Chem. com. 38 to 43 silica, 43 to 51 magnesia, 8 to 18 iron protoxide, with a little manganese. *Chrysolite* is the fine green transparent and crystallized varieties from the East, Esne in Egypt, and Brazil. *Olivine*, the darker and less pellucid, from Vesuvius, Unkel on the Rhine, the basalts of Germany, and the trap of Arthur Seat and other parts of Scotland; also in meteoric iron, as in the mass found by Pallas in Siberia, and in that of Otumpa in South America. Used as an ornamental stone, but not much valued.

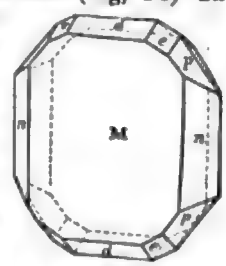


Fig. 152.

The following seem mere varieties:—

Hyalosiderite.—Brown or yellow, very ferruginous and metallic-looking; H. = 5; G. = 2·875; in other respects like olivine; Kaiserstuhl in the Breisgau. *Chusite*, *Limbelite*, and *Tautolite*; Lake Laach. *Batrachite*, greenish-gray or white, translucent; Rizoni Mountain, Tyrol. *Monticellite*, transparent, colourless or yellowish; Vesuvius.

Fayalite.—Crystalline, columnar and foliated, but often as if fused. Greenish or pitch-black, brownish or brass-yellow, with a resinous metallic lustre. H. = 6·5; G. = 4·15. Partly soluble in h. acid. Chem. com. $\dot{Fe}^3 \ddot{Si}$ with 29·7 silica, 70·5 iron protoxide, and 2 to 8 manganese protoxide.

Knebellite.—Massive, opaque, gray, green, brown, or red. Chem. com. 32·5 silica, 32 iron protoxide, and 35 manganese protoxide.

Tephroite.—Granular, with two cleavages at right angles. H. = 5·5; G. = 4…4·12. Lustre adamantine. Ash-gray, with reddish-brown tarnish. Chem. com. 70 manganese protoxide and 30 silica. Franklin and Sparta, New Jersey.

169. CHONDRODITE, Maclurite, Brucite, Humite. $\left\{ n\dot{Mg}^6 \ddot{Si}^3 + [8\,Mg\,F + 3\,Si\,F^2.] \right.$

Rhombic; ∞P 94° 26′, $\bar{P}\infty$ 112° 2′; but crystals on three types, and often monoclinic in character or indistinct; chiefly in round grains or granular. Cleavage indistinct; fracture imperfect conchoidal. H. = 6·5; G. = 3·15…3·25. Transparent or translucent; lustre vitreous or resinous. Yellow, red, brown, green, and almost black; streak white or yellowish. B.B. infusible, or only on very thin edges; decomposed by acids. Chem. com. 33 to 37 silica, 55 to 60 magnesia, 2·6 to 9·7 fluorine, with 1·7 to 6·7 iron protoxide. Chondrodite occurs at Pargas in Finnland, Åker, and Gullsjö in Sweden, Sparta in New Jersey, and Orange

county in New York; also in Saxony and on Loch Ness in Scotland. *Humite* on Monte Somma.

Family XIV.—Metallic Stones.

Crystallization predominantly rhombic; some tesseral or monoclinohedric; but many massive, or products of decomposition, and thus rather metallic clays or rocks. The crystalline species are rather hard; H. = 5·5...6·5; and with G. = 3·6...5·6. Those with high specific gravity are mostly infusible B.B., the others fusible. Most are soluble in acids, often gelatinizing. They are mostly silicates with a metallic base, and thus an intermediate group between the true stones and the metallic ores. Often opaque, and black or brown and yellow. They occur especially in the igneous and metamorphic rocks, or metallic veins of Scandinavia and the Ural.

*170. Liévrite, Yenite, Ilvaite. } $\overline{\overline{Fe}}^2 \dddot{Si} + 3\,\dot{Fe}^3 \dddot{Si} + \dot{Ca}^3 \dddot{Si}^2$.

Rhombic; P, polar edges 138° 26′ and 117° 34′, ∞P 111° 12′, $\bar{P}\infty$ 112° 40′. Crystals ∞P2 (*s*) . P(*o*) . $\bar{P}\infty$ (*d*) (fig. 153), are long prismatic and vertically striated; also radiated columnar or fibrous. Cleavages all imperfect; brittle. H. = 5·5...6; G. = 3·9...4·2. Opaque, resinous or imperfect metallic. Brownish or greenish-black; streak black. B.B. fuses easily to a black magnetic globule; soluble in h. acid forming a yellow jelly. Chem. com. 28·8 silica, 24·8 iron peroxide, 33·4 iron protoxide, and 13·0 lime. Rio in Elba, Fossum, Kupferberg, Rhode Island, and Greenland. *Wehrlite*, iron-black, with greenish-gray streak, and B.B. difficultly fusible, is a variety; Hungary.

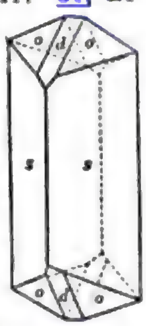


Fig. 153.

171. Hisingerite, Thraulite.—$\overline{\overline{Fe}}^2 \dddot{Si}^3 + 2\,\dot{Fe}\,\dddot{Si} + 10\dot{H}$.

Reniform, or in crusts. H. = 3·5...4; G. = 2·6...3. Opaque; resinous. Brownish or bluish-black; streak liver or yellowish brown. B.B. fuses with difficulty; soluble in acids, leaving slimy silica. Chem. com. 32·5 silica, 33·5 iron peroxide, 15·1 iron protoxide, and 19 water, of the Thraulite from Bodenmais. Also Gillinge, Rydarhyttan in Sweden, and Breitenbrun in Saxony (*Polyhydrite*).

172. Anthosiderite.—$\overline{\overline{Fe}}^2 \dddot{Si}^9 + 2\,\dot{H}$.

Fine fibrous or flower-like; very tough. H. = 6·5; G. = 3. Opaque or translucent; silky. Ochre-yellow to yellowish-brown. B.B. becomes reddish-brown, then black, and fuses with difficulty. Soluble in h. acid. Chem. com. 61 silica, 35 iron peroxide, and 4 water. Minas Geraes in Brazil.

173. Nontronite.—$\overline{\overline{Fe}}\,\dddot{Si}^3 + 5\,\dot{H}$.

Massive. Fracture uneven. G. = 2...2·3; H. = 2...3. Opaque; dull or glimmering; streak resinous. Straw-yellow, yellowish-white, or siskin-green. B.B. decrepitates, becomes black and magnetic, but without fusing; soluble, and gelatinizes in warm acids. Chem. com. nearly 43 silica, 36 iron peroxide, and 21 water, with 3·5 alumina and 2 magnesia. Nontron in France, Harz, and Bavaria.

Chloropal is similar, but B.B. brown and infusible. Unghwar in Hungary, and near Passau. *Pinguite*, sectile; H. = 1; feels greasy; and B.B. fuses on the edges; is also a silicate of iron oxides with water; Wolkenstein in Saxony, near Zwickau, and Suhl.

174. Chlorophæite.—$(\dot{Fe}, \dot{Mg})^3 \dddot{Si}^4 + 18\,\dot{H}$.

Massive. Cleavage in two directions; fracture conchoidal, earthy; very soft and sectile. G. = 2·02. When first exposed translucent and pistacio or olive-green, but soon changes to brown or black, and opaque. B.B. melts to a black glass. Chem. com. of a specimen from Faroe, 32·85 silica, 22·08 iron protoxide, 3·44 magnesia, and 41·63 water. Scuir More in Rum, Faroe, and Iceland; also in Fife and near Newcastle.

175. Thorite.—$\dot{Th}^3 \dddot{Si} + 2\,\dot{H}$.

Massive. Fracture conchoidal; hard and brittle. G. = 4·63...4·8. Opaque; splendent; vitreous. Reddish-brown, or black clouded with red; streak dark-brown. B.B. infusible; gelatinizes with h. acid. Chem. com. essentially 73·4 thorina, 16·8 silica, and 9·8 water, but combined with very many other substances: lime, iron, manganese, magnesia, uranium, lead, tin, potash, soda, and alumina. Near Brevig in Norway.

176. Eulytine.—$\dddot{Bi}\,\dddot{Si}^2$.

Tesseral and tetrahedral; $\frac{2O2}{2}$ and $-\frac{2O2}{2}$. The crystals (like fig. 9) very small, and often with curved faces. Cleavage very imperfect; fracture conchoidal. H. = 4·5...5; G. = 5·9...6. Transparent and translucent; adamantine. Clove-brown, yellowish-gray or white; streak white or gray. B.B. fuses readily with intumescence to a brown bead, leaving a yellow ring on the charcoal; decomposed by h. acid, forming gelatinous silica. Chem. com. 21 silica and 79 bismuth peroxide, with 3·3 phosphoric acid, 2·4 iron peroxide, and 1·3 fluorine. Schneeberg, and Bräunsdorf near Freiberg.

Hypochlorite or *Green Iron-earth*, also from Schneeberg, in reniform crusts, or very fine earthy; semitranslucent or opaque. Dull, and siskin or olive-green. H. = 6; G. = 2·9...3. B.B. infusible, but becomes blackish-brown; and forms a yellow ring on the charcoal; insoluble in acids. It seems a mixture of silicate of iron and bismuth with phosphate of alumina.

177. Gadolinite. $\begin{cases} (\dot{Y}, \dot{Ce}, \dot{Fe})^3 \dddot{Si}, \textit{ and} \\ (\dot{Y}, \ddot{G}, Fe, \dot{La})^3 \dddot{Si}. \end{cases}$

Monoclinohedric, probably; with P∞ 49°, ∞P 115°, (2 P∞) 70½° nearly (Scheerer); but crystals rare and indistinct. Cleavage very indistinct, or none; fracture conchoidal or splintery. H. = 6·5; G. = 4·0...4·4. Opaque or translucent on the edges; vitreous, often resinous. Black; streak greenish-gray. B.B. the conchoidal (vitreous) varieties incandesce vividly, intumesce, but do not fuse; the splintery varieties form cauliflower-like ramifications, but do not incandesce; gelatinizes in h. acid. Chem. com. uncertain, but 25 to 29 silica, 36 to 51 yttria, 10 to 15 protoxide of iron, 5 to 17 protoxide of cerium with lanthanium, and 0 to 12 glucina. Krageroe in Norway, Ytterby, and Finbo.

178. Allanite, Cerin, Orthite.—$3\,\dot{R}^3 \dddot{Si}^2 + 2\,\overline{\overline{Al}}\,\dddot{Si}$.

Monoclinohedric, like epidote, but distinct crystals rare (fig. 154), mostly long, columnar, or granular. Cleavage imperfect; fracture conchoidal or uneven. H. = 6; G. = 3·2...3·7. Opaque, or translucent in thin splinters; imperfect metallic, inclining to vitreous or resinous. Black inclining to green or brown; streak greenish or brownish-gray. B.B. frothes, and melts easily to a black or brown scoria or glass, often magnetic; gelatinizes with h. acid. Chem. com. very variable, but with 30 to 35 silica, 12 to 18 alumina and iron peroxide, whilst $\dot{R}$ includes protoxides of cerium (11 to 24), lanthanium (2 to 8), iron (4 to 21), and manganese (0 to 3·5), with lime (2 to 12), yttria (0·3 to 4), and magnesia (0·4 to 5). Allanite occurs in Greenland, also at Hitteroe, the Jotun Fjeld, and Snarum; Cerin at Rydderhyttan; Orthite at Finbo, Fahlun, Arendal, and Krageroe.

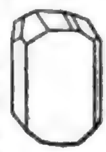


Fig. 154.

Pyrorthite, with carbonaceous and other matter; *Uralorthite*, from the Ilmen Mountains, containing more alumina; *Bodenite*, from Boden, Saxony; and *Bagrationite*, from Achmatowsk, are only varieties.

179. Tcheffkinite.

Massive. Fracture flat conchoidal. H. = 5...5·5; G. =

4·5. Opaque; vitreous, splendent. Velvet-black; streak dark-brown. B.B. intumesces greatly, becomes porous, and often incandesces; in the strongest white heat fuses to black glass; gelatinizes with warm h. acid. Chem. com. 21 silica, 20 titanic acid, 11 iron protoxide, and 47 peroxides of cerium, lanthanium, and didymium. Ilmen Mountains near Miask.

180. Cerite.—$(\dot{C}e, \dot{R})^2 (\dot{C}e, \dot{R})^2 \dddot{S}i + \dot{H}$.

Hexagonal; 0P . ∞P, in low six-sided prisms, but very rare. Generally fine granular, almost compact. Cleavage, traces; fracture uneven, splintery; brittle. H.=5·5; G.=4·9...5. Translucent on the edges, or opaque; dull, adamantine, or resinous. Clove-brown, cherry-red, or pearl-gray; streak white. B.B. infusible, but becomes dirty yellow; soluble in h. acid, leaving gelatinous silica. Chem. com. 22 silica, 72 protoxide of cerium (with didymium and lanthanium), and 6 water, with iron protoxide and lime. Bastnaes near Ridderhyttan.

181. Tritomite.—$\dddot{S}i$, $\dot{C}e$, $\dot{L}a$, $\dot{C}a$, $\dot{H}$.

Tesseral in tetrahedrons. Fracture conchoidal; brittle. H.=5·5; G=4·16...4·7. Vitreous; translucent on the edges. Dark-brown. B.B. swells and cracks; soluble in acids. Lamoe near Brevig.

182. Pyrochlore.—2 $(\dot{C}a, \ddot{T}h, \dot{C}e, \dot{F}e)$ $\dddot{N}i$ + Na F.

Tesseral; O. Cleavage octahedral; brittle; fracture conchoidal. H.=5; G.=3·8...4·3. Opaque or translucent; resinous. Dark reddish-brown, or almost black, some crystals ruby-red and transparent; streak pale-brown. B.B. becomes yellow and fuses with much difficulty into a blackish-brown scoria; the fine powder soluble in con. s. acid. Chem. com. very complex, but the Miask variety, 62 to 67 niobic (mixed with titanic and tungstic) acid, 10 to 13 lime, 6 to 13 oxide of cerium and thoria, and 7 fluoride of sodium; but yttria, iron, zirconia, lithia, and in that from Norway, also uranium, occur. Miask in Ural, Brevig and Fredriksvärn in Norway; also Chesterfield in Massachusetts (*Microlite*).

Pyrrhite, small orange-yellow octahedrons; H.=6; is a niobate of zirconia, with iron and uranium. Mursinsk and Azores.

183. Oerstedtite.

Tetragonal; P 84° 26′, like zircon. H.=5·5; G.=3·629. Opaque or translucent on the edges; adamantine vitreous. Reddish-brown. B.B. infusible. Forchhammer found 19·71 silica, 2·61 lime, 2·05 magnesia, 1·14 iron protoxide, 68·96 titaniate of zirconia, 5·53 water. Arendal.

184. Keilhauite, Yttrotitanite. } $(3\, \dot{C}a\, \dddot{S}i + (\dddot{A}l, \dddot{F}e)\, \dddot{S}i) + \dot{Y}\, \ddot{T}i^3$.

Monoclinohedric; C.=58°, ∞P = 114°. Cleavages, along −2 P intersecting at 138°. H.=6...7; G.=3·5...3·7. Translucent; vitreous or resinous. Blackish-brown; by transmitted light reddish; streak grayish-brown. B.B. fuses easily with effervescence to a black shining slag; with borax forms a blood-red glass in the red. flame; in powder soluble in h. acid. Chem. com. 28·8 silica, 27·8 titanic acid, 19·5 lime, 9·3 yttria, 6·9 alumina, and 7·7 iron peroxide. Near Arendal.

185. Wöhlerite.

Rhombic; ∞P 127° 6′, P∞ 140° 54′. Cleavage perfect; fracture conchoidal. H.=5...6; G.=3·41. Translucent; vitreous or resinous. Yellow, inclining to red or brown. B.B. fuses to a yellowish glass; easily soluble in warm con. h. acid, depositing silica and niobic acid. Analysis—30·62 silica, 14·47 niobic acid, 15·17 zirconia, 3·67 iron and manganese protoxide, 26·19 lime, and 7·78 soda. Fredriksvärn (*Eukolite*), and Brevig in Norway.

Order II.—SALINE STONES.

Comprises minerals which, in external aspect and composition, resemble (or are) the salts of the chemist. With a few exceptions, as rock-salt and fluor-spar, they are combinations of the second order of two oxygen compounds. The acid component is one of the common acids,—the carbonic, sulphuric, boracic, or phosphoric acid,—not silica or alumina, as in the former order. They are almost all crystallized, and predominantly in rhombic or monoclinohedric forms, but some rhombohedric or tesseral. Their hardness is low; one 7, a few about 5, most lower. G.=1·5...4·7. All are soluble in acids, except the sulphates (three); more than half in water. B.B. all fusible or decompose. Many of them are products of decomposition. Occur rather in veins than as components of rocks.

**Family I.—Calc-spar.

Generally rhombohedric in crystals and cleavage. H.=3...4·5; G.=2·6...3·4, becoming higher as the metallic element increases. They are soluble and often effervesce in acids; and become caustic or alkaline when burned. They form a series of closely-related compounds of carbonic acid with lime, magnesia, and isomorphous bases, as the protoxide of iron. Are generally white, translucent, with a vitreous, or pearly lustre.

**186. Calc-spar, Calcareous Spar, Carbonate of Lime. } $\dot{C}a\ \ddot{C}$.

Rhombohedral; R 105° 5′; the forms and combinations exceeding those of any other mineral. Among them are more than thirty rhombohedrons, especially −½R 135°, R, −2R 79°, and 4R 66°, with 0R and ∞R as limiting forms; more than fifty distinct scalenohedrons, as R^3, R^3, and $\frac{1}{4}R^3$; and the second hexagonal prism ∞P2, whilst hexagonal pyramids are among the rarer forms. Some of the most usual combinations are ∞R . −½R (fig. 157); or −½R . ∞R, very frequent; also ∞R . 0R; likewise −2R . R; R^3 . ∞R . −2R; R^3 (*y*) . R^3 (*r*) . R (*P*) . 4 R (*m*) . ∞R (*C*) (fig. 155); and many others, upwards of an hundred distinct combinations being known.

Macles are not uncommon, especially with the systems of axes parallel (figs. 156, 157), and others conjoined by a

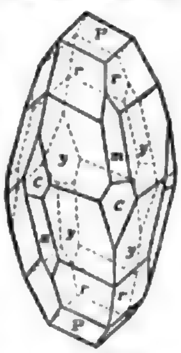


Fig. 155.

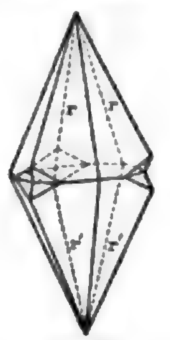


Fig. 156.

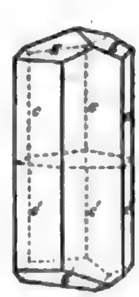


Fig. 157.

face of R with the chief axes almost at right angles, 89° 8′ (fig. 82); or by a face of −½R, in which the chief axes form an angle of 127½°; and usually many times repeated, so that the centre crystals appear in lamellæ not thicker than paper (fig. 81). Cleavage, rhombohedric along R very perfect and easily obtained, so that the conchoidal fracture is rarely observable; brittle. H.=3; G.=2·6...2·8; pure transparent crystals=2·72. Pellucid in all degrees. Very distinct double refraction. Lustre vitreous, but several faces resinous, and 0R pearly. Most frequently colourless or white, but often gray, blue, green, yellow, red, brown, or black; streak grayish-white. B.B. infusible, but becomes caustic and emits a bright light; effervesces, and is entirely soluble in h. or n. acid. The fine powder ignited on platina-foil over the spirit-lamp, according to *v. Zehmen*,

forms a somewhat connected mass, and even adheres to the platina. Chem. com. of the purest varieties, carbonate of lime, with 43·87 carbonic acid and 56·13 lime, or 40 calcium, 12·2 carbon, and 47·8 oxygen; but usually contain magnesia and protoxide of iron or manganese. Remarkable specimens of the crystallized variety, or proper calc-spar, are found in Andreasberg and other parts of the Harz (six-sided prisms), Freiberg, Tharand, Maxen, Alston Moor in Cumberland (flat rhombic crystals), and in Derbyshire (pale yellow transparent pyramids).

Certain varieties are distinguished, as,—Iceland spar, remarkable for its transparency and double refraction, occurs massive in a trap rock in that island. *Slate spar*, thin lamellar, often with a shining white pearly lustre, and greasy feel; Wicklow in Ireland, Glentilt in Scotland, and Norway. *Aphrite*, fine scaly, from Hessia and Thuringia. *Marble* is the massive crystalline variety of this mineral, produced by igneous action on compact limestone. Paros, Naxos, and Tenedos furnished the chief supply to the Grecian artists; Carrara, near the Gulf of Genoa, to those of modern times. Some of the coloured marbles of the ancients were impure limestones, as the *Cipollino*, zoned with green talc or chlorite; and *Verde antique*, mixed with green serpentine. *Ruin marble* shows irregular markings like ruins; Val d'Arno (Florentine marble), and Bristol (Cotham marble). *Lucullite*, from Egypt, and *Anthraconite*, from Kilkenny in Ireland, are black from carbon. *Lumachello*, from Bleiberg in Carinthia, exhibits beautiful iridescent colours from fossil shells, sometimes deep-red or orange (*Fire marble*).

Limestone occurs in all formations under various names, as *Oolite*, egg or roe-stone, round concretions, with a concentric structure like the roe of fish; *Pisolite*, or peastone, similar structure; *Chalk*, soft earthy; *Lithographic stone*, yellowish and compact, from Solenhofen; and *Marl*, calcareous matter more or less mixed with clay. *Tufa*, or calcareous tufa, generally a recent deposit from calcareous springs, has often a loose friable texture, but at other times is hard and compact; and in the neighbourhood of Rome forms the common building stone or *Travertino*. The sandstone of Fontainbleau is carbonate of lime ($\frac{1}{3}$) mixed with quartz sand ($\frac{2}{3}$), and occasionally crystallizing in rhombohedrons.

This mineral is employed in many ways,—the coarser varieties, as lime, for mortar, manure, tanning, a flux in melting iron and other ores, or in preparing glass, and similar purposes; the finer, as marbles, for sculpture, architecture, and ornamental stone-work; the chalk for writing, whitewashing, or producing carbonic acid.

Plumbocalcite.—Cleavage, R 104° 53′. White and pearly; softer than calc-spar; but G.=2·824. Contains 2·3 to 7·8 carbonate of lead. Wanlockhead and Leadhills, Scotland.

**187. Dolomite, Bitter Spar.—$\dot{Ca}\,\ddot{C}+\dot{Mg}\,\ddot{C}$.

Rhombohedric; R 106° 15′—20′; most frequent form R; also R and $-\frac{1}{2}$R, or 0R, ∞R, and 4R. The rhombohedrons often curved and saddle-shaped; also granular or compact, often cellular and porous. Cleavage, rhombohedral along R. H.=3·5…4·5; G.=2·85…2·95. Translucent; vitreous, but often pearly or resinous. Colourless or white, but frequently pale-red, yellow, or green. B.B. infusible, but becomes caustic, and often shows traces of iron and manganese; fragments effervesce very slightly or not at all in hydrochloric acid; the powder is partially soluble, or wholly when heated; the very fine powder ignited on platina-foil for a few minutes over a spirit-lamp *continues* pulverulent, but intumesces slightly during ignition. Chem. com. generally carbonate of lime, with more than 20 per cent. carbonate of magnesia and less than 20 per cent. carbonate of iron.

Varieties are,—*Dolomite*, massive, granular, easily divisible, white; *Rhomb* or *Bitter-spar*, larger grained, or distinctly crystallized and cleavable, often inclining to green; and *Brown-spar* and *Pearl-spar*, in simple crystals or in imitative forms, of colours inclining to red or brown, more distinct pearly lustre, and under 10 per cent. carbonate of iron. Traversella in Piedmont, St Gotthardt, Gap in France, Alston in Cumberland, in Derbyshire, and at Leadhills and Charlestown in Scotland. Greenish, macled; Miemo, in Tuscany (*Miemite*), and Tharand in Saxony (*Tharandite*). *Gurhofian*, from Gurhof in Austria, is white and compact.

The massive and compact varieties are very common, and valued as building-stones (cathedral of Milan, York Minster, and the New Houses of Parliament). The Parian marble, and also the Iona marble in the Hebrides, have been supposed to belong to this species.

Predazzite.—Granular; white and vitreous on the cleavage planes. H.=3·5; G.=2·623. Contains 6·98 per cent. water. Predazzo in Tyrol.

188. Breunnerite, Giobertite.—$\dot{Mg}\,\ddot{C}$.

Rhombohedral; R 107° 10′—30′; as yet only R; and granular or columnar. Cleavage, R very perfect, with straight faces. H.=4…4·5; G.=2·9…3·1. Transparent or translucent on the edges; highly vitreous. Colourless, but often yellowish, brown, or blackish-gray. B.B. infusible, but generally becoming gray, or black and magnetic; soluble in acids, often only when pulverized and warmed. Chem. com. essentially carbonate of magnesia, with 51·7 carbonic acid and 48·3 magnesia, but often mixed with 8 to 17 carbonate of iron or manganese. Tyrol, St Gotthardt, Harz, Fassathal; also Unst in Zetland.

Mesitine-spar, splendent, yellow, lenticular crystals; G. =3·35…3·4; Traversella in Piedmont: and *Pistomasite*; G.=4·4; Salzburg; are similar.

189. Magnesite.—$\dot{Mg}\,\ddot{C}$.

Reniform or massive. H.=3…5; G.=2·85…2·95. Sub-translucent or opaque; streak shining. Snow-white, grayish, or yellowish-white, and pale-yellow. Adheres slightly to the tongue. B.B. and with acids acts like breunnerite. Chem. com. pure carbonate of magnesia, with no metallic oxides. Tyrol, Norway, North America.

190. Hydromagnesite.—$\dot{Mg}^4\,\ddot{C}^3+4\,\dot{H}$.

Monoclinohedric; C=82½°, ∞P 88° nearly. Crystals small, acicular; also massive. H.=1·5…3·5; G.=2·14…2·18. Vitreous or silky. White. B.B. infusible; soluble with effervescence in acids. Chem. com. 36·2 carbonic acid, 44 magnesia, and 19·3 water. Moravia, Kumi, Hoboken in New Jersey, and Texas in Pennsylvania. The *Hydromagnocalcite* is a similar yellow sinter from Vesuvius with part of the magnesia replaced by lime.

**191. Arragonite, Needle Spar, Flos-ferri.—$\dot{Ca}\,\ddot{C}$.

Rhombic; ∞P 116° 16′, P$\breve{\infty}$ 108° 27′. The most common combinations are $\infty\breve{P}\infty$ (*h*), ∞P (*M*) . $\breve{P}\infty$ (*k, P*), generally long prismatic (like fig. 158, and separate crystals in fig. 159); ∞P∞ . ∞P . 0$\breve{P}$, generally short prismatic; 6$\breve{P}\frac{3}{2}$. ∞P . $\breve{P}\infty$, acute pyramidal. But simple crystals are rare,

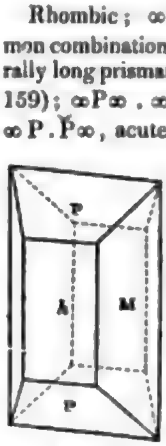


Fig. 158.

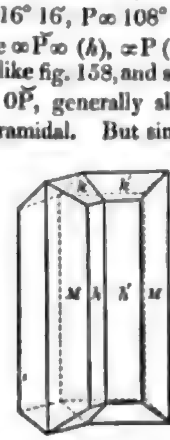


Fig. 159.

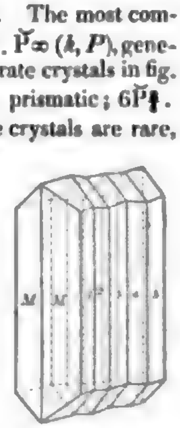


Fig. 160.

from the great tendency to form macles, conjoined by a face of ∞P, and repeated (figs. 159, 160). Also columnar, fibrous, and in crusts, stalactites, and other forms. Cleav-

Mineralogy.

age, brachydiagonal distinct, also ∞P and $\breve{P}\infty$ imperfect; fracture conchoidal or uneven. H.=3·5...4; G=2·8...3 (massive 2·7). Transparent or translucent; vitreous. Colourless, but yellowish-white to wine-yellow, reddish-white to brick-red; also light-green, violet-blue, or gray. In the closed tube, before reaching a red heat, it swells and falls down into a white coarse powder, evolving a little water. A portion of this powder heated in the forceps, B. B., colours the flame carmine-red when strontia is present; on charcoal it becomes caustic, and with fluxes acts like calc-spar. Chem. com. carbonate of lime, occasionally mixed with (0·1...4) carbonate of strontia. Valencia, Molina, and in Arragon; Leogang in Salzburg, and Antiparos. *Flos-ferri*, coralloid, in the iron mines of Styria. *Satin-spar*, fine fibrous silky, at Dufton; stalactitic in Buckinghamshire, Devonshire, coast of Galloway, and Leadhills; also deposited as tufa by the Carlsbad and other hot springs.

Arragonite is most readily distinguished from calc-spar by falling to pieces at a low temperature, and by its less distinct and prismatic cleavage.

Tarnowitzite contains 2 to 4 carbonate of lead. Tarnowitz in Silesia.

**Family II.—Fluor Spar.

Crystallization tesseral, hexagonal, or rhombic. H.=4...5, in one 7; G.=2·9...4·7, but mostly about 3. All soluble in acids, and mostly fusible or altered by heat. Those containing fluorine, when warmed with concentrated sulphuric acid, evolve vapours that corrode glass; those with phosphoric acid, when moistened with sulphuric acid, colour B.B. the flame green.

**192. Fluor Spar.—Ca F.

Tesseral; the most common form is the cube $\infty O \infty$, then the octahedron O, and the rhombic dodecahedron ∞O; but many other forms occur in combinations. Macles are common; also coarse granular, columnar, or compact and earthy. Cleavage, octahedral perfect; conchoidal fracture; brittle. H.=4; G.=3·1...3·2. Pellucid in all degrees; vitreous. Colourless, but generally very various, and beautiful shades of yellow, green, blue, and red; often two or more in one specimen. Many varieties phosphoresce when heated (*Chlorophane*, with a bright green light). B.B. decrepitates, often violently, phosphoresces and fuses in thin splinters to an opaque mass; slowly soluble in h. or nitric acids, readily in s. acid, with evolution of hydrofluoric acid. Chem. com. neutral fluoride of calcium, containing 48·14 fluorine, and 51·86 calcium (=72·45 lime), Fluor-spar is a very common mineral, chiefly in veins, as with tin ores in Saxony, Bohemia, Cornwall; with silver at Freiberg, Marienberg, Kongsberg; with lead in Derbyshire (near Castletown), Cumberland (Alston Moor), Northumberland and Ireland. It is rare in Scotland, but in greenstone near Gourock, in granite near Ballater in Aberdeenshire, on the Avon in Banffshire, and in Sutherland. In Derbyshire it occurs in large crystalline masses either with concentric colours or of a rich translucent blue (*Blue John*), and is wrought into various ornamental articles. Fluor spar is also used for etching on glass, and as a flux in reducing metallic ores, especially iron and copper.

193. Yttrocerite.

Very similar to fluor spar. Granular, crystalline, or in crusts. Cleavage imperfect. H.=4...5; G.=3·4...3·5. Translucent or opaque; weak vitreous lustre. Violet-blue to gray or white. B.B. infusible on charcoal alone, and evolves fluorine when heated with s. acid. Chem. com. fluorides of calcium, cerium, and yttrium, in variable proportions. Finbo and Broddbo near Fahlun, Massachusetts, and Amity in New York.

194. Fluocerite.— Ce F + $Ce^2 F^3$.

Hexagonal; $\infty P . 0P$. H.=4...5; G.=4·7. Opaque or translucent on the edges; lustre weak. Pale brick-red or yellowish; streak yellowish-white. In the closed tube gives out fluorine. B.B. infusible. Chem. com. 82·64 peroxide of cerium, 1·12 yttria, and 16·24 hydrofluoric acid, *Berzelius*. Finbo and Broddbo.

195. Fluocerine.—$Ce^2 F^3 + \ddot{C}e \dot{H}$.

Massive, with traces of cleavage; fracture conchoidal. H.=4·5. Opaque; vitreous or resinous. Yellow, inclining to red or brown; streak brownish-yellow. B.B. infusible. Analysis, 84·21 peroxide of cerium, 10·85 hydrofluoric acid, and 4·95 water. Finbo. A similar mineral from Bastnaes gave fluoride of cerium (and lanthanium) 50·15, peroxide of cerium 36·43, and water 13·4.

196. Cryolite.—3 Na F + $Al^2 F^3$.

Rhombic (or tetragonal ?), but only indistinct crystalline or granular. Cleavage, basal perfect, two others less so, the three nearly at right angles; brittle. H.=2·5...3; G.=2·9...3. Translucent, and after immersion in water almost transparent; vitreous, but on 0P rather pearly. Colourless and snow-white, but often grayish, yellowish, or reddish. B.B. fuses very easily (even in the flame of a candle) to a white enamel; in open tube shows traces of fluorine; partially soluble in h. acid; wholly so in s., with evolution of fluorine. Chem. com. 53·7 fluorine, 13·1 aluminium, and 33·2 sodium. Arksutfiord in West Greenland, Miask in Ural. Used as an ore of aluminium.

197. Chiolite.— $\begin{cases} 3\ Na\ F + 2\ Al^2\ F^3 = A \\ 2\ Na\ F + Al^2\ F^3 = B. \end{cases}$

Tetragonal, with middle edge 113° 25′ (or rhombic with ∞P 124° 22′); mostly granular. Cleavage, P rather perfect. H.=4. Resinous. White. Very easily fusible (more so than cryolite), colouring the flame deep yellow; evolves fluoric acid. Chem. com. twofold; one variety (A) with G.=2·8...2·9, containing 18·7 aluminium, 23·8 sodium, and 57·5 fluorine; the second (B), with G.=3·0...3·1, containing 16·4 aluminium, 27·8 sodium, and 55·8 fluorine. Miask in Siberia.

Fluellite.—Small, white, transparent, rhombic pyramids; polar edges 109° 6′ and 82° 12′, middle 144°. Consists essentially of fluorine and aluminium. Stenna-gwyn in Cornwall.

Prosopite.—Crystals like datholite. H.=4·5. Vitreous. Colourless and transparent. Contains fluorine, aluminium, calcium, and water. Altenberg; Schlackenwalde (?).

198. Hopeite.

Rhombic; $\infty \breve{P}2$, 82° 20′; P with polar edges 106° 36′ and 140°. Cleavage, macrodiagonal perfect. H.=2·5...3; G.=2·76...2·85. Vitreous or pearly. Grayish-white. B.B. melts to a clear globule, tinging the flame green; soluble in acids without effervescence. Chem. com. oxide of zinc and cadmium, with phosphoric (or boracic ?) acid, and much water. Altenberg near Aix la Chapelle.

**199. Apatite.—3 $\dot{C}a^3 \dddot{P}$ + Ca (Cl, F).

Hexagonal, and pyramidal-hemihedric; P 80° 26′; the

Fig. 161.

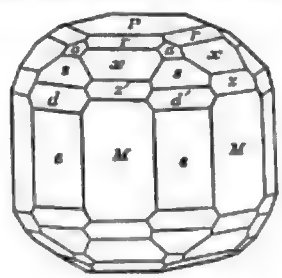


Fig. 162.

most common forms are ∞P (*M*), $\infty P2$ (*e*), 0P (*P*), P (*x*). The crystals (figs. 161, 162) are short prismatic or thick tabular, and often striated vertically. Also granular, fibrous, or compact. Cleavage, prismatic and basal both imper-

Mineralogy.

fect; fracture conchoidal or uneven and splintery; brittle. H. = 5; G. = 3·16...3·25. Transparent to opaque; vitreous, but resinous on the cleavage planes and fracture. Colourless, and white, but generally light-green, gray, blue, violet, or red. B.B. fusible in thin splinters with much difficulty to a colourless, translucent glass; moistened with sulphuric acid it colours the flame green; soluble in nitric or h. acid. Chem. com. phosphate of lime (91 to 92·3), with chloride (0 to 4·2) and fluoride (4·6 to 7·7) of calcium. In tin mines in Saxony, Bohemia, St Michael's Mount, St Agnes, and Botallack in Cornwall; in granite at Bovey Tracey in Devonshire, and at Calbeck Fell in Cumberland; also at St Gotthardt, the Tyrol, and at Hammond and Edenville in New York. *Moroxite*, opaque greenish-blue from Arendal. *Asparagus-stone*, translucent, wine-yellow crystals from the Zillerthal in Tyrol. *Phosphorite*, massive, from Logrosan in Estremadura.

Magnesia-apatite, from Kusiusk in the Ural, contains 7·74 magnesia.

200. HERDERITE, Allogonite.—$\dddot{\text{Al}}, \dot{\text{Ca}}, \dddot{\bar{\text{P}}}$, F.

Rhombic; P middle edge 77° 20′, ∞P 115° 53′. Cleavage, 0P and ∞P imperfect; fracture conchoidal. H. = 5; G. = 2·9...3. Translucent; vitreous, inclining to resinous. Yellowish or greenish-white. B.B. difficultly fusible to a white enamel; moistened with s. acid colours the flame green; soluble in warm h. acid. Ehrenfriedersdorf in Saxony, but extremely rare.

201. CHILDRENITE.—$2(\dot{\text{Fe}}, \dot{\text{Mn}})^4, \dddot{\bar{\text{P}}} + \dddot{\text{Al}}^3\ \dddot{\bar{\text{P}}} + 15\ \dot{\text{H}}$.

Rhombic; P 102° 41′, 130° 4′, 97° 52′; usual form P . 2P̄∞ . ∞P̄∞ (fig. 163). Cleavage, P imperfect. H = 4·5...5. G. = 3·18...3·3. Translucent; vitreous. Yellowish-white to wine or ochre-yellow, brown, or almost black. B.B. infusible, but colours the flame bluish-green; slowly soluble in warm h. acid. Chem. com. 30·7 iron protoxide, 9 manganese protox., 14·5 alumina, 29 phosphoric acid, and 17 water. Tavistock in Devonshire, Crinnis in Cornwall, and Callington in Cumberland.

Fig. 163.

202. XENOTIME.—$\dot{\text{Y}}^3\ \dddot{\bar{\text{P}}}$.

Tetragonal; P 82° 30′. Crystals P . ∞P. Cleavage, ∞P. H. = 4·5; G. = 4·39...4·55. Translucent in thin splinters; resinous. Yellowish or reddish-brown, and flesh-red; streak paler. B.B. infusible. Chem. com. 62·82 yttria, and 37·18 phosphoric acid, with traces of fluoric acid, and 3·39 phosphate of iron. Lindesnaes and Hitteroe in Norway, Ytterby and Georgia, U.S.

203. BORACITE.—$\dot{\text{M}}\text{g}^3, \dddot{\bar{\text{B}}}^4$.

Tesseral, and hemihedric; ∞O∞, ∞O, and $\frac{O}{2}$. Cleavage, octahedral very imperfect; fracture conchoidal; brittle. H. = 7; G. = 2·9...3. Transparent, or translucent on the edges. Vitreous or adamantine. Colourless or white, often grayish, yellowish, or greenish. Becomes polar electric by heat. B.B. fuses with difficulty to a clear yellowish bead, which on cooling forms a white opaque mass of needle-like crystals; at same time colours the flame green; soluble in h. acid. Chem. com. 69·8 boracic acid, and 30·2 magnesia. Lüneberg and Segeberg in Holstein.

Stassfurthite.—Compact, or in very minute prismatic crystals. White. Chem. com. same as boracite, and thus dimorphous. Stassfurth in Germany.

Rhodizite agrees with boracite; only H. = 8 and G. = 3·3...3·42. B.B. fuses difficultly on the edges, colouring the flame first green, then green above and red below, and at last in some varieties all red. Chem. com. borate of lime. Mursinsk in Siberia.

204. HYDROBOROCALCITE.—$\dot{\text{C}}\text{a}\ \dddot{\bar{\text{B}}}^2 + 6\ \dot{\text{H}}$

Delicate snow-white crystals, with 19 lime, 46 boracic acid, and 35 water. Iquique in Peru.

205. HYDROBORACITE.—$\dot{\text{C}}\text{a}^3\ \dddot{\bar{\text{B}}}^3 + \dot{\text{M}}\text{g}^3\ \dddot{\bar{\text{B}}}^3 + 12\ \dot{\text{H}}$.

Radiating and foliated like gypsum. H. = 2; G. = 1·9...2. Translucent. White, but partly red. B.B. melts easily, tinging the flame green; easily soluble in warm acids. Chem. com. 13·52 lime, 10·57 magnesia, 49·58 boracic acid, and 26·33 water. Caucasus. A similar mineral with soda in place of magnesia is found in Peru.

*206. DATHOLITE, Borate of Lime.—$\dot{\text{C}}\text{a}\ \dddot{\bar{\text{B}}} + \dot{\text{C}}\text{a}\ \dddot{\text{Si}} + \dot{\text{H}}$.

Monoclinohedric; C = 88° 19′, ∞P (*f*) 77° 30′, ∞P2 (*g*) 116° 9′,—P (*P*) 122°,—2P∞ (*a*) 43° 56′, (∞P∞) (*s*), 2P∞) (*o*) (fig. 164); or rhombic with *b* : *f* 90°, *b* : *a* 135°; *b* : *c* 141° 9′, and *f* : *g* 160° 39′; also coarse granular. Cleavage, orthodiagonal and ∞P very imperfect; fracture uneven or conchoidal. H. = 5...5·5; G. = 2·9...3. Transparent or translucent; vitreous; on the fracture resinous. Colourless or white, inclining to gray, green, yellow, and red. In closed tube yields water. B.B. intumesces, and melts easily to a clear glass, colouring the flame green; the powder gelatinizes in h. acid. Chem. com. 38·3 silica, 21·5 boracic acid, 34·6 lime, and 5·6 water. Arendal, Utoe, Andreasberg, Seisser Alpe, Sonthofen (*Humboldtite*); Toggianna in Modena; also Salisbury Crags, Corstorphine Hill, and Glen Farg, in Perthshire; Connecticut and New Jersey.

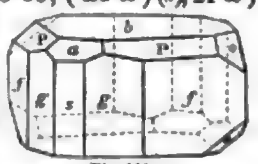


Fig. 164.

Botryolite.—Fine fibrous, botryoidal or reniform, snow-white or hair-brown; otherwise, and in chem. com., like datholite, but with two atoms water. Arendal.

FAMILY III.—HEAVY SPAR.

Crystallization rhombic specially. H. = 3...4·5; G. = 3·2...4·7, but mostly 3·6...4·5. Soluble in acids, except barytes. B.B. fusible or decompose. Those containing baryta colour the flame yellowish-green; those with strontia carmine red, best seen when moistened with h. acid. The sulphates fused with soda and then moistened leave a black stain on silver.

**207. BARYTES, Heavy Spar.—$\dot{\text{B}}\text{a}\ \dddot{\text{S}}$.

Rhombic; ∞P (*g*) 101° 40′, P̄∞ (*f*) 74° 35′, ½P̄∞ (*d*) 102° 17′; and 0P (*c*), (figs. 165, 166, 167). The crystals tabular or columnar, often in druses or groups; also foliated, fibrous, granular, or compact. Cleavage, basal perfect, prismatic along ∞P less perfect; brachydiagonal traces. H. = 3...3·5; G. = 4·3...4·7 (4·48). Transparent to translucent; vitreous or resinous. Colourless and white, but generally reddish-white, or flesh-red, yellow, gray, bluish, greenish, or brown. B.B. decrepitates violently, and fuses very difficultly, or only on the edges, colouring the flame yellowish-green; not soluble in acids. Chem. com. 34·3 sulphuric acid, and 65·7 baryta, but occasionally with 1 to 15 sulphate of strontia. Very common, chiefly in veins, either alone or accompanying ores. Crystals at Dufton, Bohemia, Felsobanya and Kremnitz in Hungary, Auvergne, and United States. Columnar at Freiberg. The radiated from near Bologna, or the *Bolognese stone*, phosphoresces in the dark. Massive or *Cawk* from Derbyshire and Staffordshire; in Scotland, at Leadhills,

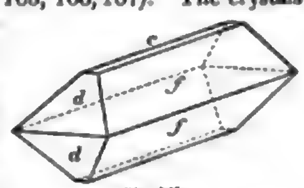


Fig. 165.

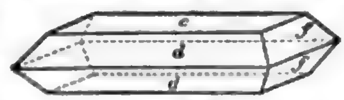


Fig. 166.

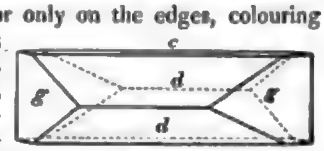


Fig. 167.

Braid Hills near Edinburgh, the Pentlands and Cheviots, and Arran, where mined as a white pigment.

Lime Barytes from Freiberg, Strontian, and Derbyshire, seems a mixture with sulphate of lime; crystals, tabular, in rosettes and other groups. G.=4·0...4·3.

Hepatite.—Dark-gray, from carbonaceous matter; Kongsberg. *Allomorphite*, scaly, white and pearly, at Unterwirbach near Rudolstadt, agrees essentially (98·05 sulphate of baryta, 1·90 sulphate of lime) with barytes.

208. Dreelite.—$\dot{Ca}\,\dddot{S} + 3\,\dot{Ba}\,\dddot{S}$.

Rhombohedric; R 93°. Cleavage, R imperfect. H.=3...4; G.=3·2...3·4. Lustre dull; on cleavage pearly. White. B.B. fuses to a white vesicular glass; effervesces with h. acid, but only partially dissolves. Chem. com. 61·73 sulphate of baryta, 14·27 sulphate of lime, 8·05 carbonate of lime, 9·71 silica, 2·40 alumina, 1·52 lime, 2·31 water. Nuissière near Beaujeu.

*209. Witherite.—$\dot{Ba}\,\ddot{C}$.

Rhombic; ∞P 118° 30′, 2P̆∞ 68°. Crystals ∞P . P∞ . 2P̆∞ (fig. 168); more common spherical, botryoidal, or reniform, with radiated columnar texture. Cleavage, ∞P distinct, 2P∞ and ∞P̆ imperfect; fracture uneven. H.=3...3·5; G.=4·2...4·3. Semitransparent or translucent; vitreous, or resinous on the fracture. Colourless, but generally yellowish or grayish. B.B. fuses easily to a transparent globule, opaque when cold; on charcoal boils, becomes caustic and sinks into the support; soluble with effervescence in nitric or h. acid. Chem. com. 22·3 carbonic acid and 77·7 baryta. Alston Moor in Northumberland, and Lancashire, where it is used for poisoning rats; also in Styria, Salzburg, Hungary, Sicily, Siberia, and Chili.

Fig. 168.

210. Alstonite.—$\dot{Ba}\,\ddot{C} + \dot{Ca}\,\ddot{C}$.

Rhombic; ∞P 118° 50′, 2P̆∞ 111° 50′; usual combination P . 2P̆∞ . ∞P . resembling a hexagonal pyramid. Cleavage, ∞P and ∞P̆∞ rather distinct. H.=4...4·5; G.=3·65...3·76. Translucent; weak resinous. Colourless or grayish-white. Chem. com. 66 carbonate of baryta and 34 carbonate of lime, thus identical with the baryto-calcite. Fallowfield near Hexham, and Alston Moor.

211. Baryto-Calcite.—$\dot{Ba}\,\ddot{C} + \dot{Ca}\,\ddot{C}$.

Monoclinohedric; C.=69° 30′; ∞P 95° 15′, P 106° 54′, P∞ 119° (fig 169); also columnar and granular. Cleavage, P perfect, P∞ less perfect. H.=4; G.=3·6...3·7. Transparent or translucent; vitreous, inclining to resinous. Yellowish-white. B.B. infusible, but becomes opaque and caustic. Chem. com. like Alstonite, Alston Moor.

Fig. 169.

*212. Celestine.—$\dot{Sr}\,\dddot{S}$.

Rhombic; forms like those of barytes and sulphate of lead; ∞P 104° 8′, P∞ 75° 58′. Usual combinations P̆∞ . ∞P . 0P, this with ½P∞, also 0P . ∞P (fig. 170); also columnar, and foliated; or fibrous, fine granular or compact. Cleavage, basal perfect; prismatic along ∞P less perfect. H.=3...3·5; G.=3·9...4. Transparent or translucent; vitreous or resinous. Colourless, but usually bluish-white to indigo-blue, and rarely reddish or yellowish. B.B. decrepitates and fuses easily to a milk-white globule; colours the flame carmine-red. Distinguished from barytes by a splinter after ignition in the inner flame, being moistened with h. acid, and held in the blue border of the flame of a candle, colouring this of a lively purple-red. Scarcely affected by acids. Chem. com. 43·6 sulphuric acid, and 56·4 strontia. Sulphur mines of Girgenti and other parts of Sicily, Herrengrund in Hungary, Bex, Salzburg, Monte Viale near Verona, and Meudon and Montmartre near Paris; in England near Bristol, and Knaresborough; in Scotland at Inverness, Tantallan Castle, Calton Hill. Used for strontium preparations, and red-light in fire-works.

Fig. 170.

Baryto-celestine.—Radiating columnar or foliated. Bluish-white; very brittle and friable. H.=2·5; G.=3·92. B.B. difficultly fusible. Chem. com. $2\,\dot{Sr}\,\dddot{S} + \dot{Ba}\,\dddot{S}$, with 36 strontia, and 23 baryta. Diamond Island in Lake Erie, Kingstown in Upper Canada, and Binnenthal.

*213. Strontianite.—$\dot{Sr}\,\ddot{C}$.

Rhombic; ∞P 117° 19′, P̆∞ 108° 12′. Crystals (fig. 171) and macles like arragonite; also broad columnar and fibrous. Cleavage, prismatic along ∞P (*M*), and 2P̆∞ (*P*) (69° 16′) imperfect. H.=3·5; G.=3·6...3·8. Translucent or transparent; vitreous or resinous on fracture. Colourless, but often light asparagus or apple-green, more rarely grayish or yellowish. B.B. fuses in a strong heat only on very thin edges; intumesces in cauliflower-like forms, shines brightly, and colours the flame red; easily soluble with effervescence in acids; the solution in hydrochloric acid, evaporated and then dissolved in alcohol, makes this burn with a carmine-red flame. Chem. com. 30 carbonic acid and 70 strontia, but often contains carbonate of lime (6 to 8). Leogang in Salzburg, Bräunsdorf in Saxony, Hamm in Westphalia, the Harz, at Schoharie and other parts of the United States (*Emmonite*); Strontian in Argyllshire, Leadhills, Yorkshire, and Giant's Causeway. It is used to produce red fire in pyrotechnic exhibitions.

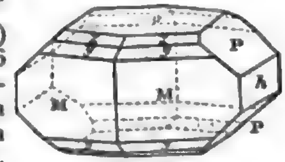


Fig. 171.

Stromnite or *Barystrontianite.*—Yellowish-white, semi-translucent, faint pearly lustre. H.=3·5; G.=3·7. Contains 68·6 carbonate of strontia, 27·5 sulphate of baryta, and 2·6 carbonate of lime. Stromness in Orkney.

Family IV.—Gypsum.

Crystallization rhombic or monoclinohedric. H.=2...3, or less, many yield to the nail. G.=2·2...2·9, or also low. All, except the sulphates, soluble in acids, some in water; also fusible in general. Mostly translucent and colourless, but often coloured by mixtures.

**214. Gypsum.—$\dot{Ca}\,\dddot{S} + 2\,\dot{H}$.

Monoclinohedric; C.=81° 26′; the most common forms are ∞P 111° 14′, P 138° 44′,—P 143° 28′, and (∞P∞). Two common combinations are ∞P (*f*) . (∞P∞) (*P*) . —P (*l*) (fig. 172), and this with P. Lenticular crystals often occur; macles frequent (fig. 83 above); also granular, compact, fibrous, scaly, or pulverulent. Cleavage, clinodiagonal very perfect, hemipyramidal along P much less perfect; sectile, thin plates flexible. H.=1·5...2 (lowest on *P*); G.=2·2...2·4. Transparent or translucent; vitreous, on cleavage pearly or silky. Colourless and snow-white, but often red, gray, yellow, brown, and more rarely greenish or bluish. In the closed tube yields water. B.B. becomes opaque and white; exfoliates and fuses to a white enamel, which is alkaline; soluble in 400 to 500 parts of water, scarcely more so in acids. Chem. com. sulphate of lime with two atoms water, or 46·47 sulphuric acid, 32·65 lime, and 20·88 water.

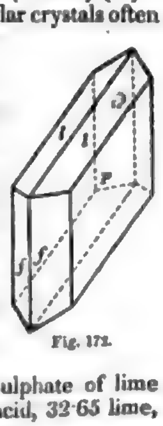


Fig. 172.

Gypsum is a very common mineral, often in nests or reniform masses in clay or marl. Transparent crystals, or *Selenite*, occur in the salt mines of Bex in Switzerland, of the Tyrol, Salzburg, and Bohemia, in the sulphur mines

of Sicily, at Lockport in New York, in the clay of Shotover Hill near Oxford, at Chatley near Bath, and many other localities. Fibrous gypsum at Ilfeld in the Harz, and Matlock in Derbyshire. Compact gypsum at Volterra in Tuscany (*Alabaster*), and in whole beds in many parts of Germany, France, Italy, and England, often with rock-salt.

The finer varieties, or *Alabaster*, are cut into various ornamental articles. Plaster of Paris, used for casts and other works of art, is formed by calcining gypsum at a temperature below 300° Fahr., and grinding it down to a fine powder, which forms a paste that soon hardens by absorbing the water driven off by the heat.

*215. ANHYDRITE, Muriazit, Karstenite.—$\dot{\text{Ca}}\,\dddot{\text{S}}$.

Rhombic; ∞P 91° 10,′ $\breve{P}\infty$ 96° 36′. Crystals $0P \,.\, \infty\breve{P}\infty \,.\, \infty\bar{P}\infty \,.\, \infty P$, but rare; chiefly granular, or almost compact or columnar. Macles rare. Cleavage, macrodiagonal and brachydiagonal both very perfect, basal perfect. H.=3...3·5; G.=2·8...3. Transparent or translucent; vitreous; on $\infty\breve{P}\infty$ pearly. Colourless or white, but often blue, red, or gray; streak grayish-white. In closed tube gives no water. B.B. fuses difficultly to a white enamel; with fluor spar fuses readily to a clear globule, which becomes opaque when cold, and, on continuation of the heat, intumesces and becomes infusible; very slightly soluble in water or acids. Chem. com. 58·75 sulphuric acid and 41·25 lime.

The crystalline, or *Muriacite*, occurs in the salt mines of Bex, Hall in Tyrol, and Aussee in Styria; also Sulz on the Neckar, and Bleiberg. Compact at Ischel in Austria, Berchtesgaden, Eisleben, and the Harz. Granular, or *Vulpinite*, near Bergamo. The contorted, or *Gekröstein*, chiefly at Wieliczka and Bochnia.

216. POLYHALITE.—$2\,\dot{\text{Ca}}\,\dddot{\text{S}}+\dot{\text{Mg}}\,\dddot{\text{S}}+\dot{\text{K}}\,\dddot{\text{S}}+2\dot{\text{H}}$.

Rhombic; ∞P 115°; mostly columnar or fibrous. Cleavage, ∞P imperfect. H.=3·5; G.=2·7...2·8. Translucent; pearly or resinous. Colourless, but generally pale red, seldom gray. Weak bitter, and slightly saline taste. Soluble in water, leaving gypsum. B.B. fuses on charcoal to an opaque reddish bead, becoming white when cold. Chem. com. sulphates of lime 45, of magnesia 20·5, of potassa 28, and water 5·5. Ischel, Aussee, and Berchtesgaden.

217. GLAUBERITE, Brongniartin.—$\dot{\text{Na}}\,\dddot{\text{S}}+\dot{\text{Ca}}\,\dddot{\text{S}}$.

Monoclinohedric; C=68° 16′; ∞P 83° 20′,—P 116° 20′. Crystals $0P \,.\, -P$, with ∞P (fig. 173). Cleavage, basal perfect, along ∞P traces. H.=2·5...3; G.=2·75...2·85. Translucent; vitreous to resinous. Colourless, but yellowish or grayish-white. Taste slightly saline and bitter. B.B. decrepitates violently, and melts to a clear glass; decomposed by water, which removes the sulphate of soda. Chem. com. 51 sulphate of soda, and 49 sulphate of lime. Villarubia in Spain, Vic, Berchtesgaden; near Brugg in Aargau, Aussee and Ischel in Austria, and Tarapaca in Peru.

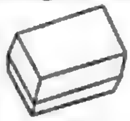


Fig. 173.

218. ALUNITE, Alumstone.—$3\,\overline{\dddot{\text{Al}}}\,\dddot{\text{S}}+\dot{\text{K}}\,\dddot{\text{S}}+6\dot{\text{H}}$.

Rhombohedric; R. 89° 10′. Crystals, R, or R . 0R (fig. 174); also fine granular, earthy, or compact. Cleavage, basal rather perfect. H.=3·5...4; G.=2·6...2·8. Translucent; vitreous, on 0P pearly. Colourless and white, but grayish, yellowish, or reddish. B.B. infusible alone. Becomes blue with cobalt solution; soluble in warm con. s. acid, not in h. acid. Chem. com. 37·95 alumina, 10·66 potash, 39·42 sulphuric acid, and 11·97 water. Beregszasz in Hungary, Tolfa in the Papal States; also in Tuscany, near Naples, Lipari Islands, Auvergne, Milo, and Argentiera.

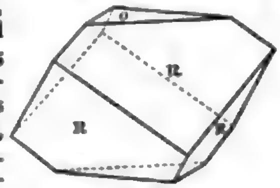


Fig. 174.

219. ALUMINITE, Websterite.—$\overline{\dddot{\text{Al}}}\,\dddot{\text{S}}+9\dot{\text{H}}$.

Reniform, and very fine scaly or fibrous. Fracture earthy; sectile or friable. H.=1; G.=1·7. Opaque; dull or glimmering. Snow-white or yellowish-white. In closed tube yields much water. B.B. emits sulphurous fumes, the remainder being infusible; easily soluble in h. acid. Chem. com. 29·8 alumina, 23·2 sulphuric acid, and 47 water. Newhaven in Sussex; Eperney, Auteuil, and Lunel Vieil in France; Halle and Morl in Prussia.

220. PHARMACOLITE.—$\dot{\text{Ca}}^2\,\overline{\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}}+6\dot{\text{H}}$.

Monoclinohedric; C=65° 4′; ∞P 117° 24′,—P 139° 17′. Crystals prismatic; often acicular or capillary, or radiated fibrous crusts. Cleavage, clinodiagonal very perfect; sectile and flexible. H.=2...2·5; G.=2·6...2·8. Translucent; vitreous; pearly or silky. Colourless and white, but sometimes rose-red or green. Yields water in the closed tube. B.B. fuses to a white enamel; in the inner flame on charcoal gives arsenic fumes, and fuses to a semi-translucent grain, colouring the flame blue; easily soluble in acids. Chem. com. 51 arsenic acid, 25 lime, and 24 water. Andreasberg, Riechelsdorf, Biber, Joachimsthal in Bohemia, Markirchen, and Wittichen in the Schwarzwald.

Picropharmacolite contains magnesia. *Roselite*, vitreous; rose-red. B.B. with borax forms a deep blue glass. Chem. com. arsenic acid, oxide of cobalt, lime, magnesia, and water. Schneeberg in Saxony.

221. HAIDINGERITE.—$\dot{\text{Ca}}^2\,\overline{\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}}+3\dot{\text{H}}$.

Rhombic; ∞P 100°. Cleavage very perfect; sectile, flexible. H.=2...2·5; G.=2·8...2·9. Transparent or translucent. Colourless and white. Chem. com. 85·68 arseniate of lime and 14·32 water. Joachimsthal in Bohemia.

222. BERZELIITE.—$\dot{\text{Ca}}^3\,\overline{\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}}+\dot{\text{Mg}}^3\,\overline{\overset{\cdot\cdot\cdot\cdot\cdot}{\text{As}}}$.

Massive, with traces of cleavage. Brittle. H.=5·5; G.=2·52. Translucent on the edges; resinous. Honey-yellow or yellowish-white. B.B. infusible, but becomes gray; soluble in nitric acid. Contains also 2 to 4 manganese protoxide. Longbanshytta in Sweden.

223. STRUVITE, Guanite.—$(\text{NH}^4\,\text{O}, \dot{\text{Mg}}^2)\,\overline{\overset{\cdot\cdot\cdot\cdot\cdot}{\text{P}}}+12\dot{\text{H}}$.

Rhombic and hemihedric; $\bar{P}\infty$ 63° 7′, $\breve{P}\infty$ 95°. Cleavage, brachydiagonal perfect. H.=1·5...2; G.=1·66...1·75. Transparent or opaque; vitreous. Colourless, but yellow or brown. In the closed tube yields water and ammonia. B.B. fuses to a white enamel; soluble in h. acid, and very slightly in water. Chem. com. 29·9 phosphoric acid, 16·3 magnesia, 10·6 ammonia, and 44 water. Under St Nicolai church at Hamburg, and in guano from Africa.

FAMILY V.—ROCK-SALT.

Crystallization monoclinohedric and rhombic, some tesseral and hexagonal. H.=1·3, but most about 2; G.=1·5...3, but generally 2. All soluble in water, and B.B. fusible or decompose. When pure, mostly white, translucent, and vitreous. They are chiefly products of decomposition, and occur especially in the rainless regions, or in lakes not communicating with the sea.

**224. ROCK-SALT.—Na Cl.

Tesseral; almost always cubes. Generally granular and fibrous. Cleavage, hexahedral very perfect; fracture conchoidal; rather brittle; yields slightly when scratched with the nail. H.=2; G.=2·1...2·2. Transparent or translucent; vitreous. Colourless or white, but often red, yellow, gray, and rarely blue. Taste saline. In the closed tube decrepitates, and yields a little water. B.B. on charcoal fuses and partly evaporates, partly sinks into the support. With soda fuses to a clear mass, colouring the flame yellow. Very soluble in water. Chem. com. 60

chlorine and 40 sodium, but often with various impurities.

This important mineral is very widely disseminated, either in thick masses, with clay, anhydrite, and gypsum, or as an efflorescence, covering extensive tracts of country. The most celebrated European deposits occur at Wieliczka and other parts of Galicia, in Hungary, Siebenburg, Moldavia, Styria, Salzburg (Hallein), in Tyrol (Hall); also in Bavaria, Wurtemburg, Switzerland (Bex), and Spain, especially at Cardona. In England the chief deposits are in Cheshire, as at Northwich. As an efflorescence it is most abundant on the sandy plains in Brazil, at the foot of the Atlas Mountains in Africa, in Abyssina, in Arabia, and in the Steppes round the Caspian Sea and Lake Ural. Also as a sublimation among the lavas of Vesuvius.

Sylvin, or chloride of potassium, found as a sublimation on Vesuvius, and in the rock-salt of Hallein and Berchtesgaden, agrees in most characters with rock salt (G.= 1·9 ...2).

*225. Alum.—$\dot{R}\dddot{S} + (\ddot{\overline{Al}}, \ddot{\overline{Fe}})\dddot{S}^3 + 24\dot{H}$.

Tesseral; O, sometimes with ∞O∞ and ∞O. Generally fibrous crusts, or as an efflorescence. Cleavage, octahedral imperfect; fracture conchoidal. H.=2...2·5; G.=1·75... 1·9. Translucent. Colourless and white. Taste sweetish astringent. Easily soluble in water. B.B. generally evolves sulphurous fumes.

(*a.*) ***Potash-alum***, with $\dot{R}=\dot{K}$, and 32·52 sulphuric acid, 10·86 alumina, 9·96 potash, and 45·66 water. In the closed tube it fuses, intumesces, and yields much water. In the Silurian alum-slates of Sweden, Norway, and Scotland; the coal formation, Hurlet and Campsie, in Scotland; the lias near Whitby; in the brown-coals of Hessia and the Rhine; and in the volcanic formations of the Lipari Islands, Sicily, and the Azores.

(*b.*) ***Ammonia-alum***, with $\dot{R}=NH^4O$, and about 4 per cent. ammonia and 48 water. In the closed tube it forms a sublimate of sulphate of ammonia. Tschermig in Bohemia.

(*c.*) ***Soda-alum***, with $\dot{R}=\dot{N}a$, and 7 soda and 48 water. Like potash-alum, but more easily soluble. Near Mendoza in South America, the Solfatara at Naples, and Milo.

(*d.*) ***Magnesia-alum***.—$\dot{R}=\dot{M}g$ with $\dot{M}n$. Translucent and silky, but soon changes in the air. South Africa, Iquique in Peru (*Pickeringite*).

(*e.*) ***Iron-alum*** (*Feather-alum*), with $\dot{R}=\dot{F}e$. Hurlet near Paisley, Mörsfield in Rhenish Bavaria, Krisuvig in Iceland (*Hversalt*).

226. Voltaite.—3 (Fe, K, Na) S + ($\overline{Fe}$, $\overline{Al}$) S^3 + 12 H.

Tesseral. Black, brown, or green; greenish-gray streak. Otherwise like alum, but more difficultly soluble in water. Solfatara of Pozzuoli.

227. Alunogene, Halotrichite, Hair Salt.—$\ddot{\overline{Al}}\,\dddot{S}^3 + 18\dot{H}$.

Capillary or acicular, in crusts or reniform masses. H.=1·5 ...2; G.=1·6...1·7. Silky. White, inclining to green or yellow. Tastes like alum. B.B. in closed tube intumesces, yields much water, and is infusible. Chem. com. 36·05 sulphuric acid, 15·40 alumina, 48·55 water. Volcanoes of South America, coal and brown coal strata of Germany, and on old walls.

228. Mirabilite, Glauber-salt.—$\dot{N}a\,\dddot{S} + 10\dot{H}$.

Monoclinohedric; C=72° 15′; ∞P 86° 31′, P 93° 12′. Crystals predominantly 0P and ∞P∞ (fig. 175); but generally efflorescent crusts. Cleavage, orthodiagonal very perfect; fracture conchoidal. H.=1·5 ...2; G.=1·4...1·5. Pellucid and colourless; taste cool, saline, and bitter; decomposes readily in the atmosphere, and falls into powder. Gives no precipitate with carbonate of soda. Chem. com. 19·3 soda, 24·7 sulphuric acid, and 56 water.

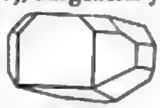


Fig. 175.

As an efflorescence in quarries and on old walls in many countries, on Vesuvius in lava. Used in medicine, and in preparing glass and soap.

N.B.—No. 229-237 form a sub-family of *Metallic salts*, or *Vitriols*.

*229. Melanterite, Green or Iron Vitriol, Copperas. } $\dot{F}e\,\dddot{S} + 7\dot{H}$.

Monoclinohedric; C=75° 40′; ∞P (*f*) 82° 21′, —P (*P*) 101° 35′, (P∞) (*o*) 69° 17′, (∞P∞) (*u*), (fig. 176); chiefly stalactitic, reniform, or in crusts. Cleavage, basal very perfect, ∞P less so. H.=2; G.=1·8 ...1·9. Translucent, rarely transparent; vitreous. Leek or mountain-green, often with a yellow coating; streak white. Taste sweetish astringent. Very soluble. B.B. becomes brown, then black and magnetic. Chem. com. 26·0 protoxide of iron, 28·8 sulphuric acid, and 45·2 water. Bodenmais, Rammelsberg in the Harz, Fahlun, Schemnitz, Bilin, and Hurlet near Paisley. Used in dyeing, in manufacturing ink, Prussian blue, and sulphuric acid.

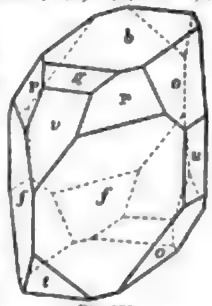


Fig. 176.

230. Botryogene, Red vitriol. } $\dot{F}e^3\dddot{S}^2 + 3\ddot{\overline{Fe}}\dddot{S}^2 + 36\dot{H}$ 2 (?).

Monoclinohedric; C=62° 26′; ∞P 119° 56′. Crystals small and short prismatic. More common botryoidal and reniform. Cleavage, ∞P rather distinct. H.=2...2·5; G.=2...2·1. Translucent; vitreous. Hyacinth-red, orange-yellow, and yellowish-brown; streak ochre-yellow. Taste slightly astringent. Partially soluble in water, leaving a yellow ochre. Chem. com. sulphates of the protoxide and peroxide of iron (48), with 31 water, and about 21 sulphates of magnesia and lime; the two latter considered mixtures by Berzelius. Fahlun in Sweden.

231. Copiapite.—$\ddot{\overline{Fe}}^2\dddot{S}^5 + 18\dot{H}$.

Six-sided tables, but crystal-system uncertain; also granular. Cleavage perfect. Translucent; pearly. Yellow. Chem. com. 30·7 iron peroxide, 38·3 sulphuric acid, and 31 water. Copiapo in Coquimbo in Chili. Also radiated fibrous masses; dirty greenish-yellow, incrusting the former. Contain 32 sulphuric acid, and 37 water; but both are probably mixtures. To these may be added—

Fibroferrite, also from Chili. *Yellow Iron-ore*, from the brown coal at Kolosoruk in Bohemia and Modum in Norway. Both are reniform, or compact and earthy. H.=2·5...3; G.=2·7...29. Colour ochre-yellow. Not soluble in water, with difficulty in hydrochloric acid.

Apatelite, reniform earthy, yellow, from Auteuil near Paris, is similar; also *Vitriol ochre* from Fahlun. *Misy*, from Rammelsberg in the Harz, contains sulphates of iron, copper, zinc, and other metals.

232. Coquimbite.—$\ddot{\overline{Fe}}\,\dddot{S}^3 + 9\dot{H}$.

Hexagonal; P 58°. Crystals 0P, with ∞P and P; usually granular. Cleavage, ∞P imperfect. H.=2...2·5; G.=2 ...2·1. White, also brown, yellow, red, and blue. Taste astringent. Chem. com. 28·5 iron peroxide, 43·6 sulphuric acid, and 28·9 water. Copiapo in Chili, and Calama in Bolivia.

233. Tectizite.—$\ddot{\overline{Fe}}$, $\dddot{S}$, $\dot{H}$.

Rhombic; dimensions unknown. H.=1·5...2; G.=2 nearly. Vitreous or resinous. Clove-brown. Saxony near Schwarzenberg, and at Bräunsdorf.

*234. Cyanose, Blue Vitriol.—$\dot{C}u\,\dddot{S} + 5\dot{H}$.

Triclinohedric. Crystals very unsymmetric; ∞P̄∞ (*n*) to ∞P̆∞ (*r*), forms an angle of 79° 19′; P′ (*P*) to ∞P′ (*T*) 127° 40′, to ∞P̄∞ (*n*) 120° 50′, to ∞P̆∞ (*r*) 103° 27′, and

$\infty P'(T)$ to $\infty'P$ (M) 123° 10′ (fig. 177). More often stalactitic, reniform, or as an incrustation. Cleavage, along $\infty P'$ and $\infty 'P$ very imperfect; fracture conchoidal. H.=2·5; G.=2·2...2·3. Translucent; vitreous. Blue. Taste very nauseous. Readily soluble in water, from which metallic copper is precipitated by iron. B.B. on charcoal, especially with soda, is easily reduced to metallic copper. Chem. com. 32 protoxide of copper, 32 sulphuric acid, and 36 water.

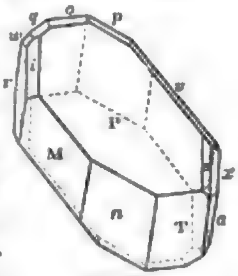


Fig. 177.

Abundant in the water of some mines, as in the Harz, Hungary, Tyrol, Fahlun, in Anglesea, Cornwall, and Wicklow. Also on the lava of Vesuvius. Used in dyeing, and in forming blue and green pigments.

*235. Goslarite, White Vitriol.—$\dot{Zn}\,\dddot{S}+7\,\dot{H}$.

Rhombic; ∞P 90° 42′, isomorphous with epsomite; $\infty P\,.\,\infty\breve{P}\infty\,.\,P$ (fig. 178). Mostly granular, or stalactitic, reniform, and encrusting. Cleavage, brachydiagonal perfect. H.=2...2·5; G.=2...2·1. Pellucid; vitreous. White, inclining to gray, yellow, green, or red. Taste nauseous astringent. Chem. com. 28·2 zinc oxide, 27·9 sulphuric acid, and 43·9 water. Rammelsberg in the Harz, Fahlun, Schemnitz, Holywell in Flintshire, in Cornwall, at Villefranche, and Guipuzcoa in Spain. Used in dyeing and medicine.

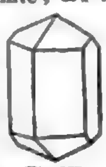


Fig. 178.

236. Bieberite, Cobalt Vitriol.—$(\dot{Co},\dot{Mg})\,\dddot{S}+7\,\dot{H}$.

Monoclinohedric; similar to melanterite; usually stalactitic, or an efflorescence. Pale rose-red. Taste astringent. Chem. com. 20 cobalt oxide, 4 magnesia, 29 sulphuric acid, and 47 water. Bieber near Hanau, and Leogang in Salzburg.

237. Johannite, Uran Vitriol.

Monoclinohedric; C=85° 40′; ∞P 69°. Crystals similar to trona (fig. 181), but very small. Cleavage, ∞P. H.=2...2·5; G.=3·19. Semitransparent; vitreous. Bright grass-green, with paler streak. Chem. com. a hydrous sulphate of the protoxide of uranium. Joachimsthal and Johann-Georgenstadt.

*238. Natron.—$\dot{Na}\,\ddot{C}+10\,\dot{H}$.

Monoclinohedric; C=57° 40. Crystals $(\infty P\infty)\,.\,\infty P\,.\,P\,.\,\infty P\infty$ (fig. 179); with ∞P (M) 79° 41′, P (P) 76° 28′. Cleavage, $\infty P\infty$ distinct; $(\infty P\infty)$ less so. H.=1...1·5; G.=1·4...15. Pellucid; vitreous. Colourless or grayish-white. B.B. melts easily, colouring the flame yellow. Chem. com. 2·18 soda, 15·4 carbonic acid, and 6·28 water; but mixed with chloride of sodium, and other salts. On lava, as on Vesuvius and Etna; as an efflorescence on the ground in Hungary, Egypt, Tartary, and in mineral springs and lakes. Used in the manufacture of soap, in dyeing, bleaching, and medicine.

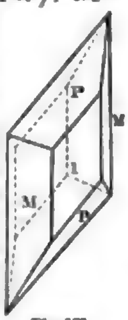


Fig. 179.

239. Thermonatrite.—$\dot{Na}\,\ddot{C}+\dot{H}$.

Rhombic; $\infty\breve{P}2$ (d) 107° 50′, $\breve{P}\infty$ (o) 83° 50′; with $\infty\breve{P}\infty$ (P), in rectangular tables (fig. 180). Cleavage, (p) perfect. H.=1·5; G.=1·5...1·6. Colourless. B.B. like natron, but does not melt. Chem. com. 50·1 soda, 35·4 carbonic acid, and 14·5 water. Natron lakes of Lagunilla in Colombia, of Lower Egypt, and of the steppes between the Ural and Altai.

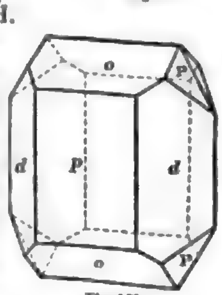


Fig. 180.

240. Trona, Urao.—$\dot{Na}^2\,\ddot{C}^3+4\,\dot{H}$.

Monoclinohedric. Crystals 0P and $\infty P\infty$ (103° 15′), (fig. 181). Cleavage, $\infty P\infty$ perfect. H.=2·5...3; G.=2·1...2·2. Transparent to translucent; colourless. Does not decompose in the air. Taste alkaline. Chem. com. 37·93 soda, 40·24 carbonic acid, and 21·83 water. Fezzan and Barbary (*Trona*), Lagunilla in Colombia (*Urao*).

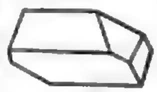


Fig. 181.

241. Gaylussite.—$\dot{Na}\,\ddot{C}+\dot{Ca}\,\ddot{C}+5\,\dot{H}$.

Monoclinohedric; C=78° 27′; ∞P 68° 51′, P 110° 30′. Cleavage, ∞P imperfect; fracture conchoidal. H.=2·5; G.=1·9...1·95. Transparent; vitreous; colourless. Slowly and partially soluble in water. B.B. fuses readily to an opaque bead. Chem. com. 34·5 carbonate of soda, 33·6 carbonate of lime, 30·4 water, with 1·5 clay. Lagunilla near Merida.

*242. Borax, Tinkal.—$\dot{Na}\,\dddot{B}^2+10\,\dot{H}$.

Monoclinohedric; C=73° 25′; ∞P 87°, P 122° 34′; almost isomorphous with augite. Twin crystals frequent. Cleavage, $(\infty P\infty)$ perfect; ∞P less distinct; fracture conchoidal, rather brittle. H.=2...2·5; G.=1·7...1·8. Pellucid; resinous. Colourless, but yellowish, greenish, and grayish-white. Taste feebly alkaline and sweetish. B.B. intumesces greatly, becomes black, and melts to a transparent bead, colouring the flame yellow, or, with sulphuric acid, green; soluble in 12 parts of cold water. Chem. com. of the pure salt, 16·37 soda, 36·53 boracic acid, and 47·10 water; but often contains many impurities. Shore of salt lakes in Thibet and Nepal, and in South America near Potosi. Borax is prepared from this mineral, and is used for blowpipe experiments, in preparing fine glass, in medicine, and for dyeing.

*243. Sassoline.—$\dddot{B}+3\,\dot{H}$.

Triclinohedric; 0P: $\infty\breve{P}\infty$ 75° 30′; usually fine scaly six-sided tables, or fibrous, and stalactitic. Macles frequent. Cleavage, basal very perfect; sectile and flexible. H.=1; G.=1·4...1·5. Translucent; pearly. Grayish or yellowish-white. Taste acidulous and slightly bitter. Feels greasy. Easily soluble in boiling, less so in cold water. Froths up and melts in the candle flame to a hard transparent glass, colouring the flame green. Chem. com. 56·3 boracic acid, and 43·7 water. Vulcano in the Lipari Islands, hot springs of Sasso near Sienna, and lagoni of Tuscany.

*244. Nitre, Salpetre.—$\dot{K}\,\dddot{\ddot{N}}$.

Rhombic; ∞P (M) 119°, $2\breve{P}\infty$ (P) 71°, $\breve{P}\infty$ 110°, $\infty\breve{P}\infty$ (h), (fig. 182); isomorphous with arragonite. Only occurs acicular, capillary, or pulverulent. Cleavage indistinct; fracture conchoidal. H.=2; G.=1·9...2. Semitransparent; vitreous, or silky. Colourless, white or gray. Taste saline and cooling. Deflagrates when placed on hot charcoal; and B.B. on platina wire melts very easily, colouring the flame violet. Chem. com. 46·6 potash, and 53·4 nitric acid, but always more or less mixed. In the limestone caves of many countries, Hungary, Spain, India. Used for producing nitric acid, in glass-making, medicine, and the manufacture of gunpowder.

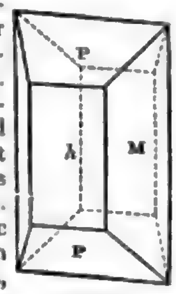


Fig. 182.

245. Nitratine.—$\dot{Na}\,\dddot{\ddot{N}}$.

Rhombohedric; R=106° 30′, isomorphous with dolomite. Cleavage rather perfect. H.=1·5...2; G.=2·1...2·2. Translucent or transparent, with very distinct double refraction; vitreous. Colourless, or grayish and yellowish-white. Taste saline and cooling. Deflagrates on hot charcoal. B.B. fuses on platina wire, colouring the

flame yellow. Chem. com. 36·6 soda, and 63·4 nitric acid, but mixed with common salt and other substances. Tarapaca in Chili. Used in the arts as a substitute for nitre; but deliquesces in the air.

246. Nitrocalcite.—$\dot{\mathrm{Ca}}\,\overset{\cdot\cdot\cdot}{\ddot{\mathrm{N}}}+\dot{\mathrm{H}}$.

Fibrous or pulverulent. White or gray. Translucent. Taste sharp and bitter. Readily soluble in water, and deliquesces in the air; melts slowly on burning charcoal, with slight detonation. Chem. com. 32·00 lime, 57·54 nitric acid, and 10·56 water. Limestone caves of Kentucky; on old walls and limestone rocks.

247. Nitromagnesite.—$\dot{\mathrm{Mg}}\,\overset{\cdot\cdot\cdot}{\ddot{\mathrm{N}}}+\dot{\mathrm{H}}$.

In the same places and similar to nitrocalcite. Taste bitter. Chem. com. 24 magnesia, 65 nitric acid, and 11 water.

*248. Sal-ammoniac.—N H^4 Cl.

Tesseral; O, also ∞O∞, ∞O, and 3O3. In crusts, stalactites, and earthy or pulverulent. Cleavage, O imperfect; fracture conchoidal. H.=1·5...2; G.=1·5...1·6. Pellucid; vitreous. Colourless, but gray or yellow, rarely green, brown, or black. Taste saline and pungent. B.B. volatilizes without fusing; on copper wire colours the flame bluish-green. Chem. com. (32 per cent. ammonia, or) 33·9 ammonium, and 66·1 chlorine. Chiefly occurs as a sublimate on active volcanoes, Vesuvius, Etna, the Solfatara, Vulcano, and Iceland; also near ignited coal seams, Newcastle, and Scotland. Used in medicine, dyeing, and various metallurgic operations.

249. Mascagnine.—N H^3 $\dddot{\mathrm{S}}+\dot{\mathrm{H}}$.

Rhombic; ∞P 107° 40′, P̆∞ 121° 16′; ∞P . ∞P̆∞ . P (fig. 183); but chiefly in crusts and stalactites. Cleavage rather perfect; sectile. H.=2...2·5; G.=1·7...1·8. Pellucid, vitreous. Colourless, white or yellowish. Taste pungent and bitter; easily soluble, and deliquesces. B.B. decrepitates, melts, and volatilizes. Chem. com. 25·9 ammonia, 60·5 sulphuric acid, and 13·6 water. Near volcanoes, as Etna, Vesuvius, the Solfatara, the Lipari Islands, in the lagoni near Sienna, and in ignited coal beds, as at Bradley in Staffordshire.

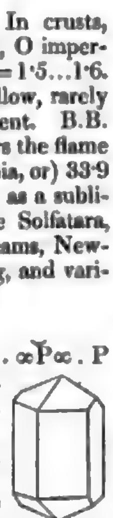


Fig. 183.

250 Arcanite, Glaserite.—$\dot{\mathrm{K}}\,\dddot{\mathrm{S}}$.

Rhombic; acute pyramids, with ∞P 120° 24′, 2P̆∞ 67° 38′, 0P, and other forms. Mostly in crusts, or pulverulent. Cleavage, basal imperfect. H.=2·5...3; G.=2·73. Pellucid; vitreous or resinous. Colourless or white. Taste saline, bitter. B.B. decrepitates, fuses, and becomes hepatic. Chem. com. 54·04 potash and 45·96 sulphuric acid. Lavas of Vesuvius and other volcanoes.

251. Thenardite.—$\dot{\mathrm{Na}}\,\dddot{\mathrm{S}}$.

Rhombic; acute pyramids P, with 0P and ∞P, in crusts and druses. Cleavage, basal rather perfect; fracture uneven. H.=2·5; G.=2·6...2·7. Pellucid, vitreous. White. Taste feebly saline. B.B. colours the flame deep yellow, and fuses. Chem. com. 43·82 soda, and 56·18 sulphuric acid. Salinas d'Espartinas near Aranjuez, and Tarapaca. Used for preparing soda.

252. Lowerite.—2 ($\dot{\mathrm{Na}}\,\dddot{\mathrm{S}}+\dot{\mathrm{Mg}}\,\dddot{\mathrm{S}}$)+5 H.

Compact with traces of one cleavage. H.=2·5...3; G.=2·376. Vitreous. Yellowish-white to flesh-red. Taste slightly saline. Chem. com. 20·3 soda, 13·2 magnesia, 52 sulphuric acid, and 14·5 water. Ischel.

*253. Epsomite, Epsom-salt.—$\dot{\mathrm{Mg}}\,\dddot{\mathrm{S}}+7\,\dot{\mathrm{H}}$.

Rhombic; P mostly hemihedric, ∞P 90° 38′; ∞P (*M*). ∞P̆∞ (*o*). P (*l*) (fig. 184). Granular, fibrous, or earthy. Cleavage, brachydiagonal perfect. H.=2...2·5; G.=1·75. Pellucid; vitreous; and white. Taste saline, bitter. B.B. on charcoal fuses, incandesces, and shows alkaline reaction; with solution of cobalt becomes pale rose-red. Chem. com. 16·32 magnesia, 32·53 sulphuric acid, and 51·15 water. Efflorescence on various rocks, as at Hurlet near Paisley, Idria, Montmartre, and Freiberg; on the ground in Spain, and the Russian steppes; in mineral waters, as at Epsom in Surrey (Epsom salts), Saidschütz and Seidlitz in Bohemia. Used in medicine and in preparing magnesia.

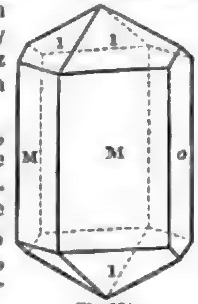


Fig. 184.

Astrakanite.—White, transparent, prismatic crystals among the salts in the salt lakes near the Wolga. Chem. com. 41·00 sulphate of soda, 35·18 sulphate of magnesia, 21·56 water. *Reussin*, white, six-sided, and pointed crystals, from Seidlitz and Saidschütz in Bohemia, is similar, but seems a mixture.

Order III.—SALINE ORES.

Resemble the saline stones both in external characters and chemical composition, forming almost a parallel series, with metallic oxides in place of the earthy bases. Lime or magnesia occasionally occur in more or less extent, and the acid element is one of the common acids of the chemist. Crystallization in the carbonates is often rhombohedric, in the others monoclinohedric or rhombic. Other systems only occur in rare cases.

Hardness is not high, mostly 3...4, in a few as high as 5, and as low as 2. Their specific gravity is high, from the metallic element in their composition; mostly from 3...4 in the salts of iron or copper, and from 5...7 or 8 in the salts of lead and some others. They are almost all soluble in acids, and the carbonates effervesce. B.B. mostly fusible, decomposed, or reduced, and with fluxes form coloured glasses characteristic of the different metals. They are mostly translucent, rarely transparent. Their lustre is often pearly or vitreous. Some are white, others are coloured, and these colours are now characteristic of the metal as the essential element.

*Family I.—The Sparry Iron Ores.

Crystallization and cleavage rhombohedric. H.=3·5...5; G.=3·3...4·5. They are all soluble in acids, and often effervesce. B.B. they are all infusible, but decomposed, and leave a magnetic residue, and show reactions of metals. The colours are white, but often with a brown, yellow, or red tinge, especially when weathered. They chiefly occur in veins.

*254. Siderite, Sparry Iron, Sphärosiderite, Chalybite.—$\dot{\mathrm{Fe}}\,\ddot{\mathrm{C}}$.

Rhombohedric; R 107°. Chiefly R, often curved, saddle-shaped, or lenticular, occasionally 0R, $-\frac{1}{2}$R, ∞R, −2R, ∞P2. Frequently fine or coarse granular, more rarely botryoidal or reniform (*Sphærosiderite*). Cleavage, rhombohedral along R perfect. H.=3·5...4·5; G.=3·7...3·9. Translucent in various degrees, becoming opaque when weathered; vitreous or pearly. Rarely white, generally yellowish-gray or yellowish-brown, changing to red or blackish-brown on exposure. B.B. infusible, but becomes black and magnetic; with borax and salt of phosphorus shows reaction for iron; with soda usually for manganese. In acids soluble with effervescence. Chem. com. carbonate of iron, with 62·6 protoxide of iron and 37·9 carbonic acid, but usually 0·5 to 10, or even 25, protoxide of manganese, 0·2 to 15 magnesia, and 0·1 to 2 lime. In beds or masses, in Styria, Carinthia, and Westphalia; in veins in Anhalt and the Harz; also in the Pyrenees, and the Basque provinces of Spain, as near Bilboa. The crystals at Joachimsthal, Freiberg, Klausthal, Beeralstone in Devonshire, Alston Moor in Cumberland, and in many of the tin mines of Cornwall.

Clay ironstone, gray, blue, brown, or black, G. = 2·8… 3·5; H. = 3·5…4·5, is an impure variety. It occurs chiefly in slate-clay or marls, in layers or nodular masses, especially in the coal formation of Britain, Belgium, and Silesia. These contain 50 to 85 per cent. carbonate of iron, and yield 25 to 42 metal. The Lanarkshire black band contains 70 carbonate of iron, 23 carbonaceous matter, 7 of silica, alumina, and lime, and yields 33·7 iron. In 1855 Great Britain produced 3,217,000 tons iron, worth about twelve millions sterling. South Wales alone produced about 839,000 tons, and Scotland 828,000 tons, worth nearly three millions sterling.

Junkerite, from Brittany, is a mere variety of siderite. *Oligon spar*, varieties with more than 20 per cent. manganese protoxide.

Ankerite.—R 106° 12′, but mostly massive and granular. G. = 2·9…3·1; otherwise like siderite. Contains 51 carbonate of lime, 12 to 33 carbonate of magnesia, 12 to 36 carbonate of iron, and 0 to 3 carbonate of manganese protoxide. Styria. Used as an ore or flux.

255. Diallogite, Red Manganese.—$\dot{M}n\, \ddot{C}$.

Rhombohedric; R 106° 51′; R and $-\frac{1}{2}$R, sometimes 0R and ∞P 2. Crystals often curved, lenticular, or saddle-shaped; also spherical, reniform, and columnar or granular. Cleavage, R perfect. H. = 3·5…4·5; G. = 3·3…3·6. Translucent; vitreous or pearly. Rose-red to flesh-red; streak white. B.B. usually decrepitates and becomes greenish-gray or black, but is infusible; the powder soluble with effervescence in warm h. acid. Chem. com. 62 manganese protoxide and 38 carbonic acid, but usually mixed with carbonates of lime 0 to 13, magnesia 0 to 7, or iron 0 to 15. Freiberg, Schemnitz, Kapnik, Nagyag, Elbingerode, and near Sargans. At the latter, also hydrated, and fibrous, silky (*Wiserite*); compact in Hessia and Glendree, Ireland.

256. Manganocalcite.—$(\dot{M}n, \dot{C}a, \dot{F}e)\, \ddot{C}$.

Rhombic; in prisms like arragonite, and bears the same relation to diallogite that arragonite does to calc-spar. H. = 4… 5; G. = 3·03. Red or reddish-white; vitreous. Schemnitz.

257. Lanthanite.—$\dot{L}a\, \ddot{C} + 3\, \dot{H}$.

Rhombic; ∞P 94° nearly; small tabular crystals; usually granular or earthy. Cleavage basal. H. = 2·5…3; G = 2·7. Dull or pearly. White or yellowish. B.B. becomes brownish-yellow; soluble in acids with effervescence. Chem. com. 21·1 carbonic acid, 52·9 lanthanium oxide, and 26 water. Bastnæs in Sweden, Lehigh in Pennsylvania.

258. Parisite.—$\dot{C}e\, \ddot{C}$, Ca F, $\dot{H}$.

Hexagonal; P 164° 58′. Cleavage, basal very perfect. H. = 4·5; G. = 4·35. Vitreous; on the cleavage planes pearly. Brownish-yellow inclining to red. B.B. infusible and phosphoresces. Chem. com. 23·6 carbonic acid, 60 protoxide of cerium, with lanthanium and didymium, 3·17 lime, 11·51 fluoride of calcium, and 2·4 water. Emerald mines of the Musso Valley in New Granada.

*259. Calamine, Smithsonite.—$\dot{Z}n\, \ddot{C}$.

Rhombohedric; R 107° 40′; R, 4 R, and R^3. The crystals generally small, obtuse-edged, and rounded. Usually reniform, stalactitic, and laminar or granular. Cleavage, R perfect but curved; fracture uneven conchoidal; brittle. H. = 5·0; G. = 4·1…4·5. Translucent or opaque; pearly or vitreous. Colourless, but often pale grayish-yellow, brown, or green. B.B. becomes white, and acts like zinc oxide; soluble in acids with effervescence; also in solution of potash. Chem. com. 64·6 zinc oxide, and 35·4 carbonic acid, but with protoxide of iron 2 to 3, and manganese 3 to 7, lime 1 to 2, or magnesia 0 to 3.

This mineral occurs in beds or veins in the crystalline and transition rocks, and also in the carboniferous and oolite formations. It is most common in limestone, and is often associated with calc-spar, quartz, blende, and ores of iron and lead. Chessy near Lyons, Altenberg near Aix-la-Chapelle, Brillon in Westphalia, Tarnowitz in Silesia, Hungary, Siberia; also Mendip in Somersetshire, Matlock in Derbyshire, Wanlockhead and Lead Hills in Scotland; compact at Alston Moor. Zinc is obtained chiefly from this mineral by distillation. In Silesia also cadmium.

Kapnite, varieties with 15 to 37 per cent. of iron protoxide. *Zinc-bloom*, reniform, earthy, pale-yellow, and shining streak; seems a mere produce of decomposition. Bleiberg and Raibel in Carinthia.

Herrerite.—Rhombohedric, with curved cleavage planes. H. = 4…5; G. = 4·3. Translucent; pearly or vitreous; green. B.B. becomes gray, fumes, and stains the charcoal white. Consists, according to Del Rio, of carbonates of zinc oxide and nickel oxide. Mexico.

*260. Galmei, Electric Calamine.—$\dot{Z}n^3\, \ddot{S}i + \dot{H}$.

Rhombic, and hemimorphic; ∞P̆ 2 (*P*) with polar edges 101° 44′, and 132° 16′; ∞ P (*d*) 104° 6′, P̄∞ (*o*) 117° 8′, P̆∞ (*l*) 129° 2′; common form ∞P̄∞ (*s*) . ∞P . P̄∞ (fig. 185). Also columnar, fibrous, granular, and earthy. Cleavage, prismatic along ∞P very perfect, along P̄∞ perfect. H. = 5; G. = 3·3…3·5. Transparent to translucent; vitreous and pearly. Colourless or white, but often light gray, also yellow, green, brown, and blue; becomes electric by heat. B.B. decrepitates slightly, but is infusible; readily soluble in acids, and gelatinizes. Chem. com. 25·7 silica, 66·8 zinc oxide, and 7·5 water. With calamine, as at Raibel and Bleiberg in Carinthia, Aix-la-Chapelle, Iserlohn, Tarnowitz, and Nertschinsk; also Mendip Hills, Matlock in Derbyshire, and Wanlockhead. Used as an ore of zinc, and in the manufacture of brass.

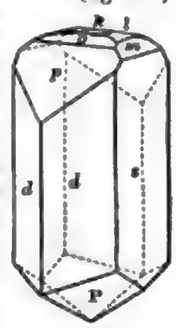


Fig. 185.

261. Willemite, Troostite.—$\dot{Z}n^3\, \ddot{S}i$.

Rhombohedric; R 115°; ∞P 2 . R; also granular and reniform. Cleavage, basal rather perfect, ∞ R imperfect; brittle. H. = 4·5; G. = 4·1…4·2. Translucent or transparent; dull resinous. White, yellowish, or brown. B.B. in closed tube yields no water, otherwise like galmei. Chem. com. 72·47 zinc oxide and 27·53 silica, with 0 to 9 protoxide of manganese, 0 to 5 iron protoxide, and 0 to 3 magnesia. Aix-la-Chapelle, Liege, Raibel, and Sterling and Franklin in New Jersey.

Family II.—Iron Salts.

Crystallization predominantly rhombic or monoclinohedric. H. = 2…5·5; G. = 2·2…4. They are all soluble in acids, and many easily. B.B. all fusible, and also often easily so. Their colours are often brown, or dark blue and dark green; the streak yellow or red. They are chiefly phosphates or arseniates of iron. The phosphates B.B. moistened with sulphuric acid, colour the flame bluish-green. The arseniates B.B. in the reducing flame, or with carbonate of soda, evolve odour of arsenic.

*262. Vivianite, Blue Iron. } 6 $(\dot{F}e^3\, \dddot{\ddot{P}} + 8\, \dot{H}) + (\dddot{F}e^3\, \dddot{\ddot{P}}^2 + 8\, \dot{H})$.

Monoclinohedric; C = 71° 25′, ∞P 111° 12′, P 119° 10′, P∞ 54° 13′. Crystals (∞P∞) . ∞P∞ . P∞ (fig. 186); also spherical or reniform, and fibrous or earthy. Cleavage, clinodiagonal very perfect; thin laminæ flexible. H. = 2; G. = 2·6…2·7. Translucent or transparent; vitreous or bright pearly on cleavage. Indigo-blue to blackish-green; streak bluish-white, but soon becomes blue on exposure. The white earthy variety also changes to blue in the air; the dry crushed powder is liver-brown. In the closed tube yields much water, intumesces, and becomes spotted with gray and red. B.B. on charcoal becomes red, and then fuses to


Fig. 186.

a gray, shining, magnetic granule; easily soluble in h. or nitric acid; becomes black in warm solution of potash. Chem. com., the colourless vivianite is a hydrous phosphate of iron protoxide, with 42 iron protoxide, 29 phosphoric acid, and 29 water; but on exposure, when it acquires a blue colour, with 29·1 phosphoric acid, 33·0 iron protoxide, 12·2 iron peroxide, and 25·7 water. Transparent indigo-coloured crystals at St Agnes in Cornwall, and Allentown and Imleytown in New Jersey. Earthy in Cornwall, Styria, North America, Greenland, and New Zealand, and in peat mosses in Northern Germany, Sweden, Norway, and the Zetland Isles. As a recent formation under some old slaughter-houses at the foot of the Castle Rock in Edinburgh. It is sometimes used as a pigment. *Mullicite* and *Anglarite* are varieties.

263. Dufrénite, Green Iron Earth.—$2\,\overline{\ddot{Fe}}^2\,\ddot{\ddot{P}} + 5\,\dot{H}$.
Rhombic; ∞P about 123°; spherical or reniform. Cleavage brachydiagonal; very brittle. H.=3...3·5; G.=3·3...3·4. Translucent on the edges, or opaque; shining or dull. Dirty, leek, or blackish green; streak siskin-green. B.B. fuses readily to a porous, black, non-magnetic globule; soluble in h. acid. Chem. com. 63 iron peroxide, 28 phosphoric acid, and 9 water. Westerwald, Hirschberg, and Limoges in France.

264. Triplite.—$\dot{Mn}^4\,\ddot{\ddot{P}} + \dot{Fe}^4\,\ddot{\ddot{P}}$.
Rhombic (?); only granular. Cleavage, in three directions at right angles; fracture conchoidal. H.=5...5·5; G.=3·6...3·8. Translucent or opaque; resinous. Chesnut or blackish-brown; streak yellowish gray. B.B. on charcoal fuses easily, with strong intumescence, to a black magnetic globule; soluble in h. acid. Chem. com. 34 iron protoxide, 33 manganese protoxide, and 33 phosphoric acid. Limoges in France.

265. Zwieselite, Eisenapatit.—$(\dot{Fe}, \dot{Mn})^2\,\ddot{\ddot{P}} + Fe\,F$.
Rhombic (?), but only massive. Cleavage, in three directions imperfect; fracture conchoidal. H.=4·5...5; G.=3·95...4. Translucent on the edges; resinous. Colour brown; streak yellow. B.B. decrepitates and fuses easily to a bluish-black magnetic globule; easily soluble in warm s. acid, showing traces of fluorine. Chem. com. 30·3 phosphoric acid, 41·4 iron protoxide, 23·3 manganese protoxide, and 6 fluorine. Zwiesel in Bavaria.

266. Triphyline.—$6\,(\dot{Fe}^3, \dot{Mn}^3)\,\ddot{\ddot{P}} + \dot{Li}^3\,\ddot{\ddot{P}}$.
Rhombic; ∞P 94°; chiefly granular. Cleavage, basal perfect, prismatic and diagonal imperfect. H.=5; G.=3·6. Translucent on the edges; resinous. Greenish-gray with blue spots. B.B. fuses very easily to a dark steel-gray magnetic bead; easily soluble in h. acid. Chem. com. 42·64 phosphoric acid, 49·16 iron protoxide, 4·75 manganese protoxide, and 3·45 lithia. Bodenmais in Bavaria. *Tetraphyline* or *Perowskine*, from Tammela in Finland, is similar.

267. Monazite, Mengite.—$(\dot{Ce}, \dot{L}, \dot{Th})^3\,\ddot{\ddot{P}}$.
Monoclinohedric; C=77°, ∞P 94° 35′; crystals of $0P \,.\, \infty P \,.\, (\infty P\infty) \,.\, P\infty \,.\, -P\infty$, with $0P : P\infty = 129°\,6'$ $0P : -P\infty = 139°\,25'$ (fig. 187); thick, tabular, or very short prismatic. Cleavage, basal imperfect. H.=5...5·5; G.=4·9...5·25. Translucent on the edges; dull resinous. Flesh-red, hyacinth-red, and reddish-brown. B.B. infusible; moistened with sulphuric acid, colours the flame green; soluble in h. acid. Chem. com. 28 phosphoric acid, 25 to 37 cerium protoxide, 23 to 27 lanthanium oxide (18 thorina), with 2 tin oxide, 1·5 lime, and some magnesia and manganese. Miask in Ural, and Norwich in Connecticut (*Edwardsite*).

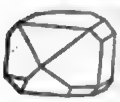


Fig. 187.

Monazitoid; G.=5·281; brown; partially soluble in acids, and with 18 phosphoric acid; probably a variety.

268. Cryptolite.—$\dot{Ce}^3\,\ddot{\ddot{P}}$.
Acicular crystals, imbedded in apatite. G.=4·6. Transparent. Pale wine-yellow. Soluble as powder in con. s. acid. Wöhler's analysis gave 73·70 cerium oxide (protoxide), 27·37 phosphoric acid, and 1·51 iron protoxide. Arendal.

269. Hureaulite.—$(\dot{Mn}, \dot{Fe})^5\,\ddot{\ddot{P}}^2 + 8\,\dot{H}$.
Monoclinohedric; C.=68°, ∞P 62° 30′, P 88°; fracture conchoidal. H.=3·5; G.=2·27. Translucent; resinous. Reddish-yellow or brown. B.B. fuses easily to a black metallic globule; soluble in acids. Chem. com. 38 phosphoric acid, 11·1 iron protoxide, 32·9 manganese protoxide, and 18 water. Hureaux near Limoges.

Beraunite.—Foliated and radiated. H.=2; G.=2·87. Vitreous or pearly. Hyacinth-red or reddish-brown; streak reddish ochre-yellow. B.B. in forceps melts and colours the flame bluish-green; soluble in h. acid. Seems a hydrous phosphate of iron. Beraun in Bohemia. *Kakoxene*, from Zbirow in Bohemia, is similar.

Heterozite.—H.=5; G.=3·5. Opaque, or translucent on the edges; vitreous or resinous. Colour dark-violet or lavender-blue to greenish-gray; streak violet-blue or crimson-red. Chem. com. 41·77 phosphoric acid, 34·89 iron protoxide, 17·57 manganese protoxide, and 4·40 water. Hureaux near Limoges.

270. Alluaudite.—$(\dot{Mn}, \dot{Na})^3\,\ddot{\ddot{P}} + \overline{\ddot{Fe}}\,\ddot{\ddot{P}} + \dot{H}$.
Rhombic, with cleavage in three directions at right angles. H. above 4; G.=3·468. Translucent on the edges; lustre dull. Clove-brown; streak yellowish-brown. B.B. on platina wire fuses to a black magnetic globule; in h. acid forms a black solution. Chem. com. 41·25 phosphoric acid, 25·62 peroxide of iron, 23·08 manganese protoxide, 1·06 manganese peroxide, 5·47 soda, 2·65 water, and 0·60 silica. Chanteloube near Limoges.

271. Diadochite.—$\overline{\ddot{Fe}}\,\ddot{\ddot{P}}^2 + 4\,\overline{\ddot{Fe}}\,\dddot{S} + 32\,\dot{H}$.
Reniform and stalactitic. Fracture conchoidal. H.=3; G.=2·035. Resinous; vitreous. Yellow or yellowish-brown; streak white. B.B. intumesces, and fuses on the edges to a black magnetic enamel. Chem. com. 36·7 iron peroxide, 14·8 phosphoric acid, 15·2 sulphuric acid, and 30·3 water. Grafenthal and Saalfeld in Thuringia.

272. Delvauxine.—$\overline{\ddot{Fe}}^2\,\ddot{\ddot{P}} + 24\,\dot{H}$.
Massive and earthy. H.=2·5; G.=1·85. Reddish or blackish brown or yellow. B.B. decrepitates, and fuses to a gray magnetic bead. In h. acid forms a brown solution. Chem. com. 35·8 iron peroxide, 48·3 water, and 15·9 phosphoric acid. Visé in Belgium.

Karphosiderite, reniform, opaque, resinous, and straw-yellow, with a greasy feel, is related. H.=4·5; G.=2·5. B.B. becomes red and fuses to a black magnetic bead; consists of hydrous phosphate of iron with a little oxide of zinc. Labrador.

273. Pissophane.—$(\overline{\ddot{Al}}, \overline{\ddot{Fe}})^2\,\dddot{S} + 15\,\dot{H}$.
Stalactitic; fracture conchoidal; very easily frangible. H.=2; G.=1·9...2. Transparent or translucent; vitreous. Olive-green to liver-brown; streak greenish-white to pale yellow. B.B. becomes black; easily soluble in h. acid. Chem. com. 7 to 35 alumina, 10 to 40 iron peroxide, 12 sulphuric acid, and 41 water. Saalfeld, and Reichenbach in Saxony.

274. Pitticite, Iron Sinter.—$\overline{\ddot{Fe}}^2\,\dddot{S} + 2\,\overline{\ddot{Fe}}\,\ddot{\ddot{As}} + 24\,\dot{H}$.
Reniform and stalactitic; brittle; fracture conchoidal. H.=2...3; G.=2·3...2·5. Translucent, or on the edges; resinous, inclining to vitreous. Yellowish, reddish, or blackish-brown, sometimes in spots or stripes; streak light-yellow, or white. B.B. on charcoal fuses easily, with effervescence and strong arsenical fumes, to a black magnetic

Mineralogy.

globule; easily soluble in h. acid to a yellow fluid. Chem. com. 35 iron peroxide, 26 arsenic acid, 14 sulphuric acid, and 24 water. In many old mines, as Freiberg and Schneeberg.

275. SYMPLESITE.

Monoclinohedric, like gypsum; in very fine prismatic crystals or groups. Cleavage perfect. H.=2·5; G.=2·957. Transparent or translucent; vitreous; pearly on the cleavage. Pale indigo to celadine-green, with bluish-white streak. B.B. emits arsenic odours, becomes black and magnetic, but does not fuse. Chem. com. arseniate of iron protoxide with water, also a little sulphuric acid and protoxide of manganese. Lobenstein in Reuss.

276. SCORODITE, Neoctese.—$\dddot{\overline{F}}e\,\overset{\cdot\cdot\cdot\cdot\cdot}{A}s+4\dot{H}$.

Rhombic; P, with polar edges 103° 5′ and 114° 34′. Crystals $\infty\bar{P}\infty$ and $\infty\breve{P}\infty$ (r); also 0P (h), $\infty\breve{P}2$ (d) 120° 10′, and $2\bar{P}\infty$ (m) 48° (fig. 188); also columnar and fibrous. Cleavage imperfect; rather brittle. H.=3·5...4; G.=3·1...3·2. Translucent; vitreous. Leek-green to greenish-black, also indigo-blue, red and brown. In closed tube yields water and becomes yellow. B.B. on charcoal fuses easily, emitting arsenic vapours, to a gray magnetic slag; easily soluble in h. (not in nitric) acid, forming a brown solution. Chem. com. 49·8 arsenic acid, 34·6 iron peroxide, and 15·6 water. St Austle in Cornwall, Vaulry in France, Schlackenwald and Schönfeld in Bohemia, Antonio Pereira in Brazil, and near Marmato.

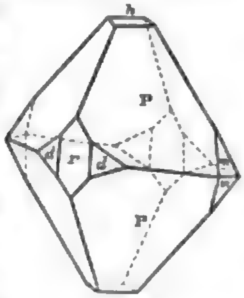


Fig. 188.

277. ARSENIOSIDERITE.—$\dot{C}a^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{A}s+3\,\dddot{\overline{F}}e^2\,\overset{\cdot\cdot\cdot\cdot\cdot}{A}s+11\dot{H}$.

Spherical and fibrous; friable, and leaves a mark on paper. H.=1...2; G.=3·52...3·88. Opaque; metallic pearly. Ochre brown, becoming darker in the air; streak brownish-yellow. B.B. fuses easily, with reaction for iron and arsenic. Chem. com. 39 arsenic acid, 40·7 iron peroxide, 11·9 lime, and 8·4 water. Romanêche near Mâçon in France.

278. PHARMAKOSIDERITE, Cube Ore. } $\dot{F}e^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{A}s+\dddot{\overline{F}}e^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{A}s^2+18\dot{H}$.

Tesseral and tetrahedral; usually $\infty O\infty$, with $\frac{O}{2}$, or ∞O. Cleavage, tesseral very imperfect; rather brittle. H.=2·5; G.=2·9...3. Semitransparent to translucent; adamantine or resinous. Olive to emerald-green, honey-yellow, and brown; streak straw-yellow. Pyro-electric. In closed tube yields water, and becomes red. B.B. on charcoal fuses easily to a steel-gray magnetic slag; easily soluble in acids. Chem. com. 40·4 arsenic acid, 28·1 iron peroxide, 12·6 iron protoxide, and 18·9 water. Huel Gorland, Huel Unity, and Carharrak, in Cornwall; Burdle Gill in Cumberland; also St Leonard in the Haute-Vienne, Lobenstein in Reuss, Schwarzenberg in Saxony, and North America.

Beudantite, said to be rhombohedral; R 92° 30′. H. above 4. Resinous; black greenish-gray streak; but probably a mixture of pharmakosiderite with sulphate of lead. Horhausen in Nassau.

FAMILY III.—COPPER SALTS.

Crystallization generally rhombic and monoclinohedric. Hardness generally from 2...3·5, but a few as low as 1...2, others 4...5. Gravity 2...4, but mostly 3...4. The colours are predominantly green, and rarely blue. They are all soluble in acids, and mostly easily so. Mostly fusible B.B. and on charcoal, when moistened with hydrochloric acid, the copper is known by colouring the flame blue. With soda they are reduced to metallic copper. They are, with a few exceptions, compounds of copper with one of the common acids, and some used as ores of this metal. They occur especially in veins.

279. DIOPTASE, Emerald Copper.—$\dot{C}u\,\dddot{S}i+\dot{H}$.

Rhombohedric; R 126° 24′; $\infty P2$ (s).—2 R (r) 95° 54′ (fig. 189). Cleavage, R perfect; brittle. H.=5; G.=3·2...3·3. Transparent or translucent; vitreous. Emerald-green, rarely verdigris or blackish green; streak green. B.B. in the outer flame becomes black, in the inner red, but is infusible; soluble, and gelatinizes in h. or s. acid, and also in ammonia. Chem. com. 38·7 silica, 50 copper protoxide, and 11·3 water. Altyn-tubeh in the Kirgis Steppe.

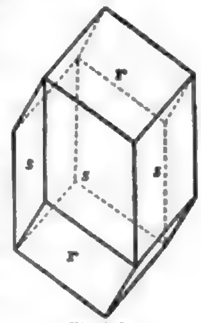


Fig. 189.

280. CHRYSOCOLLA, Copper-green.—$\dot{C}u\,\dddot{S}i+2\dot{H}$.

Botryoidal, reniform, or investing; brittle; fracture conchoidal, and fine splintery. H.=2...3; G.=2·0...2·3. Translucent or semitransparent; weak resinous. Verdigris to emerald green or azure-blue; streak greenish-white. B.B. and with acids like dioptase. Chem. com. 34·83 silica, 44·94 copper protoxide, and 20·23 water. Saxony, Bavaria, Ural, Cornwall, Hungary, the Tyrol, Spain, the Harz (*Siliceous malachite*), Mexico, and Chili.

*281. AZURITE, Blue Copper.—$\dot{C}u^3\,\ddot{C}^2+\dot{H}$.

Monoclinohedric; C=87° 39′, ∞P (M) 99° 32, $-P$ (k) 106° 14′. Crystals 0P . ∞P . $\infty P\infty$. $-P$, or h, M, s k, in fig. 190; also radiated and earthy. Cleavage, (P∞) (P) 59° 14′, rather perfect; fracture conchoidal, or splintery. H.=3·5...4·2; G.=3·7...3·8. Translucent or opaque; vitreous. Azure-blue, the earthy varieties (and streak) smalt-blue. B.B. on charcoal fuses and yields a grain of copper; soluble with effervescence in acids, and also in ammonia. Chem. com. 69·1 protoxide of copper, 25·7 carbonic acid, and 5·2 water. Crystals at Chessy near Lyons, Kolywan and Nischne-Tagilsk in Siberia, Moldawa in the Bannat; also Redruth in Cornwall, Alston Moor, and Wanlockhead; massive in Cornwall, Thuringia, the Harz, Hessia, and the Ural. Valued as an ore of copper.

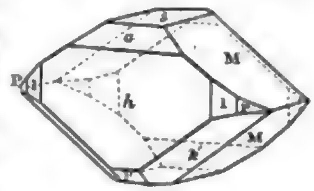


Fig. 190.

*282. MALACHITE.—$\dot{C}u^2\ddot{C}+\dot{H}$.

Monoclinohedric; C=61° 49′, ∞P 103° 42′; crystals ∞P (M) . $\infty P\infty$ (s) . 0P (P), in macles (fig. 191). In general acicular, scaly, or reniform, stalactitic, and radiated fibrous. Cleavage, basal and clinodiagonal very perfect. H.=3·5...4; G.=3·6...4. Transparent or translucent on the edges; adamantine, vitreous, silky or dull. Emerald and other shades of green; streak apple-green. B.B., and with acids, like azurite. Chem. com. 71·8 copper protoxide, 20 carbonic acid, and 8·2 water. Crystalline at Rheinbreitenbach on the Rhine, and Zellerfeld in the Harz; fibrous and compact at Chessy in France, Siberia, the Ural, Saalfeld in Thuringia, Moldawa in the Bannat, Sandlodge in Zetland, Cornwall, Wales, and Ireland, and in North America and Australia. It is a valuable ore of copper, and the finer varieties are prized for ornamental purposes.

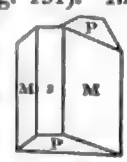


Fig. 191.

Lime-Malachite.—Reniform, botryoidal, and radiated fibrous; brittle. H.=2·5. Silky; verdigris-green. B.B. blackens and fuses to a black slag; soluble in h. acid, leaving gelatinous gypsum. Seems a hydrous carbonate of

copper and lime, with sulphate of lime and some iron. Lauterberg in the Harz. *Mysorine*, compact, blackish-brown, and soft, G.=2·62, is a mixture of a carbonate of copper with iron peroxide. Mysore in the East Indies.

283. AURICHALCITE.—$2\,\dot{Cu}\,\ddot{C}+3\,\dot{Zn}\,\dot{H}$.

Acicular. H.=2. Translucent, pearly, and verdigris-green. B.B. on charcoal in the inner flame forms a deposition of zinc oxide, and with fluxes gives reaction for copper; soluble with effervescence in h. acid. Chem. com. 29·2 copper protoxide, 44·7 zinc oxide, 16·2 carbonic acid, and 9·9 water. Loktefskoi in the Altai; Matlock in Derbyshire.

Buratite, azure-blue, and agrees with aurichalcite, but perhaps mixed with lime. Loktefskoi.

284. CHALCOPHYLLITE, Copper-mica. $\begin{cases}\dot{Cu}^6\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+23\,\dot{H}, \text{ or}\\ \dot{Cu}^4\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+12\,\dot{H}.\end{cases}$

Rhombohedral; R 69° 48'. Crystals, 0R (*o*). R (fig. 192). Cleavage, basal very perfect; sectile. H.=2; G.=2·4; ...2·6. Translucent or transparent; vitreous inclining to adamantine; pearly on 0R. Emerald to grass or verdigris green; streak light-green. B.B. decrepitates violently, emits arsenical vapours, and fuses to a gray metallic grain; easily soluble in acids and ammonia. Chem. com. 49·6 copper protoxide, 18 arsenic acid, and 32·4 water; or 51·6 copper protoxide, 25 arsenic acid, and 23·4 water; but also 2 alumina, and 1·5 phosphoric acid. Tingtang, Huel Gorland and Huel Unity Mines near Redruth; also Saida in Saxony, and Moldawa in the Bannat.

Fig. 192.

285. TIROLITE.—$(\dot{Cu}^5\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+10\,\dot{H})+\dot{Ca}\,\ddot{C}$.

Rhombic; reniform, or radiating foliated. Cleavage, basal very perfect; sectile. Thin laminæ flexible. H.=1·5...2; G.=3...3·1. Translucent; pearly or vitreous. Verdigris-green to azure-blue; streak paler. B.B. decrepitates violently and fuses to a steel-gray bead; soluble in acids, evolving carbonic acid. Chem. com. 43·88 copper oxide, 25·01 arsenic acid, 17·46 water, and 13·65 carbonate of lime, by analysis. The carbonate of lime is perhaps accidental. Falkenstein in Tyrol, in Hungary, Reichelsdorf, Saalfeld, Piombino in Italy, in Asturia and at Linares in Spain, and Matlock in Derbyshire.

286. ERINITE.—$\dot{Cu}^5\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+2\,\dot{H}$.

Reniform and foliated; conchoidal fracture. H.=4·5...5; G.=4...4·1. Translucent on the edges; dull resinous. Emerald or grass green; streak similar. Chem. com. 59·9 copper protoxide, 34·7 arsenic acid, and 5·4 water. Limerick in Ireland. *Cornwallite*, is similar, but dark-green, and $5\,\dot{H}$. Cornwall.

287. LIROCONITE.—$\dot{Cu}^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+\dddot{Al}\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+24\,\dot{H}$.

Rhombic; ∞P 119° 20', P̄∞ 72° 22' (fig. 193). Cleavage, P̄∞ imperfect, and P∞ more so. H.=2...2·5; G.=2·8...3·0. Translucent; vitreous, or resinous on fracture. Azure-blue to verdigris-green; streak paler. In the closed tube does not decrepitate, but becomes green; then ignites and brown. B.B. on charcoal emits arsenical vapours and fuses; soluble in acids and in ammonia. Chem. com. 36·6 copper protoxide, 11·9 alumina, 26·6 arsenic acid, and 24·9 water. Huel Unity and other mines near Redruth; also Herrengrund in Hungary and Ullersreuth in the Voightland.

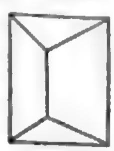


Fig. 193.

*288. OLIVENITE.—$\dot{Cu}^4\,(\overset{\cdot\cdot\cdot\cdot\cdot}{As}\,\overset{\cdot\cdot\cdot\cdot\cdot}{P})+\dot{H}$.

Rhombic; ∞P (*r*) 92° 30', P̄∞ (*l*) 110° 50'; ∞P̄∞ (*n*) (fig. 194); also spherical and reniform, and columnar or fibrous. Cleavage, (*r*) and (*l*) very imperfect. H.=3; G.=4·1...4·4. Pellucid in all degrees; vitreous, resinous, or silky. Leek, olive, or blackish-green, also yellow and brown; streak olive-green or brown. B.B. in the forceps fuses easily to a dark-brown adamantine bead covered with radiating crystals; on charcoal, detonates, emits arsenical vapours, and is reduced; soluble in acids and ammonia. Chem. com. 56.5 copper protoxide, 39·5 arsenic acid, and 4 water, but also 1 to 6 phosphoric acid. Carrarach, Tin Croft, Gwennap, and St Day in Cornwall; also Alston Moor, Thuringia, Tyrol, Siberia, Chili, and other places.

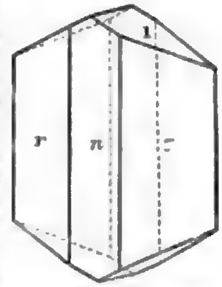


Fig. 194.

289. EUCHROITE.—$\dot{Cu}^4\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+7\,\dot{H}$.

Rhombic; ∞P (*M*) 117° 20' P̄∞ (*n*) 80° 52', with ∞P̆2 (*l*), and 0P (*P*), (fig. 195). Cleavage *M* and *n* imperfect; rather brittle. H.=3·5...4; G.=3·35...3·45. Transparent or translucent; vitreous. Emerald or leek-green; streak verdigris-green. B.B. in forceps fuses to a greenish-brown crystallized mass; on charcoal detonates; easily soluble in nitric acid. Chem. com. 47·1 copper protoxide, 34·2 arsenic acid, and 18·7 water. Libethen in Hungary.

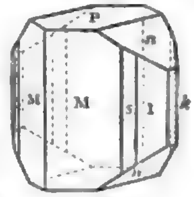


Fig. 195.

290. KLINOCLASE, Aphanese, Abichite.—$\dot{Cu}^6\,\overset{\cdot\cdot\cdot\cdot\cdot}{As}+3\,\dot{H}$.

Monoclinohedric; C=80° 30', ∞P 56°; also wedge-shaped and hemispherical. Cleavage, basal highly perfect. H.=2·5...3; G.=4·2...4·4. Translucent or opaque; vitreous; pearly on the cleavage. Dark verdigris-green inclining to sky-blue; streak bluish-green. B.B. becomes black, and is reduced; soluble in acids and ammonia. Chem. com. 62·6 copper protoxide, 30·3 arsenic acid, and 7·1 water. Cornwall and the Erzgebirge.

291. PHOSPHOROCHALCITE, Lunnite.—$\dot{Cu}^6\,\overset{\cdot\cdot\cdot\cdot\cdot}{P}+3\,\dot{H}$.

Monoclinohedric; crystals (∞P2) (*f*) 38° 56', P (*P*) 117° 49', with 0P (*a*) and ∞P∞ (*e*) (fig. 196); usually small and indistinct, more common in spherical or reniform, and radiated, fibrous. Cleavage, (*e*) imperfect; fracture uneven and splintery. H.=5; G.=4·1...4·3. Translucent, or on the edges; adamantine or resinous. Blackish, emerald, or verdigris green. B.B. decrepitates, or blackens and fuses to a black globule; easily soluble in nitric acid or ammonia. Chem. com. 70·8 copper protoxide, 21·2 phosphoric acid, and 8 water. Rheinbreitenbach, Nishne-Tagilsk, and in Cornwall. *Dihydrite*, with about a fifth less water. *Copperdiaspore* and *Prasin* seem varieties.

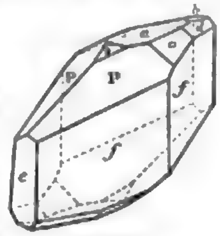


Fig. 196.

292. THROMBOLITE.—$\dot{Cu}^3\,\overset{\cdot\cdot\cdot\cdot\cdot}{P}^2+6\,\dot{H}$.

Porodine. Fracture conchoidal; brittle. H.=3...4; G.=3·38...3·40. Opaque; vitreous. Emerald, leek, or dark-green. B.B. colours the flame blue and then green; on charcoal fuses easily. Chem. com. 45·1 phosphoric acid, 37·8 copper protoxide, and 17·1 water. Retzbanya in Hungary.

293. LIBETHENITE.—$\dot{Cu}^4\,\overset{\cdot\cdot\cdot\cdot\cdot}{P}+\dot{H}$.

Rhombic; ∞P (*u*) 92° 20', P̄∞ (*o*) 109° 52', and P. (fig. 197). Cleavage, brachydiagonal and macrodiagonal imperfect. H.=4; G.=3·6...3·8. Translucent on the edges; resinous. Leek, olive, or blackish-green; streak olive-green. B.B., and with acids, acts like the phospho-

rochalcite. Chem. com. 66·37 copper protoxide, 29·86 phosphoric acid, and 3·77 water. Libethen in Hungary, Tagilsk in the Ural, and Gunnislake in Cornwall.

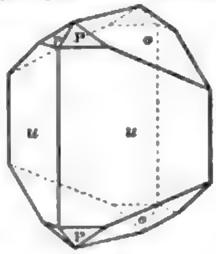


Fig. 197.

294. TAGILITE.—$\dot{Cu}^4 \dddot{\ddot{P}} + 3\dot{H}$.
Fungoid or botryoidal, and radiating fibrous or earthy. H.=3; G.=3·5. Emerald-green. Chem. com. 61·8 copper protoxide, 27·7 phosphoric acid, and 10·5 water. Nischne-Tagilsk.

295. EHLITE.—$\dot{Cu}^5 \dddot{\ddot{P}} + 3\dot{H}$.
Botryoidal or reniform, and radiating foliated, or compact. Cleavage in one direction perfect. H.=1·5 ... 2; G.=3·8 ... 4·27. Translucent on the edges; pearly on the cleavage. Verdigris-green; streak paler. B.B. breaks into small fragments thrown about violently. Chem. com. 66·8 copper protoxide, 24·1 phosphoric acid, and 9·1 water. Ehl on the Rhine, Nischne-Tagilsk, and Libethen.

296. ATACAMITE.—$Cu\,Cl + 3\,\dot{Cu}\,\dot{H}$.
Rhombic; ∞P (*M*) 112° 20′, $\breve{P}\infty$ (*P*) 105° 40′, and $\infty\breve{P}\infty$ (*h*) (fig. 198); also reniform and columnar or granular. Cleavage (*h*) perfect. H.=3...3·5; G.=4...4·3 (3·7, *Breit.*) Semitransparent or translucent on the edges; vitreous. Olive, grass, or emerald-green; streak apple-green. B.B. fuses, and leaves copper; easily soluble in acids. Chem. com. 55·85 copper protoxide, 14·86 copper, 16·61 chlorine, and 12·68 water; or 74·46 copper protoxide and 17·09 h. acid. Remolinos and Santa Rosa in Chili, Tarapaca in Bolivia, Schwarzenberg, and on lavas of Ætna and Vesuvius. Used as an ore of copper.

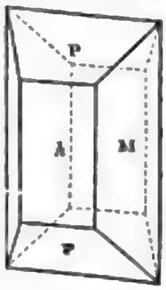


Fig. 198.

297. VOLBORTHITE.—$(\dot{Cu}\,\dot{Ca})^4\,\dddot{V} + \dot{H}$.
Hexagonal; small tabular crystals, 0P . ∞P, single or in groups. H.=3; G.=3·45 ... 3·89. Olive-green; streak almost yellow. B.B. on charcoal fuses easily, and forms a graphite-like slag, containing grains of copper; on platina wire, with salt of phosphorus, forms a green glass; soluble in nitric acids, and with water gives a brick-red precipitate. Chem. com. 37 to 38 vanadic acid, 39·4 to 46 copper oxide, 18·5 to 13 lime, 3·6 to 5 water. Syssersk, Nischne-Tagilsk, and Friedericksrode in Thuringia.

298. BROCHANTITE.—$\dot{Cu}\,\dddot{S} + 3\,\dot{Cu}\,\dot{H}$.
Rhombic; ∞P 104° 10′, $\bar{P}\infty$ 151° 52′, and $\infty\breve{P}\infty$; also reniform. Cleavage, brachydiagonal very perfect. H.=3·5 ... 4; G.=3·75...3·9. Transparent or translucent; vitreous. Emerald or blackish-green; streak bright-green. B.B. on charcoal fuses, leaving copper; easily soluble in acids. Chem. com. 70 copper protoxide, 18 sulphuric acid, and 12 water. Rezbanya, Katharinenburg, and Roughton-hill in Cumberland; also Krisuvig in Iceland (*Krisuvigite*), and in Siberia (*Königine*).

299. URANITE, Uran-Mica.—$(\dot{Ca} + \ddot{\ddot{U}})^2\,\dddot{\ddot{P}} + 8\,\dot{H}$.
Tetragonal: P 143° 2′. Crystals 0P, with ∞P or P (fig. 199). Cleavage, basal very perfect; sectile. H.=1...2; G.=3...3·2. Translucent; pearly on 0P. Siskin-green to sulphur-yellow; streak yellow. B.B. on charcoal fuses to a black semicrystalline mass; with soda forms a yellow infusible slag; in n. acid forms a yellow solution. Chem. com. 15·5 phosphoric acid, 62·6 uranium peroxide, 6·2 lime, and 15·7 water. Johann-Georgenstadt and Eibenstock in Saxony, Autun and Limoges in France, Chesterfield in Massachusetts, and Lake Onega in Russia.


Fig. 199.

300. CHALCOLITE.—$(\dot{Cu} + \ddot{\ddot{U}})^2\,\dddot{\ddot{P}} + 8\,\dot{H}$.
Tetragonal, and like uranite, but brittle. H.=2...2·5; G.=3·5...3·6. Grass to emerald or verdigris green; streak apple-green. B.B. like uranite, but with soda yields a grain of copper. Chem. com. 15·2 phosphoric acid, 61·1 uranium peroxide, 8·4 copper protoxide, and 15·3 water. Johann-Georgenstadt, Eibenstock, Schneeberg, Bodenmais, near Baltimore in North America, and near Redruth and St Austle.

*301. ERYTHRINE, Cobalt-Bloom.—$\dot{Co}^3\,\dddot{\ddot{As}} + 8\,\dot{H}$.
Monoclinohedric; (∞P∞) (*P*) . ∞P∞ (*T*) . P∞ (*M*) (like fig. 186), with *M* : *T*=55° 9′; also ∞P3 (*k*) 130° 10′, and P (*l*) 118° 23′ (fig. 200). Cleavage, clinodiagonal (*P*) very perfect; sectile; thin laminæ flexible. H.=1·5...2·5; G.=2·9...3. Translucent; vitreous; pearly on the cleavage. Crimson or peach-blossom red. B.B. on charcoal fuses with arsenic fumes to a gray globule; colours borax blue; easily soluble in acids. Chem. com. 24 water, 38·2 arsenic acid, and 37·8 cobalt protoxide; but often with 0 to 8 lime, or the protoxides of iron 1 to 4, and nickel 0 to 9. Schneeberg, Saalfeld, Allemont, Riechelsdorf, the Pyrenees, and Modum in Norway; also Cornwall, Alston in Cumberland, at Alva in Stirlingshire, and Tyndrum in Perthshire. Used in preparing blue colours.

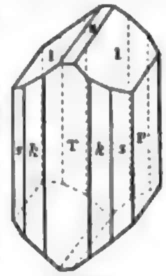


Fig. 200.

Kötigite.—White or peach-blossom red incrustations of minute crystals like erythrine, with which it agrees, except that the cobalt is almost wholly replaced by zinc. Schneeberg.

Kobaltbeschlag, or Earthy-encrusting Cobalt, reniform or spheroidal, is a mixture of erythrine with arsenious acid.

Lavendulan.—Thin reniform lavender-blue crusts; translucent; resinous or vitreous. H.=2·5...3; G.=2·95...3·1. B.B. fuses very easily, colouring the outer flame blue. Consists of arsenic acid, protoxides of cobalt, nickel and copper, and water. Annaberg.

302. NICKELINE, Nickel-Ochre.—$\dot{Ni}\,\dddot{\ddot{As}} + 8\,\dot{H}$.
Monoclinohedric (?); capillary and massive; earthy, rather sectile. H.=2...2·5; G.=3...3·1. Dull or glistening. Apple-green or greenish-white; streak greenish-white and shining. B.B. on charcoal fuses with arsenical vapours; easily soluble in acids. Chem. com. 38·7 arsenic acid, 37·3 nickel protoxide, and 24 water, but with a little cobalt or iron. Andreasberg, Annaberg, Saalfeld, Riechelsdorf, Joachimsthal, and Leadhills. Used in preparing blue colours.

FAMILY IV.—LEAD-SALTS.

Crystallization predominantly rhombic and monoclinohedric in the salts of lead, but several tetragonal and hexagonal. Hardness moderate, or from 2...4·5, or generally about calc-spar. All have a high specific gravity, or from 5·3...8,—this family including all minerals without metallic lustre and aspect, with G. above 5·5. They are all soluble in nitric acid, and form coloured solutions or precipitates. They are all easily fusible, and mostly readily reduced alone, or with soda, to lead. They are mostly compounds of lead, and the cerussite is an ore of this metal. The others are not abundant, but often show fine colours. Occur chiefly in veins and mines with other ores of lead.

Lead B.B. on charcoal forms a greenish or sulphur-yellow coating round the assay. Solutions in nitric acid

Mineralogy.

give, with sulphuric acid, a white precipitate; reduced B.B., and with chromate of potassa, a yellow precipitate.

*303. Cerussite, Lead Spar.—$\dot{Pb}\ddot{C}$.

Rhombic; isomorphous with arragonite and nitre; ∞P (*M*) 117° 14′, $\bar{P}\infty$ 108° 13′, $2\breve{P}\infty$ (*u*) 69° 18′; also $0P$, P (*t*), $\frac{1}{2}\breve{P}\infty$ (*s*), $\infty\breve{P}\infty$ (*l*), $\infty\breve{P}3$ (*e*) (figs. 201, 202).

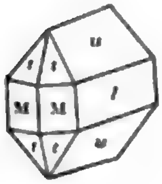


Fig. 201.

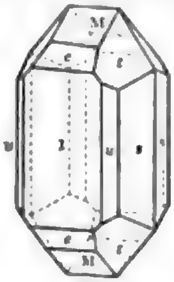


Fig. 202.

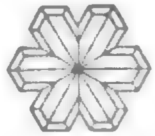


Fig. 203.

Macles are very common (fig. 203); also granular or earthy. Cleavage, ∞P and $2\breve{P}\infty$ rather distinct; fracture conchoidal; brittle and easily frangible. H. = 3...3·5; G. = 6·4...6·6 (earthy 5·4). Transparent or translucent; adamantine or resinous. Colourless and often white, but also gray, yellow, brown, black, rarely green, blue, or red; streak white. B.B. decrepitates violently, but easily fused and reduced; soluble with effervescence in nitric acid. Chem. com. 83·6 protoxide of lead and 16·4 carbonic acid. Very common at Przibram, Mies, and Bleistadt, Tarnowitz, Johann-Georgenstadt, Zellerfeld, Klausthal, Beeralston in Devonshire, St Minver's in Cornwall, Alston Moor, Keswick, Leadhills and Wanlockhead, and many other places.

304. Anglesite.—$\dot{Pb}\dddot{S}$.

Rhombic; ∞P 103° 43′, $\breve{P}\infty$ 75° 35′. The crystals (fig. 204) short prismatic, or pyramidal, or tabular. Cleavage, prismatic along ∞P and basal, neither very perfect; fracture conchoidal; very brittle. H. = 3; G. = 6·2...6·3. Transparent or translucent; adamantine or resinous. Colourless and white, but occasionally yellow, gray, brown, or blue; streak white. Decrepitates in candle; B.B. on charcoal fuses in the ox. flame to a milk-white bead; very difficultly soluble in acids, wholly in solution of potash. Chem. com. 73·7 lead protoxide and 26·3 sulphuric acid, in some with a little silver. Zellerfeld, Clausthal, Badenweiler, Siegen, Silesia, Linares, Southampton in Massachusetts, Parys Mine in Anglesea, St Ives in Cornwall, Derbyshire, Leadhills and Wanlockhead. Compact (*Bleiglas*), Alston Moor in Cumberland.

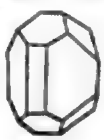


Fig. 204.

305. Leadhillite.—3 $\dot{Pb}\ddot{C}$ + $\dot{Pb}\dddot{S}$.

Rhombic; P middle edge 137°, ∞P 120° 20′, $2\breve{P}\infty$ 43° 12′. Crystals, $0P$. ∞P . $\infty\bar{P}\infty$ (fig. 205), mostly tabular; also macles. Cleavage, basal very perfect; slightly brittle. H. = 2·5; G. = 6·2...6·4 (6·0). Transparent or translucent; resinous or adamantine-pearly on $0P$. Yellowish-white, inclining to gray, green, yellow, or brown. B.B. on charcoal intumesces, and becomes yellow, but again white when cold, and easily reduced; soluble with effervescence in nitric acid, leaving sulphate of lead. Chem. com. 72·6 carbonate and 27·4 sulphate of lead. Leadhills; also Grenada in Spain, and the Greek island Serpho.

Fig. 205.

306. Susannite.—3 $\dot{Pb}\ddot{C}$ + $\dot{Pb}\dddot{S}$.

Rhombohedric; R 72° 30′. Cleavage, basal perfect. H. = 2·5; G. = 6·55. White, green, yellow, or brown. Otherwise like Leadhillite. Susannah Mine, Leadhills.

307. Lanarkite.—$\dot{Pb}\dddot{S}$ + $\dot{Pb}\ddot{C}$.

Monoclinohedric; ∞P 85° 48′, $P\infty$ 120° 45′. Cleavage, basal very perfect; sectile, thin laminæ flexible. H. = 2...2·5; G. = 6·3...7. Transparent; resinous or adamantine; on $0P$ pearly. Greenish or yellowish-white, inclining to gray; streak white. B.B. on charcoal fuses to a white globule containing some metallic lead; partially soluble in nitric acid with effervescence. Chem. com. 53·15 sulphate and 46·85 carbonate of lead. Leadhills in Scotland.

308. Caledonite.—3 $\dot{Pb}\dddot{S}$ + 2 $\dot{Pb}\ddot{C}$ + $\dot{Cu}\ddot{C}$ (?).

Rhombic; $\bar{P}\infty$ 95°, ∞P 109°. Crystals $\infty\bar{P}\infty$. $\infty\breve{P}\infty$. $\bar{P}\infty$ (fig. 206). Cleavage, $\bar{P}\infty$ brachydiagonal and macrodiagonal all imperfect. H. = 2·5...3; G. = 6·4. Transparent or translucent; resinous. Verdigris to mountain green; streak greenish-white. B.B. on charcoal easily reduced; soluble in nitric acid, leaving sulphate of lead. The solution is greenish, and shows reaction for lead and copper. Chem. com. 55·8 sulphate of lead, 38·8 carbonate of lead, and 11·4 carbonate of copper. Leadhills, Roughton Gill in Cumberland, and Rezbanya.

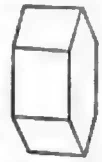


Fig. 206.

309. Linarite.—$\dot{Pb}\dddot{S}$ + $\dot{Cu}\dot{H}$.

Monoclinohedric; ∞P 61° 0′, $P\infty$ 77° 15′,—$P\infty$ 74° 25′. Crystals $\infty P\infty$. $0P$, with the above or other forms; macles united by $\infty P\infty$. Cleavage, orthodiagonal very perfect, and $P\infty$ less so; fracture conchoidal. H. = 2·5...3; G. = 5·2—5·45. Translucent; adamantine. Azure-blue; streak pale-blue. Chem. com. 75.7 sulphate of lead, 19·8 copper protoxide, and 4·5 water. Wanlockhead, Leadhills, Roughton Gill, and Linares.

310. Phosgenite, Corneous Lead, Cerasine. } Pb Cl + $\dot{Pb}\ddot{C}$.

Tetragonal; P 113° 48′. Crystals of ∞P, $0P$, $\infty P\infty$, with P or $2P\infty$. Cleavage, ∞P rather perfect; fracture conchoidal. H. = 2·5 ... 3; G. = 6 ... 6·2. Transparent or translucent; resinous adamantine. White, yellow, green, or gray. B.B. fuses easily to an opaque yellow globule, citron-yellow or white and crystalline on cooling; soluble with effervescence in nitric acid. Chem. com. 51 chloride and 49 carbonate of lead. Very rare near Matlock in Derbyshire, and Elgin in Scotland.

311. Mendipite, Berzelite.—Pb Cl + 2 $\dot{Pb}$.

Rhombic; but chiefly massive. Cleavage, along ∞P 102° 36′ highly perfect; fracture conchoidal or uneven. H. = 2·5...3; G. = 7·0...7·1. Translucent; adamantine-pearly on the cleavage. Yellowish-white to straw-yellow and pale-red; streak white. B.B. decrepitates, fuses easily, and becomes more yellow; easily soluble in nitric acid. Chem. com. 40 chloride and 60 protoxide of lead = 85·8 lead, and 9·8 chlorine. Churchill in the Mendip Hills, and Brilon in Westphalia.

312. Matlockite.—Pb Cl + $\dot{Pb}$.

Tetragonal; P 136° 17′. Crystals, $0P$. P. $P\infty$, small, thin, tabular. Cleavage, basal indistinct; fracture uneven conchoidal. H. = 2·5; G. = 7·21 (*Greg*), 5·39 (*Ram.*) Transparent or translucent; adamantine. Yellowish or greenish. B.B. decrepitates and fuses to a grayish-yellow globule. Chem. com. 55·6 chloride of lead, and 44·4 lead oxide. Matlock, on Galena.

313. Cotunnite, Cotunnia.—Pb Cl.

Rhombic; ∞P 118° 38′, $\bar{P}\infty$ 126° 44′. Small acicular crystals. Transparent; adamantine. White. Easily scratched with the knife. G. = 5·238. B.B. on charcoal fuses easily, colours the flame blue, volatilizes as a white vapour, forms a white ring, and leaves a very little metallic lead; soluble in a large amount of water. Chem. com. 74 lead and 26 chlorine. Crater of Vesuvius after the eruption of 1822.

*314. Pyromorphite.—3 $\dot{Pb}^3\dddot{P}$ + Pb Cl.

Hexagonal; P 80° 44′. Crystals ∞P . $0P$, with $\infty P2$, P

(fig. 207) or other pyramids, occasionally thicker in the middle, or spindle-shaped; also reniform or botryoidal. Cleavage, P very imperfect, ∞P in traces; fracture conchoidal or uneven. H. = 3·5...4; G. = 6·9...7. Translucent; resinous or partly vitreous. Colourless, but generally grass, pistacio, olive, or siskin green, and clove or hair brown. B.B. fuses easily, with a transitory ignition, to a crystalline granule; soluble in nitric acid and in solution of potash. Chem. com. 89·7 phosphate and 10·3 chloride of lead, but with 0 to 9 arseniate of lead, 0 to 11 phosphate of lime, and 0 to 1 fluoride of calcium. Przibram, Mies and Bleistadt in Bohemia, Zschopau, Clausthal, Poullaouen, Beresof, and Mexico; also Cornwall, Derbyshire, Yorkshire, Durham, Cumberland, Wicklow, and Leadhills and Wanlockhead. *Miesite*, *Polysphærite*, and *Nussierite*, from near Beaujeu, are varieties.

Fig. 207.

315. Mimetesite, $3\,\dot{P}b^3\,\ddot{\ddot{A}}s + Pb\,Cl$.

Hexagonal; P 81° 48′. Crystals, ∞P . 0P . P, or P . 0P. Cleavage, P rather distinct, ∞P very imperfect; fracture conchoidal or uneven. H. = 3·5...4·0; G. = 7·19...7·25. Translucent, Colourless, but usually honey or wax yellow, yellowish-green, or gray. B.B. on charcoal fusible, but less easily than pyromorphite, with strong arsenious vapours. Chem. com. 90·7 arseniate and 9·3 chloride of lead; but part of the arsenic occasionally replaced by phosphoric acid. Johann-Georgenstadt, Zinnwald, Badenweiler, St Prix in France, Nertschinsk, and Zacatecas in Mexico; Huel Alfred and Huel Unity in Cornwall, Caldbeckfell in Cumberland, and Beeralston in Devonshire.

Kampylite.—Orange-yellow; G. = 6·8...6·9; Chem. com. like mimetisite, but contains phosphate of lime and chromate of lead. Alston in Cumberland and Badenweiler.

Hedyphane.—Crystalline masses with an imperfect hexagonal cleavage. G. = 5·4...5·5. Translucent; resinous adamantine. White. Chem. com. like mimetesite, but with 13 arseniate and 15·5 phosphate of lime. Langbanshytta in Sweden.

316. Bleinierite.—$\dot{P}b$, $\dddot{S}b$, $\dot{H}$.

Reniform, spheroidal; earthy, or encrusting. H. = 4; G. = 3·9...4·76. Opaque; dull resinous, or earthy. Gray, brown, red, or yellow; streak grayish or yellowish-white. B.B. on charcoal reduced with antimony fumes. Chem. com. mixture of protoxide of lead (40 to 62), antimony oxides (31 to 47), and water (6 to 12); some also contain arsenic acid. Nertschinsk in Siberia, Cornwall.

317. Vanadinite.—$3\,\dot{P}b^3\,\dddot{V} + Pb\,Cl$.

Hexagonal; ∞P . 0P. H. = 3; G. = 6·6...7·2. Opaque; resinous. Yellow and brown; streak white. B.B. decrepitates violently, and on charcoal fuses to a globule, which emits sparks and is reduced, colouring the support yellow; in the forceps fuses, and retains its yellow colour when cold; in nitric acid forms a yellow solution. Chem. com. 89·7 vanadiate, and 10·3 chloride of lead. Zimapan in Mexico, Beresof in the Ural, and Wanlockhead.

318. Dechenite.—$\dot{P}b\,\dddot{V}$.

Botryoidal or thin lamellar. H. = 3·5...4; G. = 5·81. Resinous; translucent on the edges. Red or reddish-yellow; streak yellow. B.B. fuses easily to a yellow bead, and on charcoal reduced to lead; easily soluble in nitric acid. Chem. com. 54·7 lead oxide, and 45·3 vanadic acid, but analyses gave 46 to 49 of the latter. Niederschlettenbach in Rhenish Bavaria.

Similar are—*Aræoxene*; botryoidal; red, with a brown tinge. Chem. com. vanadic acid, with 48·7 lead oxide, and 16·3 zinc oxide. Dahn on the Rhine.

Eusynchite.—Yellowish-red; opaque. B.B. melts easily to a lead-gray globule. Chem. com. 56 lead oxide, 23 vanadic acid, and 21 deutoxide of vanadium.

Descloizite.—$\dot{P}b^3\,\dddot{V}$. In small rhombic crystals. Cleavage wanting; brittle. Translucent. Olive-green to black; on fracture concentric yellow and brown zones. B.B. fuses and partially reduced. Chem. com. 54·7 lead oxide, and 22·46 vanadic acid, but also oxides of manganese, zinc, iron, and copper. La Plata.

319. Wulfenite.—$\dot{P}b\,\dddot{M}o$.

Tetragonal; P 131° 35′; 0P (*a*), ¼ P (*b*), P, ∞P, and P∞ (fig. 208). Cleavage, P rather perfect, basal imperfect; fracture conchoidal to uneven; rather brittle. H. = 3; G. = 6·3...6·9. Pellucid; resinous or adamantine. Colourless, but generally yellowish-gray, wax, honey, or orange yellow. B.B. decrepitates violently; on charcoal fuses and sinks into the support, leaving lead; in con. h. acid forms a yellow solution. Chem. com. 61·5 protoxide of lead and 38·5 molybdic acid. Bleiberg and Windisch Kappel in Carinthia, Retzbanya, Badenweiler, and Zacatecas in Mexico.

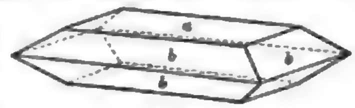


Fig. 208.

320. Scheeletine, Stolzit.—$\dot{P}b\,\dddot{W}$.

Tetragonal and hemihedric; P 131° 25′. Crystals, 2 P . P . ∞P, spindle-shaped. Cleavage, P imperfect. H. = 3; G. = 7·9...8·1. Semitransparent or translucent; resinous. Gray, brown, yellow, or green. B.B. fuses to a dark crystalline grain; soluble in nitric acid, with a yellow precipitate. Chem. com. 51·6 tungstic acid and 48·4 protoxide of lead. Zinnwald in Bohemia and Coquimbo.

321. Plombgomme.—$\dot{P}b^3\,\dddot{\ddot{P}} + 6\,\dddot{Al}\,\dot{H}^3$.

Reniform or stalactitic. Fracture conchoidal and splintery. H. = 4...4·5; G.6 = 3...6·4. Translucent; vitreous, inclining to resinous. Yellowish or greenish white to reddish brown, often in stripes. B.B. on charcoal becomes opaque and white, intumesces, and partially fuses; soluble in nitric acid. Chem. com. 38 protoxide of lead, 35 alumina, 8 phosphoric acid, and 19 water; but with 2 chloride of lead, a little iron peroxide and lime. Poullaouen in Brittany, and at Nussiére near Beaujeu. It much resembles gum-arabic.

322. Crocoisite, Krokoit.—$\dot{P}b\,\dddot{C}r$.

Monoclinohedric; C = 78° 1′; ∞P 93° 44′ (*M*), −P 118° 58′ (*t*), (∞P2) 56° 10′ (*r*), (∞P∞) (*g*) (fig. 209). Cleavage, ∞P rather distinct; sectile. H. = 2·5...3; G. = 5·9...6·1. Translucent; adamantine. Hyacinth or aurora red; streak orange-yellow. B.B. decrepitates, blackens, and fuses on charcoal, the lower part being reduced; with borax or salt of phosphorus in the ox. flame a green, in the red. flame a gray glass; soluble in warm h. acid. Chem. com. 31·7 chromic acid, and 68·3 lead protoxide. Beresof, Mursinsk, and Nischne-Tagilsk in the Ural; Congonhas do Campo in Brazil, Rezbanya, Moldawa, and Tarnowitz. Used as a pigment, but not permanent.

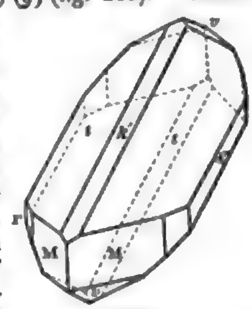


Fig. 209.

323. Melanochroite, Phœnikochroite.—$\dot{P}b^3\,\dddot{C}r^2$.

Rhombic; dimensions unknown. Cleavage imperfect. H. = 3...3·5; G. = 5·75. Translucent on the edges; resinous or adamantine. Cochineal to hyacinth red; streak brick-red. B.B. on charcoal fuses easily to a dark crystalline mass; in the red. flame yields lead; soluble in h. acid. Chem. com. 23·6 chromic acid, and 76·4 protoxide of lead. Beresof.

324. Vauquelinite.—$\dot{C}u^3\,\dddot{C}r^2 + 2\,\dot{P}b^3\,\dddot{C}r^2$.

Monoclinohedric; C = 67° 15′. Crystals 0P . −P . −P∞,

always macled (fig. 210), the facesof 0P forming an angle of 134° 30′; also botryoidal or reniform. H. $=2\cdot5\ldots3$; G. $5\cdot5\ldots5\cdot8$. Semitranslucent or opaque; resinous. Blackish or dark olive-green; streak siskin-green. B.B. on charcoal intumesces, frothes up, and fuses to a dark-gray metallic globule surrounded by small grains of lead; in nitric acid forms a dark-green solution with a yellow residue. Chem. com. 60·87 lead protoxide, 10·80 copper protoxide, 28·33 chromic acid. Beresof, Congonhas do Campoin Brazil.


Fig. 210.

325. Bismuthite.

Disseminated or investing. Fracture conchoidal or uneven; very brittle. $H.=4\ldots4\cdot5$; $G.=6\cdot8\ldots6\cdot91$. Opaque; weak vitreous. Gray, yellow, or green. B.B. decrepitates, fuses very readily, and is reduced with effervescence; in h. acid it forms a deep-yellow solution. Chem. com. essentially carbonate, with a little sulphate of bismuth. Ullersreuth near Hirschberg, Schneeberg, and Johann-Georgenstadt.

326. Kerate, Hornsilver.—$\dot{A}g\,Cl$.

Tesseral; chiefly $\infty O \infty$; small or very small; also massive. Fracture conchoidal; malleable and yields to the nail. $H.=1\ldots1\cdot5$; $G.=5\cdot3\ldots5\cdot4$, or $5\cdot5$. Translucent; adamantine resinous; gray, occasionally bluish or greenish. B.B. fuses very easily to a gray, brown, or black bead, which in the inner flame is reduced; slightly affected by acids, and slowly soluble in caustic ammonia. Chem. com. 75 silver and 25 chlorine, but with some (0 to 6) iron peroxide. Johann-Georgenstadt, Joachimsthal, Huelgöet, Kongsberg in Norway, Spain, and Cornwall; now chiefly from Mexico and Peru. At Andreasberg in the Harz, mixed with clay (*Buttermilcherz*).

Carbonate of Silver (*Selbite*), ash-gray, massive, very soft, effervescing in nitric acid, and B.B. easily reduced, seems a mixture. Wolfach in Baden, and Real de Catorce in Mexico (*Plata azul*, a rich silver ore).

327. Calomel.—$Hg^2\,Cl$.

Tetragonal; P 135° 50′. Crystals like fig. 118 above but very small; sectile. $H.=1\ldots2$; $G.=6\cdot4\ldots6\cdot5$ (artificial 7·0). Translucent; adamantine. Grayish or yellowish-white. In the closed tube it sublimes as a white mass, and with soda yields mercury. B.B. on charcoal, when pure, wholly volatilizes; in nitric acid not soluble, in h. acid partially. Chem. com. 15 chlorine and 85 mercury. Moschellandsberg in Rhenish Bavaria, also Idria and Almaden.

328. Iodite.—Ag I.

Thin flexible plates. Malleable. $H.=1\ldots1\cdot5$; $G.=5\cdot5\ldots5\cdot7$. Translucent; lustre inclining to adamantine. Pearl-gray, yellowish-gray, or greenish-yellow. B.B. on charcoal becomes red, fuses easily, colouring the flame purple-red, and leaves a grain of silver. Chem. com. 54 iodine and 46 silver. Albarradon in Zacatecas, Mexico; Arqueros in Chili, and Guadalajara in Spain.

329. Coccinite.—Hg I.

Scarlet-red, easily fusible, and subliming; said to occur at Casas Viejas in Mexico, and to be used as a pigment. Chem. com. probably 44·3 mercury and 55·7 iodine, like the artificial salt, which crystallizes in tetragonal pyramids.

330. Bromite.—Ag Br.

Tesseral; $\infty O \infty$ and O. Crystals very small; also crystalline grains. $H.=1\ldots2$; $G.=5\cdot8\ldots6$. Very splendent. Olive-green or yellow, with gray tarnish; streak siskin-green. B.B. very easily fusible; scarcely affected by acids. Chem. com. 57·5 silver and 42·5 bromine. San Onofre in the district of Plateros in Mexico (*Plata verde*), and used as an ore of silver.

331. Embolite.—2 Ag Br + 3 Ag Cl.

Tesseral; $\infty O \infty$ and O. $H.=1\ldots1\cdot5$; $G.=5\cdot3\ldots5\cdot4$ or 5·8 (*Breit.*) Resinous or adamantine. Yellow or green. Chem. com. 67 silver, 20 bromine, and 13 chlorine. Chili, Mexico, and Honduras. Ore of silver.

332. Romeite, Romeine.—$\dot{C}a^3\,\dddot{S}b\,\ddot{S}b$.

Tetragonal; P 110° 30′; consequently very like an octahedron. Scratches glass. $G.=4\cdot6\ldots4\cdot7$. Honey-yellow or hyacinth-red. B.B. fuses to a blackish slag; not soluble in acids. Chem. com. 41·3 antimonic acid, 37·3 antimony oxide, and 21·4 lime, but with 2 to 3 manganese and iron protoxide. St Marcel in Piedmont.

*333. Scheelite, Tungsten.—$\dot{C}a\,\dddot{W}$.

Tetragonal and hemihedric; P 112° 2′; often alone. The usual combinations are P (*P*) . 2 P∞ (*g*), (fig. 211). Cleavage, 2P∞ 129° 2′ rather perfect, along P and 0P less perfect. Fracture conchoidal and uneven. $H.=4\ldots4\cdot5$; $G.=5\cdot9\ldots6\cdot2$. Translucent; vitreous, inclining to resinous or adamantine. Colourless, but gray, yellow, or brown; streak white. B.B. fuses difficultly to a translucent glass; decomposed in h. or n. acid, leaving tungstic acid; also in solution of potash. Chem. com. 80·6 tungstic acid and 19·4 lime, but with 0 to 3 silica and 0 to 1·5 iron peroxide, or rarely copper protoxide when the mineral is green. Caldbeckfell near Keswick; Pengilly, Cornwall; at Zinnwald and Schlackenwald in Bohemia; also in the gold mines of Salzburg and of Hungary; Chili and Siberia; also in the Monroe Mines in Connecticut, where used in preparing tungstic acid, a very fine yellow pigment.

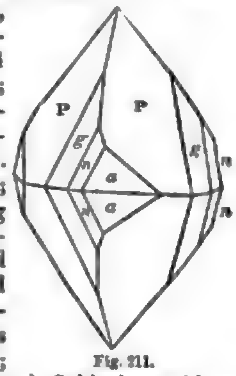


Fig. 211.

Order IV.—OXIDIZED ORES.

Crystallization rhombic, then tesseral or tetragonal, less frequently hexagonal or rhombohedric. Hardness generally high, or 5…7, most equal to felspar. Gravity also high, or 4…7 or 8. They are generally soluble in acids and solutions coloured. B.B. infusible, or very difficultly so. Chem. com. oxides of the metals alone or in composition. They are mostly opaque, with metallic lustre, and of black, brown, or dark-gray colours. Occur in beds, veins, or large masses, especially in the metamorphic and igneous rocks.

Family I.—Oxidized Iron Ores.

Crystallization tesseral, rhombohedric, or rhombic. $H.=5\ldots6\cdot5$; $G.=3\cdot4\ldots6\cdot5$; crystalline species $4\cdot5\ldots5\cdot3$. Soluble in acids; solution green. B.B. infusible or very difficult, but becomes magnetic in the red. flame. With borax show reaction for iron. Colours black, brown, or red. Occur in beds, veins, or large masses in the older rocks, or as rock constituents.

**334. Magnetite, Magnetic Iron.—$\dot{F}e\,\dddot{\overline{F}}e$.

Tesseral; O and ∞O, also $\infty O \infty$, 2O2 and 2O. Macles common, united by O (fig. 212). Generally granular or almost compact; often also in loose grains. Cleavage, octahedral perfect, or mere traces; fracture conchoidal or uneven; brittle. $H.=5\cdot5\ldots6\cdot5$; $G.=4\cdot9\ldots5\cdot2$. Opaque; lustre metallic. Iron-black, or inclining to brown or gray; highly magnetic. B.B. becomes brown and non-magnetic, and fuses with extreme difficulty; powder soluble in h. acid. Chem. com. 31·03 of the protoxide, and 68·77

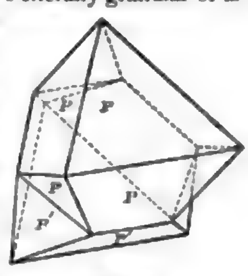


Fig. 212.

of the peroxide of iron, or 72·4 iron and 27·6 oxygen. Crystals at Traversella in Piedmont, Greiner in Tyrol, Kraubat in Styria; large masses Arendal in Norway; Dannemora, Utoe, Norberg, Taberg in Sweden; Kurunavara and Gellivara in Lapland; Nischne-Tagilsk, Blagodat, and the Kaschkanar in the Ural; also Scotland, the Harz, Saxony, Bohemia, Silesia, Elba, and Spain; Mexico, Brazil, and North America. Magnetite is the most important ore of iron in Norway, Sweden, and Russia.

*335. Chromite.—$(\dot{F}e, \dot{M}g)\,(\dddot{\bar{C}r}\ \dddot{\bar{A}l})$.

Tesseral, only in octahedrons; generally granular. Cleavage, octahedral imperfect; fracture imperfect, conchoidal, or uneven. H.=5·5; G.=4·4...4·5. Opaque; semi-metallic or resinous. Iron or brownish-black; streak yellowish or reddish-brown. Sometimes magnetic. B.B. infusible and unchanged, but the non-magnetic in the red. flame become magnetic; in borax forms an emerald-green bead; scarcely affected by acids. Chem. com. 19 to 37 iron protoxide, 0 to 10 magnesia, 36 to 60 chrome peroxide, and 9 to 21 alumina, with 0 to 10 silica as a mixture. Saxony, Silesia, Bohemia, Styria (Kraubat), Gassin in the Var dept. in France, Röraas in Norway, Katherinenburg in the Ural, near Baltimore, Chester in Massachusetts, and Hoboken; in Scotland in great abundance in Unst and Fetlar in the Zetlands, at Portsoy in Banff, and Tyndrum. Used in the preparation of various pigments.

336. Franklinite.—$(\dot{F}e, \dot{Z}n, \dot{M}n)\,(\dddot{\bar{F}e}, \dddot{\bar{M}n})$ (?).

Tesseral; O and O . ∞O; also granular. Cleavage, octahedral, but very imperfect; fracture conchoidal or uneven; brittle. H.=6...6·5; G.=5·0...5·3. Opaque; imperfect metallic lustre. Iron-black; streak dark reddish-brown. B.B. infusible, but shines brightly and gives out sparks when strongly heated. On charcoal, with soda, a deposition of zinc; soluble in h. acid with strong extrication of chlorine. Chem. com. 66 to 69 iron and 15 to 18 manganese peroxide (or in part protoxides), and 10 to 17 zinc oxide. Franklin and Sterling in New Jersey.

Dysluite, from Sterling, N. J.; dark or yellowish-brown; vitreous; G.=4·5; contains 30 per cent. alumina. *Isophane*, G.=5·01, seems also Franklinite.

**337. Hæmatite, Specular Iron.—$\dddot{\bar{F}e}$.

Rhombohedral; R 86°. Crystals rhombohedric, prismatic, or tabular, of R . 0R, 0R . R (fig. 213.), R . −½R ∞P2, R . ⅘P2 . 0R, ⅘P2 . R . ¼R, (or *n*, *P*, *s*.), (fig. 214).

Fig. 213.

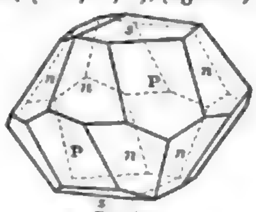


Fig. 214.

Macles with parallel axes, and mostly intersecting. Cleavage, R and 0R, but seldom distinct; fracture conchoidal or uneven; brittle. H.=5·5...6·5; G.=5·1...5·3. Opaque, or in very thin laminæ translucent and deep blood-red. Metallic; iron-black to steel-gray, but often tarnished, also red; streak cherry-red or reddish-brown. Usually weak magnetic. B.B. in the red. flame black and magnetic; slowly soluble in acids. Chem. com. 70·03 iron and 29·97 oxygen, but sometimes contains oxide of titanium, chrome, or silica.

Specular Iron Ore, varieties with crystalline structure and high metallic lustre, includes *micaceous iron*, thin lamellar, and *red iron froth*, finer or scaly. The *Red Hæmatite* or *red iron*, with inferior lustre, lower specific gravity (4·5...4·9), and hardness (3...5), and deeper blood-red or brownish-red colours; comprises the *fibrous red iron*, reniform, botryoidal, and stalactitic, often with an irregular concentric structure; the *compact* and *ochrey* iron ores, more earthy or minute; the *reddle* or red chalk, still more earthy, and used as a drawing material; and the *jaspery*, *columnar*, and *lenticular clay iron*, mere impure varieties.

Crystals, Elba, St Gotthardt, Framont in the Vosges, Arendal, Langbanshytta, Tilkerode in the Harz, Altenberg, Capas in Brazil, Katherinenburg and Nischne-Tagilsk. Micaceous, Zorge in the Harz, Tincroft in Cornwall, Tavistock in Devonshire, Wales, Cumberland, and Birnam in Perthshire; also in Auvergne, on Vesuvius, Ætna, and Stromboli. The *Red Hæmatite*, the Harz, Ulverstone in Lancashire, near Edinburgh, and in many other parts of Britain. A most abundant ore of iron.

Martite.—Tesseral, O, O . ∞O and O . ∞O∞ . H.=6; G.=4·6...5·33. Iron-black, with reddish-brown streak. Either pseudomorphs after magnetite, or a dimorphous form of hæmatite. Brazil, Monroe in New York, Framont, and Auvergne.

338. Irite.—$(\dot{I}r, \dot{O}s, \dot{F}e)\,(\dddot{\bar{I}r}, \dddot{\bar{O}s}, \dddot{\bar{C}r})$.

Tesseral; O; but in fine iron black scales, with strong metallic lustre, which mark paper. G.=6·506. Strongly magnetic. B.B. fused with nitre gives out the odour of osmium; insoluble in acids. Chem. com. 62·86 peroxide of iridium, 10·30 osmium protoxide, 12·50 iron protoxide, 13·7 chrome oxide, with traces of manganese. Ural, with platina.

*339. Limonite, Brown Iron Ore.—$2\,\dddot{\bar{F}e} + 3\,\dot{H}$.

Fine fibrous, in spherical, reniform, and stalactitic masses; also compact and earthy. H.=5...5·5; G.=3·4...3·95. Opaque; lustre weak silky, glimmering, or dull. Colour brown, especially yellowish, clove, hair, and blackish-brown, also yellow and green; streak yellowish-brown. In the closed tube yields water, and the powder becomes red. B.B. in the outer flame red on ignition; in the inner flame thin splinters fuse to a black magnetic glass. Chem. com. 85·6 peroxide of iron (=60 iron), and 14·4 water; but occasionally with silica, alumina, or phosphoric acid. Harz, Thuringia, Siegen near Bonn, Naussau, Styria, Carinthia, Pyrenees, Siberia, Brazil, and the United States; in Britain in Cornwall, at Clifton near Bristol, Sandlodge in Zetland, and in many other places. A valuable ore of iron, the iron usually uniting hardness with tenacity. *Stilpnosiderite*, *Lepidokrokite*, and *Yellow ochre* seem partly this mineral, partly Götheite, or mixtures.

Bog-Iron Ore is also an hydrated oxide of iron, with no definite composition, and often containing thirty to fifty per cent. of impurities. Phosphoric acid to 11 per cent. Occurs chiefly in bogs, meadows, and lakes, as in North Germany, Sweden, and Britain; especially the northern and western islands of Scotland.

*340. Gothite, Pyrrhosiderite.—$\dddot{\bar{F}e} + \dot{H}$.

Rhombic; P with polar edges 121° 5′ and 126° 18′, ∞P(*g*) 94° 53′, ∞P̆2 (*d*) 130° 40′, P̆∞ (*b*) 117° 30′, with ∞P̆∞ (*M*) and P (*P*), (fig. 215); also columnar, fibrous, or scaly. Cleavage, brachydiagonal very perfect; brittle. H.=5...5·5; G.=3·8...4·4. Opaque, or in fine lamellæ, translucent, and hyacinth-red; lustre adamantine or silky. Colour yellowish, reddish, or blackish-brown; streak brownish or reddish-yellow. In the closed tube the powder yields water, and becomes reddish-brown. B.B. in the ox. flame also brown; in the red. flame black and magnetic; difficultly fusible; soluble in h. acid, often leaving a little silica. Chem. com. 90 peroxide of iron and 10 water, with silica and manganese peroxide. Foliated, Eiserfeld near Siegen. Crystals, Lostwithiel in Cornwall, and Clifton near Bristol. Capillary, Przibram, Hüttenberg in Carinthia, and Norway. Compact,

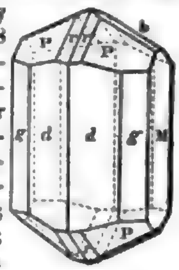


Fig. 215.

Saxony, the Pyrenees, Ural, North America, and many other localities.

Turgite, with 94·15 peroxide of iron and 5·85 water; compact reddish-brown; G.=3·54...3·74; Turginsk in the Ural; is probably a mixture.

*341. Ilmenite, Titanitic Iron.—$\dddot{Fe}$, $\dddot{Ti}$.

Rhombohedric, and isomorphous with hæmatite, but sometimes tetartohedral; R 86° (85° 40′ to 86° 10′). Crystals tabular or rhombohedral, of 0R (*a*) and R, with $-\frac{1}{2}$R (*e*), -2R (*d*), and $\frac{1}{4}(\frac{4}{3}$P 2) (*b*′), (fig. 216.) Also in macles, granular or foliated, or in loose grains. Cleavage, basal more or less perfect, and rhombohedral R less distinct; fracture conchoidal or uneven. H.=5 ...6; G.=4·66...5. Opaque; semimetallic. Iron-black, often inclining to brown, rarely to steel-gray; streak generally black, but sometimes reddish-brown. Slightly or not at all magnetic. B.B. infusible alone, but with salt of phosphorus in the red. flame a red glass; soluble, but often with much difficulty in h. acid. Chem. com. peroxide of iron with 8 to 53 blue oxide of titanium. Ilmen Mountains; Gastein in Salzburg (*Kibdelophan*); Egersund in Norway; near Arendal (*Hystatit*); Menaccan in Cornwall (*Menaccanite*); Bourg d'Oisans in Dauphiné (*Crichtonite*). *Mohsite* is the same, or connected.

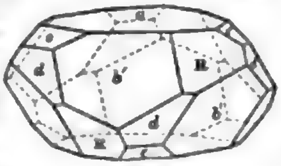


Fig. 216.

Iserine, or magnetic iron sand, in cubes, octahedrons, and dodecahedrons, generally with rounded edges or in loose grains; strongly magnetic in chemical action and composition; resembles ilmenite, but is perhaps only magnetite mixed with peroxide of titanium. Iserweise in Bohemia, the Eifel, Auvergne, near Rome and Naples; also in Northern Germany; Cornwall, sands of the Don in Aberdeenshire, and Loch of Tristan in Zetland.

Family II.—Tin Ore.

Crystallization tetragonal, rhombic, or rarely monoclinohedric, with prismatic forms. Hardness 5·5...6·5 or 7. Gravity 3·4...4·3 in the titanium compounds, 4·6...8 in the remainder. Mostly not soluble, or very difficultly, in acids, and also B.B. very difficultly, or not fusible. Colours dark, as black, brown, or red. Lustre resinous, semimetallic, or adamantine. Occur chiefly in the older crystalline strata, or in granite and syenite.

**342. Cassiterite, Tin Ore.—$\ddot{Sn}$.

Tetragonal; P 87° 5′, P∞ 67° 50′. Crystals ∞P . P; ∞P (*g*) . P (*s*) . ∞P∞ (*l*), or with P∞ (*P*), (fig. 217); and also ∞P 2 (*r*), and 5 P 2 (*z*), (fig. 218). Macles very

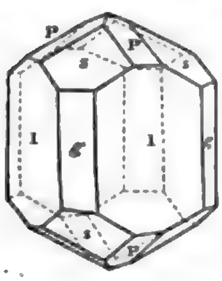


Fig. 217.

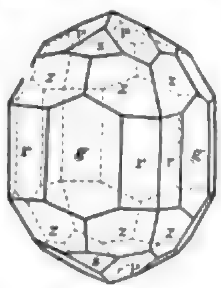


Fig. 218.

common, combined by a face of P ∞, with the chief axis 112° 10′ (figs. 219, 220); also granular or fibrous (*wood tin*), or in rounded fragments and grains (*stream tin*). Cleavage, prismatic along ∞P and ∞P ∞, rather imperfect; brittle. H.=6...7; G.=6·8...7. Translucent or opaque; adamantine or resinous. White, but usually gray, yellow, red, brown, and black; streak white, light-gray, or brown. B.B. in the forceps infusible; on charcoal, in the inner flame, more easily with soda, reduced to tin. Not affected by acids. Chem. com. 79 tin and 21 oxygen, but often

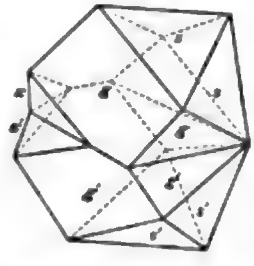


Fig. 219.

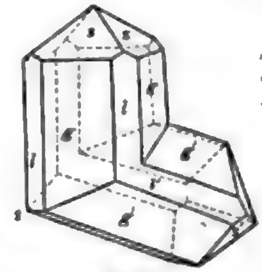


Fig. 220.

mixed with peroxide of iron or manganese, tantalic acid, or silica. Cornwall, Bohemia, Saxony, Galicia in Spain, and Portugal; also Silesia, the Haute Vienne in France, Greenland, Sweden, Russia, North and South America, Malacca, and Banca. The only ore of tin. The produce of the Cornish mines is about 100,000 cwts. annually.

Stannite.—Compact; brittle. H.=6·75; G.=3·5. Translucent only on thinnest edges; weak resinous. Yellowish white to yellow. B.B. infusible. Chem. com. 36·5 tin oxide with silica and alumina. Probably a mixture. Cornwall.

*343. Wolfram.—($\dot{Fe}$, $\dot{Mn}$) $\dddot{W}$.

Rhombic; ∞P 101° 45′, $\frac{1}{2}$P∞ 123° 57′, P̆∞ 98° 27′. Crystals ∞P (*r*) . $\frac{1}{2}$P∞ (*t*) . ∞P̄∞ (*M*) . P̆∞ (*u*), (fig. 221). Macles rather common, also columnar, laminar, or coarse granular. Cleavage, brachydiagonal very perfect; macrodiagonal imperfect; fracture uneven. H.=5 ...5·5; G.=7·1...7·5. Opaque; resinous, metallic-adamantine on the cleavage. Brownish-black; streak reddish-brown to black. Sometimes weak magnetic. B.B. on charcoal fuses to a magnetic globule covered with small crystals; soluble in warm h. acid, leaving a yellow residue. Chem. com. 76 tungstic acid, 9·5 to 20 protoxide of iron, and 4 to 15 protoxide of manganese, in some with a little lime or magnesia. Altenberg, Geyer, Ellenfriedersdorf, Schlakenwald, Zinnwald, the Harz, Cornwall, near Redruth, Rona in the Hebrides; also the Ural, Ceylon, and North America.

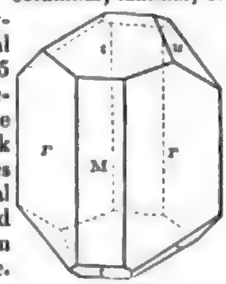


Fig. 221.

344. Columbite, Niobite.—($\dot{Fe}$, $\dot{Mn}$) $\ddot{Nb}$.

Rhombic; ∞P 100° 40′, 2 P̆ 8 59° 20′. Tabular, or broad prismatic (fig. 222). Macles with chief axes at 59° 20′; also foliated or granular. Cleavage, brachydiagonal very distinct, macrodiagonal less so, and basal imperfect. H.=6; G.=5·4...6·4. Opaque; metallic adamantine. Brownish or iron-black; streak reddish brown or black. B.B. infusible; not affected by acids. Chem. com. 14 to 17 protoxide of iron, 3·7 to 4·8 protoxide of manganese, and 78 to 81 niobic (or columbic) acid, with a little oxide of tin or copper. Middletown and Haddam in Connecticut, and Chesterfield in Massachusetts; Rabenstein near Bodenmais, and Ilmen Mountains.

Fig. 222.

345. Samarskite, Uranotantalite, Yttroilmenite.

Rhombic; isomorphous with columbite; mostly flat, somewhat polygonal grains. Fracture conchoidal; brittle. H.=5·5; G.=5·625. Opaque; strong semi-metallic. Velvet-black; streak dark reddish-brown. B.B. fuses on the edges to a black glass. In the closed tube decrepitates, yields water, incandesces, and becomes brown. Soluble in h. acid with difficulty, but wholly to a greenish fluid. Chem. com. 56 niobic acid, 15 to 16 iron protoxide, 14 to 17 ura-

anium oxide, and 8 to 11 yttria with lime and magnesia. Ilmen Mountains in miascite.

346. TANTALITE.—($\dot{Fe}$, $\dot{Mn}$) $\dddot{Ta}$.

Rhombic; P with polar edges 126° and 112° 30′, middle 91° 42′. Cleavages all very indistinct; fracture conchoidal or uneven. H.=6...6·5; G.=7·1...8. Opaque; semimetallic, adamantine, or resinous. Iron-black; streak cinnamon or coffee brown. B.B. infusible; scarcely affected by acids. Chem. com. 7 to 14 protoxide of iron, 1 to 7 protoxide of manganese, and 67 to 84 tantalic acid, with tin oxide and lime. Kimito and Tammela in Finnland, Broddbo and Finbo near Fahlun.

Cassiterotantalite, varieties with much tin oxide, have G. =6·2...6·5, and with soda yield tin.

347. YTTROTANTALITE.—($\dot{Y}$, $\dot{Ca}$, $\dot{Fe}$, $\dot{U}$)^3 ($\dddot{Ta}$, $\dddot{W}$.)

Crystallization unknown; indistinct four or six sided prisms; also in grains and lamellæ. Cleavage in one direction; fracture conchoidal or uneven. Opaque, or in thin splinters translucent. Three varieties are distinguished—(*a.*) *Black Y.*, iron-black, semimetallic, and greenish-gray streak; H.=5·5; G.=5·4...5·7. (*b.*) *Dark* or *Brown Y.*, brownish-black, bright brown streak, vitreous or resinous. (*c.*) *Yellow Y.*, yellowish-gray, or brown, often striped or spotted; streak white; resinous or vitreous. H.=5; G.= 5·88. B.B. infusible, but become brown or yellow; not affected by acids. Chem. com. 57 to 60 tantalic acid, 1 to 8 tungstic acid, 20 to 38 yttria, 0·5 to 6 lime, 0·5 to 6 uranium peroxide, and 0·5 to 3·5 iron peroxide. Ytterby, and near Fahlun.

348. EUXENITE.—$\dddot{Ta}$, $\ddot{Ti}$, $\dot{Y}$, $\dot{Ce}$, $\dot{Ca}$, $\dot{H}$.

Monoclinohedric probably; also compact, with no trace of cleavage. Fracture imperfect conchoidal. H.=6·5; G.=4·6. Opaque; thin splinters reddish-brown translucent; metallic vitreous. Brownish-black; streak reddish-brown. B.B. infusible; not affected by acids. Chem. com. uncertain. Jölster and Arendal in Norway.

349. FERGUSONITE.—($\dot{Y}$, $\dot{Ce}$, $\dot{Zr}$)^6 $\dddot{Ta}$.

Tetragonal and hemihedric; P 128° 28′ (fig. 223). Cleavage, traces along P; fracture imperfect conchoidal; brittle. H.=5·5...6; G.=5·8... 5·9. Translucent in thin splinters; semimetallic. Brownish-black; streak pale-brown. B.B. infusible. Chem. com. 48 tantalic acid, 42 yttria, 5 cerium protoxide, 3 zirconia, with tin oxide, uranium, and iron peroxide. Cape Farewell in Greenland.

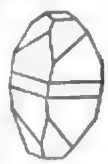


Fig. 223.

Tyrite, brown, resinous or semimetallic; H.=6·5; G. =5·13...5·36; Helle, near Arendal; is similar or identical. *Azorite*, minute, greenish or yellowish white tetragonal pyramids from the Azores, seems a tantalate of lime.

350. SPHENE, Titanite.—$\dot{Ca}\,\dddot{Si}^2 + \dot{Ca}\,\ddot{Ti}^2$.

Monoclinohedric; C=85° 6′; ∞P (*l*) 133° 54′, ½P∞ (*x*) 52° 21′, P∞ (*y*) 34° 27, 0P (*P*), (∞P∞) (*q*), (∞P3) (*M*), and (⅔P2) (*n*) 136° 6′. Crystals horizontal prismatic or tabular, or very often oblique prismatic (figs. 224, 225). Macles frequent; also granular or foliated.

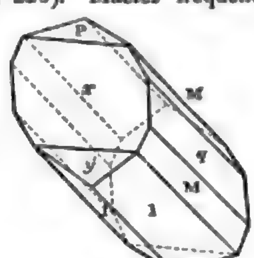


Fig. 224.

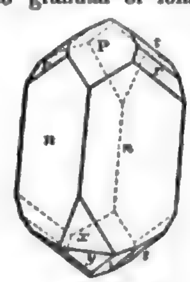


Fig. 225.

Cleavage, in many ∞P; in others (P∞) (*r*) 113° 30′, imperfect. H.=5...5·5; G.=3·4...3·6. Semitransparent or opaque; adamantine or often resinous. Brown, yellow, or green. B.B. fuses on the edges to a dark glass; with salt of phosphorus in the red. flame reaction for titanic acid; wholly soluble in s. acid, which forms sulphate of lime. Chem. com. 31·3 silica, 40·4 titanic acid, and 28·3 lime, with 0 to 5 iron protoxide in the brown varieties. Dauphiné near Mont Blanc, St Gotthard, Tyrol, Arendal, Sweden, Saxony, France, America, and the Ural; also Lake Laach and Vesuvius; in Scotland, in Criffell, near King's House, Ben Nevis, Strontian, Loch Ness, Aberdeenshire, Fetlar and Burra in Zetland.

Greenovite, flesh-red, from St Marcel in Piedmont, with much protoxide of manganese, is not distinct. *Schorlamite*, black shining; H.=7...7·5; G.=3·78...3·86; from Arkansas, is related.

351. BROOKITE.—$\ddot{Ti}$.

Rhombic; P with polar edges 135° 37′ and 101° 3′, ∞P̆2 99° 50′ (fig. 226). Cleavage macrodiagonal. H.=5·5...6; G.=3·86...4·2. Opaque or translucent; metallic adamantine. Yellowish, reddish, or hair-brown; streak yellowish-white. B.B. infusible; with salt of phosphorus forms a brownish-yellow glass. Chem. com. titanic acid, with 1·4 to 4·5 per cent. peroxide of iron. Bourg d'Oisans, Chamouni, and near Amstäg in the Canton Uri, Miask, Magnet Cove in Arkansas (*Arkansite*); Snowdon and Tremaddoc in North Wales.

Fig. 226.

*352. RUTILE, Nigrine.—$\ddot{Ti}$.

Tetragonal; P 84° 40′, P∞ 65° 35′. Crystals ∞P . ∞P∞ . P, and ∞P3 . P (fig. 227). Macles very common (like fig. 220) with chief axis at 114° 26′; also imbedded or granular. Cleavage, ∞P and ∞P∞ perfect. H.=6...6·5; G.=4·2...4·3. Translucent or opaque; metallic adamantine. Reddish-brown to red, also yellowish and black (*Nigrine*); streak yellowish-brown. B.B. unchanged alone; with borax in the ox. flame forms a greenish, in the red. flame a violet glass; not affected by acids. Chem. com. titanic acid, with 1·5 per cent. or more peroxide of iron. Alps, in Spain, St Yrieux near Limoges, Norway, the Ural, Brazil, and North America; Craig Cailleach near Killin, Ben-y-gloe and Crianlarich in Perthshire, and Burra in Zetland. Used in painting porcelain to produce a yellow colour.

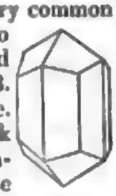


Fig. 227.

353. ANATASE, Octædrite.—$\ddot{Ti}$.

Tetragonal; P 136° 36′. Crystals P . 0P (fig. 228), or P . ⅕P. Cleavage, basal and P both perfect; brittle. H.=5·5...6; G.=3·8...3·93. Semitransparent or opaque; metallic adamantine. Indigo-blue, almost black, red, yellow, or brown, rarely colourless; streak white. B.B. infusible; only soluble in warm con. s. acid. Chem. com. titanic acid with a little peroxide of iron, or rarely tin oxide. The Alps, as Bourg d'Oisans, Dauphiné, Valois, and Salzburg; Hof in Bavaria, at Slidre in Norway, Ural, Minas Geraes in Brazil, and in Cornwall.

Fig. 228.

354. POLYMIGNITE.

Rhombic; P with polar edges 136° 28′ and 116° 22′, ∞P 109° 46′. Crystals long prismatic, rather broad, and vertically striated. Cleavage imperfect; fracture conchoidal. H.=6·5; G.=4·806. Opaque; semimetallic. Iron-black; streak dark-brown. B.B. infusible alone, or with soda; soluble in con. h. acid. Analysis by Berzelius—46·30 titanic acid, 14·14 zirconia, 12·20 iron peroxide, 2·70 manganese peroxide, 5·00 cerium peroxide, 11·50 yttria, 4·20 lime (=96·04). Fredriksvärn, Norway.

355. POLYKRASE.—$\dot{Zr}$, $\dot{Y}$, $\bar{Fe}$, $\dot{U}$, $\dot{Ce}$, $\ddot{Ti}$, $\dddot{Ta}$.

Rhombic, six-sided tables, ∞P 140°. Cleavage not observable; fracture conchoidal. H.=5...6; G.=5·0... 5·15. Opaque, or in very fine splinters translucent yel-

lowish-brown. Black; streak grayish-brown. B.B. decrepitates violently, incandesces, and becomes grayish-brown, but is infusible; imperfectly soluble in warm h. acid, wholly in s. acid. Hitterö in Norway.

356. Perrowskite.—$\dot{C}a\,\ddot{T}i$.

Tesseral; especially ∞O∞, also O, ∞O. Cleavage hexahedral. H.=5·5; G.=4. Opaque, or translucent on the edges; adamantine. Grayish or iron-black, or dark reddish-brown. B.B. infusible; slightly affected by acids. Chem. com. 58·9 titanic acid, and 41·1 lime, with 2 to 5 iron protoxide. Slatoust, Kaiserstuhl in Baden.

357. Aeschynite.—$2(\dot{C}e,\dot{L}a,\dot{F}e)(\ddot{N}b,\ddot{T}i)+\ddot{C}e(\ddot{N}b,\ddot{T}i)$.

Rhombic; ∞P 127° 19′, 2P̆∞ 73° 44′. Crystals long prismatic (fig. 229). Cleavage, only in traces; fracture imperfect conchoidal. H.=5...5·5; G. =4·9...5·1. Opaque; submetallic or resinous. Iron black or brown; streak yellowish-brown. B.B. swells and becomes yellow or brown, but is infusible; not soluble in h. acid, partially in con. s. acid. Miask in the Ural.

Fig. 229.

358. Mengite.—$\ddot{F}e$, $\ddot{Z}r$, $\ddot{T}i$.

Rhombic; ∞P 136° 20′. The crystals small, prismatic; fracture uneven. H.=5...5·5; G.=5·48. Opaque; semi-metallic. Iron-black; streak chestnut-brown. B.B. infusible, but becomes magnetic; almost wholly soluble in warm con. s. acid. Ilmen Mountains.

359. Pechurane, Pitch-Blende.—$\dot{U}\,\ddot{U}$.

Tesseral; O; also granular, reniform, columnar or lamellar. H.=5...6; G.=6·5 or 7·9...8. Opaque; imperfect metallic or resinous. Grayish, greenish, or brownish-black; streak greenish-black. B.B. infusible; not soluble in h. acid, but easily in warm n. acid. Chem. com. proto-peroxide of uranium, 84·78 uranium, and 15·22 oxygen, but with lead, iron, arsenic, lime, magnesia, silica, and other impurities. Some contain vanadium, others also selenium (*Gummierz*, H.=2·5...3). *Pittinerz*, olive-green streak; H.=3·0...3·5; G.=4·8...5·0; and *Coracite*, from Lake Superior, seem mixtures. Johann-Georgenstadt, Marienberg, Annaberg, Przibram, Rezbanya, and near Redruth in Cornwall. Used in porcelain-painting.

360. Plattnerite.—$\ddot{P}b$.

Hexagonal; ∞P . 0P . P. Cleavage indistinct; fracture uneven; brittle. G.=9·39...9·44. Opaque; metallic adamantine. Iron-black; streak brown. Chem. com. 86·2 lead and 13·8 oxygen, with trace of sulphuric acid. Leadhills in Scotland.

Family III.—Manganese Ores.

Crystallization rhombic, tetragonal, and monoclinohedric. Crystals often prismatic. H.=1...7; G.=2·3...5. Opaque; lustre more or less perfect metallic. Colour black or brown. B.B. infusible, mostly give out much oxygen, and do *not* become magnetic; soluble in hydrochloric acid, with fumes of chlorine. The solution, saturated with carbonate of lime and filtered, gives, with chloride of lime, a copious dark-brown precipitate which acts like manganese oxide. Occur chiefly in veins in the older rocks, often along with barytes.

*361. Pyrolusite.—$\ddot{M}n$.

Rhombic; ∞P 93° 40′; P̄∞ 140°. Crystals short, prismatic, or pointed (fig. 230); generally massive or reniform, and radiating, fibrous, earthy, or compact. Cleavage, ∞P, also macro- and brachydiagonal; rather brittle or friable. H.=2...2·5; G.=4·7...5. Opaque; semimetallic or silky. Dark steel-gray, bluish, or iron-black; streak black and soiling. B.B. infusible, loses oxygen, and becomes brown; soluble in h. acid, with large evolution of chlorine. Chem. com. 63·6 manganese and 36·4 oxygen. Ilmenau, Ihlefeld, Goslar, Johann-Georgenstadt; also France, Hungary, Brazil, Cornwall and Devon. Used for producing oxygen, chlorine, and chloride of lime, removing the brown and green tints in glass, in painting glass and enamel-work, and for glazing and colouring pottery.

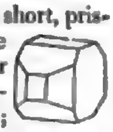


Fig. 230.

Varvacite.—With 5 water, pseudomorphs after calc-spar; also crystals with ∞P=99° 36′, or columnar, and fibrous. G.=4·5...4·6. Semimetallic. Iron-black to steel-gray; streak black. Warwickshire.

362. Polianite.—$\ddot{M}n$.

Rhombic; ∞P 92° 52′, P̆∞ 118°. Crystals generally short, prismatic, and vertically striated; also granular. Cleavage, brachydiagonal perfect. H.=6·5...7; G.= 4·84...4·88. Opaque; weak metallic. Light steel-gray. B.B. acts like pure hyperoxide of manganese. Chem. com. identical with pyrolusite, which seems thus a less hard variety or product of decomposition. Platten, Schneeberg, and Johann-Georgenstadt.

*363. Manganite.—$\dddot{\bar{M}}n+\dot{H}$.

Rhombic, sometimes hemihedric; ∞P (*M*) 99° 40′, ∞P̆2 (*l*) 118° 42′, P̄∞ (*c*) 114° 19′; also P̄3 (*g*), ∞P̆2 (*r*), 2P̄ (*m*), and 2P̆2 (*n*), (fig. 231). Crystals prismatic, vertically striated, and in bundles; also columnar or fibrous, rarely granular. Cleavage, brachydiagonal very perfect, basal and ∞P less perfect; rather brittle. H.=3·5...4; G. =4·3...4·4. Opaque; imperfect metallic. Dark steel-gray to iron-black, or often brownish-black and tarnished; streak brown. B.B. infusible; soluble in warm con. h. acid. Chem. com. 89·9 manganese peroxide and 10·1 water. Ihlefeld, in the Harz, Thuringia, Christiansand in Norway, Undenaes in Sweden, Nova Scotia, and Danestown near Aberdeen.

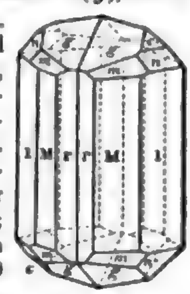


Fig. 231.

364. Hausmannite.—$\dot{M}n+\dddot{\bar{M}}n$, *or* $\dot{M}n^2\,\ddot{M}n$.

Tetragonal; P 117° 54′, P∞ 99° 11′. Crystals P or P . ⅓P. Macles common (fig. 77); also granular. Cleavage, basal rather perfect, less distinct P and P∞; fracture uneven. H.=5·5; G.=4·7...4·8. Opaque; strong metallic. Iron-black; streak brown. B.B. like peroxide of manganese; soluble in h. acid, with escape of chlorine; powder colours con. s. acid bright-red in a short time. Chem. com. 31 protoxide and 69 peroxide of manganese, or 72·4 manganese and 27·6 oxygen. Ihlefeld, and near Ilmenau.

365. Braunite.—$\dddot{\bar{M}}n$.

Tetragonal; P 108° 39′; hence almost an octahedron. Crystals P and P . 0P. Cleavage, P rather perfect; brittle. H.=6...6·5; G.=4·818. Opaque; imperfect metallic. Colour and streak dark brownish-black. B.B., and with acids like manganite. Chem. com. 70 manganese and 30 oxygen. Elgersburg, Oehrenstock, Ihlefeld, and St Marcel (*Marceline*).

366. Psilomelane.—$(\dot{M}n, \dot{B}a, \dot{K}, \dot{C}u), \ddot{M}n+\dot{H}$.

Massive, botryoidal, or stalactitic. Fracture conchoidal or uneven. H.=5·5...6; G.=4·1...4·2. Opaque; dull or glimmering. Iron-black or bluish-black; streak brownish-black and glistening. B.B. infusible. Chem. com. 4·7 to 11 protoxide of manganese, 80 hyperoxide (but 20 to 50 mixed), 6 to 16 baryta, 2 to 5 potash, 0 to 1 copper, and 0·5 cobalt protoxide; and thus a mixture. Schneeberg, Ilmenau, France, Vermont, Cornwall, and Devon.

367. Crednerite.—$\dot{C}u^3\,\dddot{\bar{M}}n^2$.

Monoclinohedric; granular, foliated. Cleavage, basal very distinct, prismatic imperfect. H.=4·5...5; G.=4·9 ...5·05. Opaque; metallic. Iron-black; streak brownish-

black. B.B. very thin foliæ scarce fusible on the edges; with salt of phosphorus in the inner flame forms a glass first green, then copper-red; in h. acid it forms a green solution. Chem. com. 42·85 copper protoxide and 57·15 peroxide of manganese. Freidrichsroda in Thuringia.

368. Cupreous Manganese.—$(\dot{M}n, \dot{C}u)\ddot{M}n^2 + 2\dot{H}$.

Amorphous; botryoidal, stalactitic, or earthy. Rather brittle or friable. H.=3·5 or less; G.=3·1...3·2. Opaque; vitreous. Black, inclining to brown or blue; streak similar. Gives off much water in the closed tube. B.B. fusible, and yields copper. Contains 14 to 17 copper protoxide, 1·6 baryta, 2·5 lime, 0·2 to 0·6 protoxide of cobalt and nickel, 15 to 17 water, and other substances; thus scarcely a true species. Silesia, Saxony, the Harz, and Cornwall.

Black copper, with 28 iron peroxide, 29·5 water, is similar. Harz.

369. Earthy Cobalt.—$(\dot{C}o, \dot{C}u)\ddot{M}n^2 + 4\dot{H}$.

Amorphous; reniform, sectile. H.=1...1·5; G.=2·1...2·2. Opaque; dull. Bluish or brownish-black; streak black, shining, and leaves a mark. B.B. infusible. Contains about 20 cobalt protoxide, 4·5 copper protoxide, and 21 water. Saalfeld, Glücksbrun, Riechelsdorf, and Alderley Edge in Cheshire. *Horn-cobalt*, Siegen, is a mixture with quartz.

*370. Wad.—$\dot{M}n(\dot{C}a, \dot{B}a, \dot{K})\ddot{M}n^2 + 3\dot{H}$.

Massive; reniform, stalactitic, or froth-like; also scaly, earthy, or compact. Very soft and sectile (rarely brittle, and H.=3); G.=2·3...3·7; or porous, and swims on water. Opaque; semimetallic, and shining or dull. Colour and streak brown or black. B.B. like peroxide of manganese; soluble in h. acid. Chem. com. very uncertain. Saxony, Harz, France, Devonshire, and Cornwall. *Groroilite* is a variety, and *Newkirkite* related.

Family IV.—Ochres.

The following substances, chiefly products of decomposition, and all compact, earthy, or disseminated, and scarcely true mineral species, may be described here:—

371. Cobalt-ochre, Earthy Cobalt.—$\ddot{\bar{F}}e, \dddot{A}s, \dot{C}o, \dot{C}a, \dot{H}$.

H.=1...2; G.=2...2·65. Yellowish-gray or brown to liver-brown; streak brown or yellowish-gray and shining. In the closed tube yields water. B.B. emits odour of arsenic, and fuses to a black magnetic slag. Saalfeld, Riechelsdorf, Dauphiné, and other localities.

372. Molybdena-ochre.—$\dddot{M}o$.

Opaque; dull. Straw, sulphur, or orange yellow. B.B. fuses and smokes; soluble in h. acid. Sweden, Norway, the Tyrol, and on Corybuy, near Loch Creran in Scotland.

373. Bismuth-ochre.—$\ddot{\bar{B}}i$.

Very soft and friable. G.=4·36...4·7. Opaque; dull, or glimmering. Straw-yellow to light-gray or green. B.B. fusible and easily reduced; easily soluble in nitric acid. Schneeberg, Siberia, and St Agnes in Cornwall.

374. Antimony-ochre.—$\ddot{\bar{S}}b, \dot{H}$.

Soft and friable. G.=3·7...3·8. Opaque; dull or glimmering, with glistening streak. Yellow, yellowish-gray, or white. B.B. easily reduced. Harz, Hungary, Saxony, France, Spain, and Padstow in England.

375. Stiblite.—$\dddot{S}b, \dot{H}$.

H.=5·5; G.=5·28. Resinous or dull. Yellowish-white or yellow. B.B. not reduced alone, but easily with soda. Chem. com. 75 antimony, 20·5 oxygen, and 5·5 water. Kremnitz, Felsöbanya, and Mexico.

376. Tungsten-ochre.—$\dddot{W}$.

Soft. Opaque; dull. Yellow or yellowish-green. Soluble in caustic ammonia. Huntington in North America.

377. Uranium-ochre.—$\ddot{\bar{U}}, \dot{H}$.

Sectile, soft, and friable. Opaque; dull. Straw, sulphur, or orange yellow. In the closed tube yields water, and becomes red. B.B. in the red. flame becomes green, but does not fuse; easily soluble in acids. Joachimsthal, Johann-Georgenstadt, and St Symphorien in France.

378. Minium (Native).—$\ddot{P}b + 2\dot{P}b$.

H.=2...3; G.=4·6. Opaque, dull or weak resinous. Aurora-red; streak orange-yellow. B.B. fuses easily, and reduced; in h. acid loses its colour, and changed into chloride of lead. Chem. com. 90·7 lead and 9·3 oxygen. Schlangenberg in Siberia, Badenweiler, Anglesea, Grassington Moor and Weirdale in Yorkshire.

379. Lead-ochre.—$\dot{P}b$.

G.=8·0. Opaque; dull. Sulphur or lemon yellow. Popocatepetl in Mexico.

380. Chrome-ochre.—$\dddot{\bar{C}}r$.

Opaque, or translucent on the edges; dull. Grass-green to siskin or yellowish green. B.B. infusible; soluble to a green fluid in solution of potash. Unst in Zetland, Creuzat in France, and Sweden. *Wolchonskoite*, emerald or blackish green, from Okhansk in Perm, is similar.

381. Tellurite.—$\ddot{T}e$.

Spherical, and radiated fibrous. Yellowish or grayish-white. Siebenbürg.

Family V.—The Red Copper Ores.

Tesseral and hexagonal. H.=3·5...4·5; G.=5·4...6. Translucent; metallic. Red or dark-gray. Soluble in acids, and B.B. fusible, except zincite. Are oxides of copper or zinc.

*382. Cuprite, Red Copper Ore.—$\dot{\bar{C}}u$.

Tesseral; O, ∞O, and ∞O∞; granular or compact. Cleavage, octahedral rather perfect; brittle. H.=3·5...4; G.=5·7...6. Translucent or opaque; metallic-adamantine. Cochineal to brick red, with a lead-gray tarnish; or crimson in transmitted light; streak brownish-red. B.B. on charcoal becomes black, fuses, and reduced; soluble in acids and ammonia. Chem. com. 88·9 copper and 11·1 oxygen. Siberia, the Bannat, Chessy near Lyons, Linares in Spain, and in the Huel Gorland, Huel Muttrel, Carvath, and United Mines in Cornwall.

383. Chalcotrichite.

Rhombic or tesseral; in fine capillary crystals (prisms or cubes). Cochineal and crimson red. In other characters like cuprite. Rheinbreitenbach, Moldawa, and Huel Gorland, Carharrack, and St Day, in Cornwall.

Tile-ore.—Reddish-brown, or brick-red and earthy. Chem. com. suboxide of copper, mixed with much peroxide of iron and other substances. Bannat, Thuringia, Cornwall, and Shropshire.

384. Tenorite.—$\dot{C}u$.

Hexagonal, in thin tables; also fine scaly or earthy. Translucent and brown; metallic. Dark steel-gray or black. On lava, Vesuvius.

385. Zincite, Red Zinc.—$\dot{Z}n$.

Hexagonal; granular or foliated. Cleavage, basal and ∞P very perfect. H.=4...4·5; G.=5·4...5·5. Translucent on the edges; adamantine. Blood or hyacinth red; streak orange-yellow. B.B. infusible, but phosphoresces. Chem. com. 80·26 zinc and 19·74 oxygen, but with 3 to 12 manganese peroxide. Franklin and Sterling in New Jersey. Ore of zinc.

Family VI.—The White Antimony Ores.

386. Valentinite, White Antimony.—$\dddot{\bar{S}}b$.

Rhombic; ∞P 137°, $\bar{P}\infty$ 70½°. Crystals $\infty\bar{P}\infty$. ∞P . $\bar{P}\infty$ (fig. 232); broad prismatic, or long tabular; also granular, columnar, or foliated. Cleavage, ∞P very per-

fect, brachydiagonal imperfect. H. = 2·5...3; G. = 5·5 ...5·6. Translucent; adamantine or pearly. Yellowish and grayish-white, brown, gray, and rarely peach-blossom red; streak white. B.B. becomes yellow, and fuses (in the flame of a candle) to a white mass. In the closed tube wholly sublimes; on charcoal forms a thick white coating; easily soluble in h. acid; the solution yields with water a white precipitate. Chem. com. 83·6 antimony and 16·4 oxygen. Przibram, Braunsdorf in Saxony, Harz, Hungary, Allemont in Dauphiné, and Siberia.

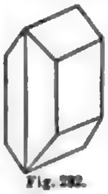


Fig. 232.

387. Senarmontite.—$\dddot{Sb}$.

Tesseral; O; also massive. Cleavage, O imperfect. G. = 5·22...5·30. Transparent to translucent; brilliant resinous or adamantine. White or gray. B.B. and chem. com. like valentinite. Sensa, near Constantine in Algeria, Perneck in Hungary.

388. Cervantite.—$\dddot{Sb}\ \ddddot{Sb}$.

Acicular or incrusting. G. = 4·1. Resinous. Yellow or white. B.B. infusible, but reduced on charcoal; soluble in h. acid. Chem. com. 79·5 antimony, 20·5 oxygen. Cervantes in Spain, Auvergne, Hungary, and Pereta in Tuscany.

389. Arsenite.—$\dddot{As}$.

Tesseral; O; usually capillary, flaky, or pulverulent. Cleavage octahedral. H. = 1·5 (3, *Breit.*); G. = 3·6...3·7. Translucent; vitreous. Colourless and white. Taste sweetish astringent; highly poisonous. B.B. in closed tube sublimes in small octahedrons; on charcoal volatilizes with strong smell of garlic. Chem. com. arsenious acid, with 75·76 arsenic and 24·24 oxygen. Andreasberg, Joachimsthal, Kapnik, Alsace, and Pyrenees.

Order V.—NATIVE METALS.

Form only one family. Crystallization either tesseral in regular octahedrons, as gold, silver, copper, and lead; or rhombohedric, with R = 86° to 88°, as antimony, arsenic, tellurium, and bismuth (tin is tetragonal). H. ranges from 1·5 in lead to 6...7 in iridium; G. from 5·7 in arsenic to 23 in iridium. Some (platina, palladium, iridium, and iron) are infusible; gold and the others easily fusible; antimony, arsenic, and tellurium, burn and fume.

They are all opaque, metallic lustre, and pure metallic colours (not lead-gray nor black); streak similar and shining. Are simple metals or their combinations.

*390. Platina.—Pt, Fe.

Tesseral; very rarely in small cubes, commonly in minute, flat, or obtuse grains and roundish lumps. Cleavage wanting; fracture hackly; malleable and ductile. H. = 4...5; G. = 17...19 (hammered 21·23). Steel-gray, inclining to silver-white. Sometimes slightly magnetic. Very difficultly or not fusible; in nitrochloric acid forms a red coloured solution. Chem. com. platina, but generally alloyed with 4 to 13 iron, 1 to 5 iridium, and many other metals. Found in diluvial deposits in Columbia, Brazil, and St Domingo; in the Ural; also in California, Canada, Borneo, the Harz, and France. The largest mass from South America weighs 1 lb. 9½ oz.; from the Ural, 18⅓ lb. English avoirdupois. Its hardness, infusibility, power of resisting acids, and other properties, render platina a very important material for chemical, mathematical, and philosophical instruments. In Russia also used for money.

391. Paladium.—Pd.

Tesseral; in very minute octahedrons; mostly small grains or scales. Malleable. H. = 4·5...5; G. = 11·8...12·2. Light steel-gray or silvery-white. B.B. infusible; in nitric acid forms slowly a brownish-red solution. Chem. com. palladium, alloyed with platinum and iridium. Brazil, in gold sands; Tilkerode in the Harz, in very small, brilliant, hexagonal tables;—hence rhombohedric and dimorphous. Used for astronomical and other instruments.

392. Osmium-iridium.—Ir, Os.

Hexagonal; P 124°; or rhombohedric, R 84° 52′, 0P . P . ∞P (fig. 233), more common in small flat grains. Cleavage, basal rather perfect. Slightly malleable. Not affected by acids.

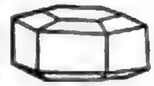


Fig. 233.

(*a.*) *Osmiridium.*—Tin-white. H. = 7; G. = 19·38...19·47. B.B. not altered. Analysis, 46·77 iridium, 49·34 osmium, 3·15 rhodium, 0·74 iron, and trace of palladium. Katherinenburgh.

(*b.*) *Iridosmium.*—Lead-gray. H. = 7; G. = 21·118 (*G. Rose*). B.B. on charcoal becomes black, with a very strong odour of osmium; in the flame of a spirit-lamp shines brightly and colours it yellowish-red. In one variety Berzelius found 25 iridium and 75 osmium, or Ir Os^3; in another, 20 iridium and 80 osmium, or Ir Os^4. Nischne-Tagilsk, Ural, Brazil, and Borneo.

393. Iridium, Platin-iridium.—Ir, Pt.

Tesseral; ∞O∞ . O; also small rounded grains. Cleavage, traces; slightly malleable. H. = 6...7; G. = 21·57...23·46. Silver-white, inclining to yellow on the surface. B.B. unalterable; insoluble in acids, even the nitrochloric. Chem. com., by Svanberg's analysis, 76·80 iridium, 19·64 platina, 0·89 palladium, and 1·78 copper. Nischne-Tagilsk and Newjansk. Used in porcelain-painting.

*394. Gold.—Au.

Tesseral; O, ∞O∞, ∞O, 3O3, ∞O2, and other forms. Crystals small, often elongated, deformed, and indistinct; also capillary, wire-like, arborescent, and in plates and grains. Remarkably ductile and malleable. H. = 2·5...3; G. = 17·0 ...19·4. Gold-yellow to brass or bronze yellow. B.B. easily fusible; soluble in aqua regia, often with a precipitate of chloride of silver. The solution is yellow, and colours the skin deep purple-red. Chem. com. gold with silver to 38 per cent., and copper and iron under 1 per cent. In beds, veins, and alluvial deposits in many parts of the world,—the Ural, Brazil, California, Australia; in the sand of many rivers, as Rhine and Tagus; in Britain in many of the Cornish stream-works; in mineral lodes near Dolgelly, North Wales; in Scotland at Leadhills, Tyndrum, and Glen Coich, Perthshire; and in Ireland in Wicklow.

*395. Silver.—Ag.

Tesseral; cubes and octahedrons; also ∞O, 3O3, and ∞O2. Crystals small and often misshapen; also capillary, filiform, arborescent, or tooth-like, and in leaves, plates, or crusts. Malleable and ductile. H. = 2·5...3; G. = 10·1 ...11·1. Silver-white, but often tarnished yellow, red, brown, or black. B.B. easily fusible; easily soluble in nitric acid; the solution colours the skin black. Chem. com. silver, often with copper, iron, gold (28 per cent.), platina, antimony, and arsenic. Chiefly in veins, as at Andreasberg, Freiberg, Johann-Georgenstadt, and Kongsberg in Norway; Mexico and Peru; St Mewan, St Stephens, Huel Mexico, and Herland in Cornwall; and at Alva in Stirlingshire.

396. Antimony-silver, Discrasite.—Ag^4 Sb.

Rhombic; P with polar edges 132° 42′ and 92°, ∞P 120° nearly. Crystals short prismatic or thick tabular, and vertically striated; macles united by a face of ∞P; often in stellar groups (fig. 234); also massive or granular. Cleavage, basal and $\breve{P}\infty$ distinct; ∞P imperfect; rather brittle, and slightly malleable. H. = 3·5; G. = 9·4... 9·8. Silver-white to tin-white, with a yellow or blackish tarnish. B.B. fuses easily; fumes, staining the charcoal white, and

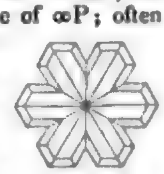


Fig. 234.

leaves a grain of silver; soluble in nitric acid. Chem. com. 78 silver and 22 antimony. Andreasberg, Allemont in Dauphiné, Spain, and Arqueras in Coquimbo. A valuable ore of silver.

397. Mercury, Native Quicksilver.—Hg.

Fluid; but at −40° congeals, and forms tesseral crystals. G.=13·545 fluid, 15·612 solid. Bright metallic; tin-white. B.B. wholly volatile, or leaves a little silver. Chem. com. mercury, sometimes with a little silver. Idria, Almaden, Wolfstein, and Mörsfeld on the Rhine, the Harz, Peru, China, and California.

398. Amalgam.—Ag Hg^2, and Ag Hg^3.

Tesseral; ∞O, with 2O2, O, ∞O∞, 3O$\frac{3}{2}$, and ∞O3; also compact, or in crusts and plates. Cleavage, traces along ∞ O; rather brittle. H.=3...3·5; G.=13·7...14·1. Silver-white, and leaves the same colour on copper. In the closed tube yields mercury and leaves silver; easily soluble in nitric acid. Chem. com. 35 and 26·5 per cent. silver. Mörsfeld and Moschellandsberg in Rhenish Bavaria, Hungary, Sala, Allemont, and Almaden. *Arquerite* in small octahedrons and arborescent; ductile and malleable. H.=2...2·5; G.=10·8. Chem. com. 86·5 silver. Forms the chief ore in the rich silver mines of Arqueros near Coquimbo.

399. Antimony.—Sb.

Rhombohedric; R 87° 35′, but very rarely crystallized, generally massive or spherical, and botryoidal. Cleavage, basal highly perfect; R perfect, and −2R imperfect; rather brittle and sectile. H.=3...3·5; G.=6·6...6·8. Tin-white, with a grayish or yellowish tarnish. B.B. easily fusible; on charcoal burns with a weak flame; volatilizes and forms a white deposit. Chem. com. antimony, with a little silver, iron, or arsenic. Andreasberg, Przibram, Sala, and Allemont.

400. Arsenic-Antimony.—Sb As^3.

Rhombohedric; spherical or reniform. H.=3·5; G.=6·1...6·2. Tin-white to lead-gray, and tarnished with brownish-black. B.B. gives out a strong smell of arsenic. Chem. com. 35·2 antimony and 64·8 arsenic; but the two metals are isomorphous, and form indefinite compounds. Allemont; also Przibram, Schladming, and Andreasberg.

401. Arsenic.—As.

Rhombohedric; R 85° 26′; 0R, R, −$\frac{1}{2}$R (fig. 235); usually fine granular, rarely columnar, botryoidal, or reniform. Cleavage, basal perfect, R and −$\frac{1}{2}$R imperfect; brittle. H.=3·5; G.=5·7...5·8. Whitish lead-gray, but in a few hours acquires a grayish-black tarnish.

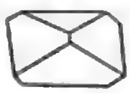


Fig. 235.

When broken or heated gives out arsenical odours. B.B. easily fusible, but on charcoal gives off dense white vapours, and may be wholly volatilized without fusing. Chem. com. arsenic, with some antimony, and traces of iron, silver, or gold. Andreasberg, Annaberg, Schneeberg, Marienberg, Freiberg, Joachimsthal, Kapnik, Orawitza, Allemont, St Marie aux Mines in Alsace, and Konigsberg; Tyndrum in Perthshire; also the Altai, North America, and Chili.

Arsenic-silver is a compound with silver; Kongsberg. *Arsenic-glance*, with 3 bismuth; H.=2; G.=5·36...5·39; dark lead-gray; takes fire at the flame of a candle, and burns; Marienberg. Arsenic is used in various pharmaceutical preparations and metallurgic processes.

402. Tellurium.—Te.

Rhombohedric; R 86° 57′; ∞R . 0R . R . −R; usually massive, and fine granular. Cleavage, ∞R perfect, basal imperfect; slightly sectile. H.=2...2·5; G.=6·1...6·3. Tin-white. B.B. very easily fusible; burns with a greenish flame and much smoke, which forms a white ring with a reddish margin on charcoal. In con. s. acid forms a bluish-red solution. Chem. com. tellurium, with a little gold or iron. Facebay in Siebenburg.

403. Lead.—Pb.

Tesseral, but only capillary, filiform, or in thin plates. Ductile and malleable. H.=1·5; G.=11·3...11·4. Bluish-gray with a blackish tarnish. B.B. very easily fusible; on charcoal volatilizes and forms a sulphur-yellow coating; soluble in nitric acid. In lava on Madeira; also near Bristol and Kenmare in Ireland; in meteoric iron from Chili.

404. Tin.—Sn.

This metal has not certainly been found native, though quoted from Cornwall. The fused metal crystallizes in regular octahedrons. That formed by galvanic action is described as tetragonal, with P 57° 13′.

*405. Bismuth.—Bi.

Rhombohedric; R 87° 40′. Crystals R . 0R, but often misshapen, also aborescent or reticulated; often massive and granular. Cleavage, −2 R 69° 28′, and basal perfect. Not malleable; very sectile. H.=2·5; G.=9·6...9·8. Reddish silver-white, often with a yellow, red, brown, or parti-colour tarnish. B.B. very easily fusible, even in the flame of a candle. On charcoal volatilizes, leaving a citron-yellow coating. Soluble in nitric acid. Chem. com. bismuth; sometimes with a little arsenic. Schneeberg, Annaberg, Marienberg, Joachimsthal; Bieber in Hanau; Wittichen; also Modum and Fahlun; near Redruth in Cornwall, Carrick-Fell in Cumberland, and Alva in Stirlingshire.

*406. Copper.—Cu.

Tesseral; O, ∞O∞, ∞O, ∞O2. Crystals small, and generally irregular and deformed. Macles united by a face of O. Often filiform and arborescent, or in plates and laminæ. Malleable and ductile. H.=2·5...3; G.=8·5...8·9. Copper-red, with yellow or brown tarnish. B.B. rather easily fusible, colouring the flame green; readily soluble in nitric acid. In large masses (200 tons) near Lake Superior, with native silver. Cornwall, near Redruth and the Lizard; Yell in Zetland, Chessy near Lyons, the Bannat, and Hungary; Faroe Islands, Siberia, China, Canada, Mexico, Brazil, and Chili.

*407. Iron.—Fe.

Tesseral; chiefly the octahedron. Cleavage hexahedral, but often mere traces; fracture hackly; malleable and ductile. H.=4·5; G.=7...7·8. Steel-gray or iron-black, often with a blackish tarnish. Very magnetic. B.B. infusible, or only in thin plates with a strong heat; soluble in h. acid. Two varieties are distinguished.

(*a*.) *Telluric Iron.*—In grains and plates, or disseminated. Almost pure iron, or contains carbon, graphite, lead, or copper, but not nickel. Said to occur at Gross Camsdorff, Oule in Dauphiné; in the gold sands of Brazil, the Ural and Olahpian; in veins in South Africa; also at Leadhills in Scotland, and in basalt in north of Ireland.

(*b*.) *Meteoric Iron.*—Steel-gray and silver-white; contains nickel, with cobalt, copper, and other substances. Polished and etched with nitric acid, the surface is marked by lines intersecting at 60° or 120°, named Widmanstadt's figures. Has fallen from the sky in very many countries. Siberia, Brazil, North America, South Africa, Hungary, Britain and Ireland.

Order VI.—SULPHURETTED METALS.

Crystallization often tesseral ($\frac{2}{5}$ths), rhombic ($\frac{1}{3}$d), or hexagonal and rhombohedric ($\frac{1}{5}$th), rarely other forms. H.=1...7; G.=3·4...9. Soluble in acids, and mostly B.B. easily fusible, many yielding fumes characteristic of sulphur, arsenic, or antimony. All (with one or two exceptions of blendes) are opaque, and show metallic lustre and colour. Are all compounds of sulphur, arsenic, or antimony with metals. Occur frequently in veins, more rarely disseminated in rocks.

Family I.—Pyrites.

Crystallization tesseral, rhombic, or hexagonal, one tetragonal. Brittle, except bornite. H.=3...6·5, the iron

pyrites being the harder, the copper ores the softer; G.= 4·1...8·1, but sulphur compounds = 4·1...5·3, arsenic or antimony 6...8·1, sulphur with arsenic or antimony 6...6·5. Colour mostly yellow, becoming lighter or more gray in those with less sulphur. They are all soluble in nitric acid; solutions generally coloured, and all fusible, and give out fumes.

**408. Pyrite, Iron Pyrites.—Fe$''$.

Tesseral, and dodecahedral-semitesseral. The cube $\infty O \infty$, then O, $\frac{\infty O2}{2}$ (fig. 236), and others (fig. 237), and macles (fig. 238). In druses or groups, spheroidal or reniform, and massive. Cleavage, hexahedral or octahedral very imperfect, or scarcely perceptible; brittle. H. = 6...6·5; G. = 4·9...5·2. Bronze-yellow, inclining to gold-yellow, often with a brown or rarely variegated tarnish; streak brownish-black. When broken emits a smell of sulphur. B.B. on charcoal burns

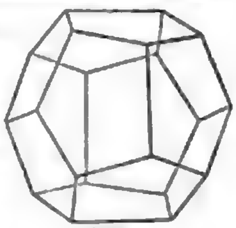


Fig. 236.

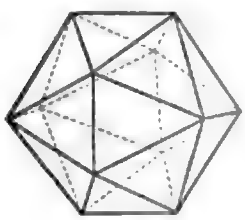


Fig. 237.

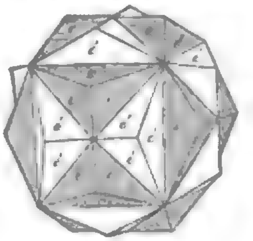


Fig. 238.

with a bluish flame, and a strong smell of sulphur. In the red. flame fuses to a blackish magnetic bead. Soluble in nitric acid with deposition of sulphur; scarcely affected by h. acid. Chem. com. 46·7 iron and 53·3 sulphur. Very often contains gold, silver, or silicium, the gold occasionally in visible grains. Common in rocks of all ages and classes. Fine varieties, Elba, Cornwall, Persberg, Traversella; also Alston Moor and Derbyshire. Auriferous pyrites, Beresof, Marmato, Mexico, Aedelfors in Sweden, and many parts of England and Scotland. Used for the manufacture of sulphur, sulphuric acid, and alum.

*409. Marcasite, White Iron Pyrites.—Fe$''$.

Rhombic; ∞P 106° 5', $\frac{1}{3}\breve{P}\infty$ 136° 54', $\breve{P}\infty$ 80° 20', $\bar{P}\infty$ 64° 52'. Crystals like figs. 193 and 158; tabular or thin prismatic, or pyramidal. Macles frequent; also cockscomb-like groups, or spherical, reniform, and stalactitic. Cleavage, ∞P indistinct, $\breve{P}\infty$ traces; fracture uneven; brittle. H.=6...6·5; G.=4·65...4·9. Pale, or grayish bronze-yellow, sometimes almost greenish-gray; streak dark greenish-gray or brownish-black. B.B. and with acids acts like pyrite. Varieties are:—*Radiated pyrites*, radiated, fibrous masses. *Spear pyrites*, macles, very fine at Littmitz, Przibram, Schemnitz, and Freiberg. *Hepatic pyrites*, or *Leberkies*, liver-brown, generally decomposing; Harz, Saxony, Sweden, Derbyshire, and Cornwall. *Cockscomb pyrites*, compound, comb-like crystals, often greenish, or with a brown tarnish; Derbyshire and the Harz. *Wasserkies* or *Hydrous pyrites* contains water; the *Kyrosite* copper and arsenic; *Lonchidite* also arsenic.

*410. Pyrrhotine, Magnetic Pyrites.—Fe', *or* Fe'^{5} $\overline{Fe}'''$.

Hexagonal; P126° 50'. Crystals 0P . ∞P, or with P (fig. 239) tabular or short prismatic, but rare. Commonly massive, granular, or compact. Cleavage, 8P imperfect, laminar structure along 0P; brittle. H. = 3·5...4·5; G.= 4·4...4·7. Colour between bronze-yellow and copper-red, with a pinchbeck-brown tarnish; streak grayish-black; more or less magnetic. Unaltered in the closed tube; in the open tube yields sulphurous fumes, but

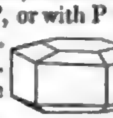


Fig. 239.

no sublimation. B.B. on charcoal on the red. flame fuses to a black strongly-magnetic globule; soluble in h. acid. Chem. com. 63·65 iron and 36·35 sulphur, or 60·44 iron and 39·56 sulphur, in some with 2 to 8 nickel. Bodenmais, Fahlun, Kongsberg, Andreasberg, Moel Elion and Llanrwst in Caernarvonshire, Cornwall, Appin in Argyleshire, and Vesuvius; also in some meteoric stones.

*411. Leucopyrite, Arsenical Pyrites, Lölingite. } Fe As, *or* Fe^4 As^3.

Rhombic; ∞P 122° 26', $\bar{P}\infty$ 51° 20', $\breve{P}\infty$ 86° 10'. Crystals ∞P . $\bar{P}\infty$ (fig. 240). Generally massive, granular, or columnar. Cleavage, basal rather perfect, $\breve{P}\infty$ imperfect; fracture uneven; brittle. H.=5...5·5; G.=7·0...7·4. Silver-white to steel-gray, with a darker tarnish; streak grayish-black. B.B. on charcoal emits a strong smell of arsenic, and fuses to a black magnetic globule. Chem. com. 27·2 iron and 72·8 arsenic, or 32·2 iron and 66·8 arsenic, but always 1·3 to 21 sulphur, and sometimes 13·4 nickel, and 5 cobalt. Reichenstein in Silesia; Schladming in Styria; Löling in Carinthia; Andreasberg, in the Harz, and Fossum in Norway. Used for the manufacture of arsenious acid.

Fig. 240.

*412. Mispickel.—Fe S^2 + Fe As.

Rhombic; ∞P 111° 12', $\frac{1}{4}\breve{P}\infty$ 146° 28', $\breve{P}\infty$ 79° 22', $\bar{P}\infty$ 59° 2'. Crystals ∞P . $\frac{1}{4}\breve{P}\infty$. Macles short prismatic or tabular; also massive, granular, or columnar. Cleavage, ∞P rather distinct; fracture uneven; brittle. H. =5·5...6; G.=6...6·2. Silver-white, almost steel-gray, with a grayish or yellowish tarnish; streak black. In the closed tube yields first a red then a brown sublimate of sulphuret of arsenic, and then metallic arsenic. B.B. on charcoal fuses to a black magnetic globule. Chem. com. 19·9 sulphur, 46·6 arsenic, and 33·5 iron, but some contain silver or gold, others 5 to 9 cobalt. Freiberg, Altenberg, Joachimsthal, Zinnwald, Schlackenwald, Andreasberg, Sweden, North America, and in many Cornish tin mines; Cobalt-mispickel, from Skutterud in Norway. *Danaite* and *Plinian* seem the same mineral. Used as an ore of arsenic or of silver.

*413. Cobaltine.—Co S^2 + Co As.

Tesseral and semitesseral, like pyrite; also massive or granular, disseminated. Cleavage, hexahedral perfect; brittle. H.=5·5; G.=6·0...6·3. Brilliant, silver-white, inclining to red, often with a grayish or yellowish tarnish; streak grayish-black. B.B. on charcoal fuses with strong smell of arsenic to a gray, weak magnetic globule; after roasting shows reaction for cobalt with borax. Chem. com. 35·9 cobalt (with 3·6 iron), 44·9 arsenic, and 19·2 sulphur. Skutterud in Norway, Tunaberg, Querbach in Silesia, Siegen, and St Just in Cornwall.

Glaukodote.—Rhombic like mispickel. Dark tin-white; streak black; with 11·9 iron, 24·8 cobalt. Huasco and Valparaiso in Chili, Orawitza.

*414. Smaltine.—Co As.

Tesseral; chiefly the cube and octahedron, the faces of the cube convex or cracked; also reticulated, reniform, or granular compact. Cleavage, traces along $\infty O \infty$ and O; fracture uneven; brittle. H.=5·5; G.=6·4...7·3. Tin-white or steel-gray, with a dark-gray or iridescent tarnish; streak grayish-black. Gives out an odour of arsenic when broken. In the closed tube gives no sublimate of arsenic. B.B. fuses easily, with a strong smell of arsenic, to a white or gray magnetic globule. Chem. com. 71·4 arsenic and 28·6 cobalt, but with 3 to 19 iron and 1 to 12 nickel; others 1 to 3 bismuth. Schneeberg, Annaberg, Riechelsdorf, Allemont in Dauphiné; Tunaberg in Sweden; Chatham in Connecticut; Huel Sparnon, Dolcoath, and Redruth in Cornwall. *Gray Smaltine* has 10 to 18 iron,

and G.=6·9 to 7·3. Smaltine and cobaltine are used in preparing blue colours for painting porcelain and stoneware.

415. MODUMITE, Skutterudite.—$Co^2 As^3$.

Tesseral; O and ∞O∞, or granular. Cleavage, hexahedral distinct; fracture conchoidal or uneven; brittle. H.=6; G.=6·74...6·84. Tin-white to pale lead-gray, sometimes with an iridescent tarnish. Lustre rather brilliant. In the closed tube it gives a sublimate of metallic arsenic; in other respects acts like smaltine. Chem. com. 79 arsenic, and 21 cobalt. Skutterud, near Modum in Norway.

416. LINNÉITE.—$(Ni', Co', Fe') + (\cancel{Ni}''', \cancel{Co}''', \cancel{Fe}''')$.

Tesseral; in octahedrons and cubes, or macled; also massive. Cleavage, hexahedral imperfect; brittle. H. =5·5; G.=4·9...5·0. Silver-white inclining to red, often with a yellowish tarnish; streak blackish-gray. B.B. on charcoal fuses in the red. flame to a gray magnetic globule, bronze-yellow when broken. Chem. com. 11 to 53 cobalt, 0 to 42·6 nickel, 2 to 5 iron, and 1 to 15 copper. Bastnæs in Sweden, and Müsen near Siegen.

417. SYEPOORITE.—Co′.

Massive. Steel-gray or yellowish. G.=5·45. Chem. com. 65·2 cobalt, and 34·8 sulphur. Syepoor near Rajpootanah in North-West India. The Indian jewellers use it to give a rose colour to gold.

418. GRUNAUITE, Saynite.

Tesseral; O and ∞O∞; also granular. Cleavage octahedral; brittle. H.=4·5; G.=5·14. Light steel-gray inclining to silver-white, with a yellow or grayish tarnish. B.B. fuses to a gray, brittle, magnetic bead, yellow on the fracture, and colours the support yellow. The solution in nitric acid is green. Chem. com. nickel, bismuth, sulphur, iron, cobalt, copper, lead, in variable proportions. Grünau in Sayn-Altenkirchen.

419. GERSDORFFITE.—$(Ni, Fe) As + (Ni, Fe) S^2$.

Tesseral; O, ∞O∞; usually granular. Cleavage, hexahedral rather perfect; fracture uneven; brittle. H.=5·5; G.=5·6...6·13 (6·64?) Silver-white to steel-gray, with a grayish tarnish. In the closed tube decrepitates violently B.B. fuses to a brittle, black, slag-like globule; partially soluble in nitric acid. Chem. com. 35·2 nickel (with 2·4 to 6 iron, 0 to 3 cobalt), 45·4 arsenic, and 19·4 sulphur; but others give different formula, with 10 to 15 iron and 14 cobalt. Harzgerode and Tanne, Schladming, Camsdorf, Loos in Helsingland, Sweden; also Spain and Brazil. Used as an ore of nickel.

Amoibite, *Tombazite*, and *Wodankies*, are similar.

420. ULLMANNITE.—$Ni\ Sb + Ni\ S^2$, *or* $Ni^3\ (Sb, As, S)^3$.

Tesseral; O, ∞O∞, ∞O; usually granular. Cleavage, hexahedral perfect; fracture uneven. H.=5...5·5; G.=6·2...6·5. Lead-gray to tin-white or steel-gray; with a grayish-black or iridescent tarnish. B.B. fuses with dense fumes, and slight odour of arsenic; soluble in con. nitric acid. Chem. com. 27·4 nickel, 57·5 antimony, and 15·1 sulphur, with 2 to 12 arsenic. Westerwald, Siegen, Harzgerode, and Lobenstein.

421. BREITHAUPTITE.—$Ni^2\ Sb$.

Hexagonal; P 112° 10′. Crystals, thin striated hexagonal tables of 0P . ∞P. H.=5; G.=7·54. Brilliant. Light copper-red, with violet-blue tarnish. B.B. fumes and fuses with great difficulty. Chem. com. 32·2 nickel, and 67·8 antimony, but mixed with 6 to 12 sulphuret of lead. Andreasberg.

422. NICKELINE, Copper Nickel.—$Ni^2\ As$.

Hexagonal; P 86° 50′. Crystals, ∞P, 0P (fig. 241), very rare and indistinct; also arborescent, reniform, or generally massive. Fracture conchoidal and uneven; brittle. H.=5·5; G.=7·5...7·7. Light copper-red, with a tarnish first gray then blackish. It forms no sublimate in the closed tube. B.B. fuses with strong fumes to a white, brittle, metallic globule. Chem. com. 43·6 nickel and 56·4 arsenic, but with 0 to 2 cobalt, 0·2 to 9 iron, 0·1 to 4 sulphur, and 0 to 29 antimony. Freiberg, Schneeberg, Joachimsthal, Andreasberg, Chatham in Connecticut, Pengelly and Huel Chance in Cornwall, and Leadhills in Scotland. Used as an ore of nickel.

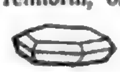


Fig. 241.

Plakodine is a furnace product, not a native mineral.

423. RAMMELSBERGITE, White Nickel.—Ni As.

Tesseral; O, ∞O∞, ∞O; also fine granular or compact. Fracture uneven; brittle. H.=5·5; G.=6·4...6·6. Tin-white, but first a gray, then a blackish tarnish, and loses its lustre. Yields an odour of arsenic when broken. In the closed tube forms a sublimate of metallic arsenic, and becomes copper-red. B.B. on charcoal fuses easily with much smoke, continues long ignited, becomes invested with crystals of arsenious acid, and leaves a brittle grain of metal. Chem. com. 28 nickel and 72 arsenic, but often with cobalt; and many smaltines belong to this species. Schneeberg, Riechelsdorf, Allemont.

424. CHLOANTHITE.—Ni As.

Rhombic; ∞P 123°...124°. G.=7·099...7·188. Colour tin-white, inclining to red on the fresh fracture. Otherwise like Rammelsbergite, with which it occurs. The names are sometimes transposed.

425. MILLERITE.—Ni′.

Rhombohedric; R 144° 8′, in fine acicular prisms of ∞P2 . R. Brittle. H.=3·5; G.=4·6, or 5·26, and 5·65. Brass or bronze-yellow, with a gray or iridescent tarnish. B.B. fuses easily to a blackish metallic globule, which boils and sputters. In nitro-chloric acid forms a green solution. Chem. com. 64·4 nickel and 35·6 sulphur. Johann-Georgenstadt, Joachimsthal, Przibram, Camsdorf, Riechelsdorf, near St Austle in Cornwall, and at Merthyr Tydvil.

426. INVERARITE, Eisennickelkies.—2 Fe′ + Ni′.

Tesseral; massive and granular. Fracture uneven; brittle. H.=3·5...4; G.=4·6. Light pinchbeck-brown, with darker streak. Not magnetic. B.B. acts in general like pyrrhotine; the roasted powder forms with borax in the red. flame a black opaque glass. Chem. com. 36 sulphur, 42 iron, and 22 nickel; but mixed with phyrrhotine and chalcopyrite. Lillehammer in Southern Norway, near Inverary in Scotland.

*427. CHALCOPYRITE, Yellow Copper Ore, Copper Pyrites. } $Cu' + Fe'$, *or* $\cancel{Cu}' + \cancel{Fe}'''$.

Tetragonal and sphenoidal-hemihedric; ½ P (*P*) with polar edges 71° 20′; P∞ (*b*), 2 P∞ (*c*) 126° 11′, 0P (*a*), P and ∞P∞. Crystals generally small and deformed (fig. 242); macles very common, like fig. 243. Most

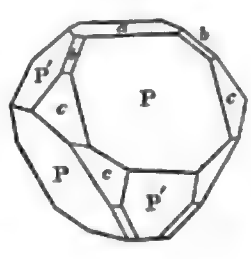


Fig. 242.

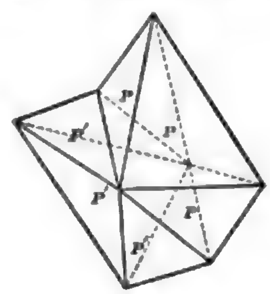


Fig. 243.

commonly compact and disseminated; also botryoidal and reniform. Cleavage, pyramidal 2 P∞ sometimes rather distinct; fracture conchoidal or uneven. H.=3·5...4; G.=4·1...4·3. Brass-yellow, often with a gold-yellow or iridescent (*peacock copper ore*) tarnish; streak greenish-black. B.B. on charcoal becomes darker or black, and on cooling red. Fuses easily to a steel-gray globule, which at length becomes magnetic, brittle, and grayish-red on the fractured surface. With borax and soda yields a grain of copper. Moistened with h. acid colours the flame blue.

Chem. com. essentially 1 atom copper, 1 atom iron, and 2 atoms sulphur, with 34·5 copper, 30·5 iron, and 35 sulphur. The most abundant ore of copper. Anglesea (Parys Mine), Derbyshire, Staffordshire, Cumberland; Wicklow in Ireland; also in the Cornish mines (Gunnis Lake and St Austle); in Scotland in Kirkcudbrightshire and Wigtownshire, Tyndrum in Perthshire, Inverness-shire, Zetland, and other places. Of foreign European localities, Fahlun, Roraas, Freiberg, Mansfeld, Goslar, Lauterberg, Musen, may be mentioned; also in Siberia, the United States, and Australia. The ores raised in Cornwall and Devon give 8 per cent. metal on the average; and that picked for sale at Redruth rarely yields 12, sometimes only 3 or 4 per cent. The richness of the ore may in general be judged of by the colour; if of a fine yellow hue, and yielding readily to the hammer, it may be considered a good ore; but if hard and pale yellow, it is assuredly a poor one, being mixed with iron pyrites. From pyrite it is distinguished by yielding readily to the knife, by its tarnish, and by soon forming a green solution in nitric acid.

Cuban.—$\bar{\mathrm{Cu}}'\,\bar{\mathrm{Fe}}''' + 2\,\mathrm{Fe}'$. Tesseral in cubes or massive, with a hexahedral cleavage. G.=4·02...4·04. B.B. very easily fusible, otherwise like chalcopyrite. Chem. com. 22·96 copper, 42·51 iron, and 34·78 sulphur. Bacaranao in Cuba.

*428. Bornite, Variegated or Purple Copper. $\bar{\mathrm{Cu}}'^{3}\,\bar{\mathrm{Fe}}'''$.

Tesseral. Crystals, $\infty O \infty$, and $\infty O \infty \,.\, O$, but rare, and generally rough or uneven; also macles. Mostly massive. Cleavage, octahedral very imperfect; fracture conchoidal or uneven; slightly brittle, or almost sectile. H.=3; G.=4·9...5·1. Colour between copper-red and pinchbeck-brown, with very pale tarnish, especially steel-blue, inclining to red and green; streak grayish-black. B.B. acts like chalcopyrite; soluble in con. h. acid, leaving sulphur. Chem. com. 3 atoms copper, 1 atom iron, and 3 atoms sulphur, with 55·6 copper, 16·4 iron, and 28 sulphur, but often, especially when compact, mixed, and then 56 to 71 copper, and 6 to 17 iron. Crystals near Redruth and St Day in Cornwall; massive at Killarney in Ireland; also Norway, Sweden, Mansfeld, Silesia, Tuscany, and Chili. An ore of copper.

429. Domeykite.—$\mathrm{Cu^6\,As}$.

Botryoidal, reniform, or massive. Fracture uneven or conchoidal; brittle. H.=3...3·5. Tin or silver white, inclining to yellow, with an iridescent tarnish. B.B. fuses easily with strong odour of arsenic; not affected by h. acid. Chem. com. 71·63 copper and 28·37 arsenic. Calabazo in Coquimbo and Copiapo in Chili.

Condurrite.—Massive, soft, and soils the fingers. Fracture flat conchoidal. Colour brownish or bluish black. G.=4·20...4·29. B.B. on charcoal fuses, with escape of arsenic vapours, to a globule, which, on cooling, cracks, swells, and falls to pieces. With soda and borax leaves a grain of copper. Seems an impure variety. Condurrow Mine and near Redruth in Cornwall.

430. Arseniuret of Manganese.—$\mathrm{Mn^2\,As}$.

Massive and botryoidal, granular or foliated. Fracture uneven; brittle. G.=5·55. Grayish-white, with a black tarnish. B.B. burns with a blue flame, and emits fumes of arsenic; soluble in nitro-chloric acid. Chem. com. 42·75 manganese, 57·25 arsenic, with trace of iron. Saxony.

Family II.—Lead Glance.

Crystallization, chiefly tesseral; also rhombic and rhombohedric. H.=1...2·5, rarely more; G.=4·6...8·9, and mostly 5·5, or higher. Colours generally lead-gray, and more or less dark. All soluble in acids. B.B. all fusible, and mostly very easily, and easily reduced. They are compounds with sulphur, arsenic, or selenium; known by their fumes. Chiefly occur in veins.

*431. Galena, Sulphuret of Lead.—Pb'.

Tesseral; $\infty O \infty$, ∞O; seldomer 2O, and 2O2. Crystals, $\infty O \infty \,.\, O$. Also massive and granular, compact, or laminar. Cleavage, hexahedral very perfect; fracture scarcely observable; sectile. H.=2·5; G.=7·2...7·6. Lead-gray, with darker, or rarely iridescent tarnish; streak grayish-black. B.B. decrepitates, fuses, and leaves a globule of lead; soluble in nitric acid. Chem. com. 86·7 lead, and 13·3 sulphur, but usually contains a little silver,—ranging from 1 to 3, or 5 parts in 10,000; rarely 1 per cent. or more. Some contain copper, zinc, or antimony, others selenium, and others (the *supersulphuret*) probably free sulphur (2 to 8 per cent.). Most common ore of lead in many countries. Cornwall, Derbyshire (Castletown), Wales, Cumberland, Alston Moor, Durham (Altonhead); Isle of Man; Leadhills, Pentland Hills, Linlithgow, Inverkeithing, Monaltrie, Strontian, Islay, and many other places in Scotland. In 1855 the produce was,—England, 66,265 tons; Wales, 18,204; Isle of Man, 3573; Ireland, 2005; and Scotland, 1587 tons.

432. Cuproplumbite.—$\bar{\mathrm{Cu}}'\,\mathrm{Pb}'^{2}$.

Tesseral; massive, with distinct hexahedral cleavage. Rather sectile and brittle. H.=2·5; G.=6·408...6·428. Blackish lead-gray; streak black. B.B. does not decrepitate; with soda gives a grain of metal. Chem. com. 65 lead, 19·9 copper, and 15·1 sulphur (with 0·5 silver). Chili.

433. Clausthalite.—Pb Se.

Tesseral; but massive and fine granular, with hexahedral cleavage. H.=2·5...3; G.=8·2...8·8. Lead-gray; streak gray. B.B. on charcoal fumes, smells of selenium, colours the flame blue, stains the support red, yellow, and white; and volatilizes, except a small remainder, without fusing. Chem. com. 72·7 lead (with 11·6 silver), and 27·3 selenium. Lerbach, Zorge and Tilkerode in the Harz.

Tilkerodite, with 3 cobalt; G.=7·7; colours borax glass smalt-blue. *Lehrbachite;* Lerbach and Tilkerode; with 17 to 45 mercury, seems a mixture.

434. Selencopperlead.—($\bar{\mathrm{Cu}}$, Pb) Se.

Massive and fine granular. Sectile. H.=2·5; G.=7...7·5. Light lead-gray inclining to brass-yellow, or with a bluish tarnish; streak darker. B.B. like clausthalite, only some fuse slightly on the surface, others easily forming a gray metallic mass. Chem. com. 30 to 35 selenium, 47 to 64 lead, and 4 to 16 copper (with 0 to 1·3 silver). Tilkerode, Zorge, and near Gabel in Thuringia.

435. Onofrite.—Hg Se + 4 Hg S.

Massive, and granular. H.=2·5. Blackish lead-gray or steel-gray; streak shining. In the closed tube wholly volatile with a black sublimate. With soda gives metallic mercury. Chem. com. 82·8 mercury, 6·6 selenium, and 10·6 sulphur. St Onofre in Mexico, Zorge in the Harz.

436. Tiemannite.—Hg Se, *or* $\mathrm{Hg^6\,Se^5}$.

Fine granular; brittle. H.=2·5; G.=7·1...7·4. Brilliant. Dark lead-gray. In the closed tube decrepitates, swells, fuses, and volatilizes to a black and brown deposit. Only soluble in nitro-chloric acid. Chem. com. 75 mercury, 25 selenium. Clausthal.

437. Naumannite.—Ag Se.

In thin plates and granular. Cleavage, hexahedral perfect. Malleable. H.=2·5; G.=8. Iron-black; splendent. B.B. on charcoal fuses; with soda a grain of silver; easily soluble in con. nitric acid. Chem. com. 73 silver and 27 selenium, with 4·91 lead. Tilkerode.

Silverphyllinglanz.—Massive, foliated; perfect cleavage; thin lamina flexible. H.=1...2; G.=5·8...5·9. Dark-gray. Chem. com. antimony, lead, tellurium, gold, and sulphur (*Plattner*). Deutsch-Pilsen in Hungary.

*438. Argentite, Sulphuret of Silver.—Ag'.

Tesseral; $\infty O \infty$, O, ∞O, and 2O2 (fig. 244). Crystals generally misshapen, with uneven or curved faces;

in druses, or linear groups; also arborescent, capillary, or in crusts. Cleavage, very indistinct traces along ∞O and ∞O∞; fracture uneven and hackly; malleable and flexible. H.=2...2·5; G.=7 ...7·4. Rarely brilliant; more so on the streak. Blackish lead-gray, often with a black, brown, or rarely iridescent tarnish. B.B. on charcoal fuses, intumesces greatly, and leaves a grain of silver; soluble in con. nitric acid. Chem. com. 87 silver, and 13 sulphur. Freiberg, Marienberg, Annaberg, Schneeberg, Johann-Georgenstadt; Joachimsthal; Schemnitz and Kremnitz; Kongsberg; Huel Duchy, Dolcoath, Herland, and near Callington, in Cornwall; Alva in Stirlingshire. Common ore at Guanaxuato and Zacatecas in Mexico, in Peru, and Blagodat in Siberia. Valuable ore of silver.

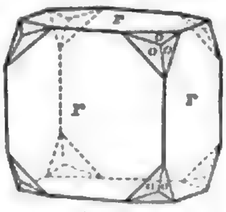


Fig. 244.

439. STROMEYERITE.—$\dot{C}u' + \dot{A}g'$.

Rhombic; isomorphous with redruthite. Crystals rare; usually massive, or in plates; fracture flat, conchoidal, or even; very sectile. H.=2·5...3; G.=6·2...6·3. Bright. Blackish lead-gray. B.B. fuses easily to a gray metallic semimalleable globule. Chem. com. 52·9 silver, 31·4 copper, and 15·7 sulphur, but often indeterminate proportions of silver 3 to 53, and copper 30 to 75. Schlangenberg in Siberia, Rudelstadt in Silesia, and Catemo in Chili. Ore of silver and copper.

*440. REDRUTHITE, Copper Glance.—$\dot{C}u'$.

Rhombic; ∞P (*o*) 119° 35′, P (*P*) middle-edge 125° 22′, ⅓P (*a*) middle-edge 65° 40′, 2P̄∞ (*d*) middle-edge 125° 40′, ⅔P̆∞ (*e*) middle-edge 65° 48′. Crystals 0P.(*s*) ∞P.(*o*) ∞P̆∞ (*p*), (fig. 245). Mostly thick tabular; also macles; and massive, in plates or lumps. Cleavage, ∞P imperfect; fracture conchoidal or uneven; very sectile. H.=2·5...3; G.=5·5...5·8. Rather dull; brighter on the streak. Blackish lead-gray, with a blue or other tarnish. B.B. colours the flame blue; on charcoal in the ox. flame sputters and fuses easily; in the red. flame becomes solid. With soda gives a grain of copper. Green solution in nitric acid. Chem. com. 79·8 copper, and 20·2 sulphur. Saxony, Silesia, Norway, the Bannat, Siberia, and the United States; near Redruth and Land's End in Cornwall; Fassnet Burn in Haddingtonshire, in Ayrshire, and in Fair Island, Orkney. Important copper ore.

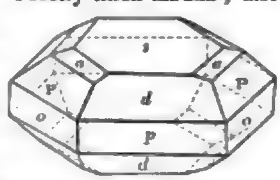


Fig. 245.

Digenite.—Massive. G.=4·568...4·680; in other respects like redruthite. Contains 70·20 copper, 29·56 sulphur, and 0·24 silver. Sangerhausen in Thuringia, and Chili.

441. KUPFERINDIG, Covelline.—$\dot{C}u'$.

Hexagonal. Crystals ∞P.0P rare; usually reniform, and fine granular. Cleavage, basal often very perfect; sectile, and thin laminæ flexible. H.=1·5...2; G.=3·8 ...3·85. Dull resinous, inclining to metallic. Indigo-blue, inclining to black; streak black. B.B. burns with a blue flame; on charcoal like redruthite, but remains fluid in the inner flame; soluble in nitric acid. Chem. com. 66·7 copper, and 33·3 sulphur. Vesuvius, Sangerhausen, Badenweiler, Schwarzwald; Kielce in Poland, Leogang in Salzburg, and Cairn Beg in Cornwall.

442. EUKAIRITE.—$Cu^2\,Se + Ag\,Se$.

Massive and fine granular. Soft (cuts with the knife). Lead-gray; streak shining. B.B. fuses to a brittle gray metallic grain. Chem. com. 43 silver, 25·2 copper, and 31·8 selenium. Skrickerum in Smoland.

443. BERZELINE.—$Cu^2\,Se$.

Crystalline, in thin dendritic crusts. Soft. Silver-white; streak shining. B.B. on charcoal fuses to a gray, slightly malleable bead. With soda a grain of copper. Chem. com. 61·5 copper and 38·5 selenium. Skrickerum in Sweden, Lerbach in the Harz.

444. NAGYAGITE, Black or Foliated Tellurium.

Tetragonal; P 137° 52′, P∞ 122° 50′, and 0P. Crystals tabular, but rare; in general thin plates or foliated. Cleavage, basal very perfect; very sectile; the thin laminæ flexible. H.=1...1·5; G.=6·85...7·2. Splendent. Blackish lead-gray. B.B. fuses easily, with white fumes, and forms a yellow deposit on the charcoal; with soda leaves a grain of gold; soluble in nitric acid, with residue of gold. Chem. com. 51 to 63 lead, 6·7 to 9 gold, 1 to 1·3 copper and silver, 13 to 32 tellurium, 3 to 12 sulphur, and 0 to 4·5 antimony. Nagyag in Siebenburg, and Offenbanya.

445. ALTAITE.—Pb Te.

Tesseral and granular; hexahedral cleavage. Fracture uneven; sectile. H.=3...3·5; G.=8·1...8·2. Tin-white inclining to yellow, with yellow tarnish. B.B. on charcoal colours the flame blue; in the red. flame fuses to a globule that almost wholly volatilizes. Chem. com. 61·9 lead with 1·28 silver, and 38·1 tellurium. Sawodinski mine in the Altai.

446. HESSITE.—Ag Te.

Massive and granular; slightly malleable. H.=2·5...3; G.=8·31...8·83. Blackish lead gray to steel-gray. B.B. on charcoal fumes, fuses to a black grain with white spots, and leaves a brittle grain of silver. Chem. com. 62·8 silver, and 37·2 tellurium, but some (*Petzite*) 0·7...18 gold. Sawodinski mine in the Altai, Nagyag in Siebenburg.

447. TETRADYMITE.—$2\,Bi\,Te^3 + Bi\,S^3$.

Rhombohedric; 3R 66° 40′. Crystals 3R.0R; almost always macles, with the faces of 0R at 95°; also granular foliated. Cleavage, basal very perfect; sectile, and in thin laminæ flexible. H.=1...2; G.=7·2...7·5. Dull. Tin-white to steel-gray. B.B. on charcoal fuses easily, occasionally with odour of selenium, staining the support yellow and white; at length yields a white grain of metal, almost entirely volatile; soluble in nitric acid. Chem. com. 59·66 bismuth, 35·86 tellurium, and 4·48 sulphur, with traces of selenium; but the tellurium and bismuth are isomorphous, and probably in indeterminate proportions, the sulphur and selenium not essential. Schubkau near Schemnitz, Deutsch-Pilsen in Hungary, San Jose in Brazil, Virginia and Carolina.

*448. MOLYBDENITE.—Mo''.

Hexagonal; but only tabular or short prismatic crystals of 0P.∞P or 0P.P. Generally scaly or curved foliated. Cleavage, basal very perfect; very sectile, and thin laminæ flexible. Feels greasy. H.=1...1·5; G.=4·6...4·9. Reddish lead-gray; makes a gray mark on paper, a greenish mark on porcelain. B.B. in the forceps colours the flame siskin-green, but is infusible. On charcoal yields sulphurous fumes, and forms a white coating, but burns slowly and imperfectly. In warm nitrochloric acid forms a greenish, in boiling sulphuric acid a blue solution. Chem. com. 59 molybdena and 41 sulphur. Arendal, Altenberg, Ehrenfriedersdorf, Zinnwald, Schlackenwald, Mont Blanc, Shutesbury in Massachusetts, in Maine, Haddam in Connecticut; Caldbeckfell in Cumberland, Shap in Westmoreland, Huel Gorland, and many Cornish mines; Peterhead, Corybuy on Loch Creran, and Glenelg. Readily distinguished from graphite by its streak, lustre, gravity, and action before the blowpipe. Used for preparing blue carmine for colouring porcelain.

FAMILY III.—GRAY ANTIMONY ORE.

Crystallization rhombic, rarely tesseral or hexagonal. H.=3...3·5, or less; G.=4...6·8 (sylvanite 8·1). Colour

steel or lead gray. All soluble in acids with precipitates; generally very easily fusible, even in the flame of a candle, and give out fumes.

*449. STIBINE, Antimonite.—Sb'''.

Rhombic; P polar edges 109° 16', and 108° 10', ∞P 90° 45'. Crystals ∞P (*m*) . ∞P̆∞ (*o*) . P (*P*), or with ⅓P̆∞ (*a*), 2 P̆ 2 (*b*), ⅔ P̆ 2 (*e*), ⅓ P (*s*), (fig. 246). Mostly long prismatic or acicular, with strong vertical striæ, often in druses, or stellar groups; also radiating, fibrous, or fine granular. Cleavage, brachydiagonal (*o*) highly perfect, and often horizontally striated; also basal, ∞P, and macrodiagonal imperfect; sectile. H.=2; G.=4·6...4·7. Brilliant. Lead-gray, with a blackish or iridescent tarnish. B.B. fuses easily, colouring the flame green, and volatilizes, leaving a white coating on the support; soluble in warm h. acid. Chem. com. 71·8 antimony and 28·2 sulphur. Near Freiberg in Saxony, Wolfsberg in the Harz, Przibram, Felsöbanya, Kremnitz, Schemnitz, Auvergne, Spain, and North and South America; St Stephen's, Padstow, and Endellion in Cornwall; Glendinning in Dumfriesshire, New Cumnock in Ayrshire, and in Banffshire. Chief ore of antimony.

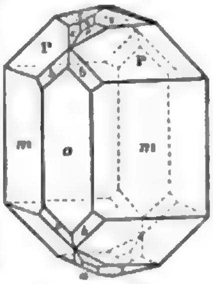


Fig. 246.

450. JAMESONITE.—$Pb'^3+Sb'''^2$.

Rhombic; ∞P 101° 20'. Crystals ∞P . ∞P̆ ∞, long prismatic, parallel or radiating. Cleavage, basal very perfect, ∞ P and brachydiagonal imperfect; sectile. H.=2...2·5; G.=5·5...5·7. Steel-gray to dark lead-gray. B.B. decrepitates, fuses easily, and wholly volatilizes, except a small slag; soluble in warm h. acid. Chem. com. 44·6 lead, with 2 to 4 iron, 34·8 antimony, and 20·6 sulphur. Cornwall, Estremadura, Hungary, Siberia, and Brazil.

451. ZINCKENITE.—$Pb'\,Sb''$.

Rhombic; ∞P 120° 39', P̆∞ 150° 36'. Crystals, prismatic or acicular, vertically striated, and macled in threes. Cleavage, prismatic very imperfect; fracture uneven; rather sectile. H.=3...3·5; G.=5·30...5·35. Dark steel-gray to lead-gray, with a steel-blue or iridescent tarnish. B.B. decrepitates violently, fuses, emits fumes of antimony, and wholly volatilizes, except a small remainder; soluble in warm h. acid. Chem. com. 35·9 lead, 42 antimony, 22·1 sulphur, with 0·42 copper. Wolfsberg in the Harz.

452. PLAGIONITE.—$Pb'^4\,Sb'''^3$.

Monoclinohedric; C=72° 28', P 134° 30' and 142° 3' −2 P 120° 49'. Crystals thick tabular, minute, and in druses. Cleavage, −2 P rather perfect; brittle. H.=2·5; G.=5·4. Blackish lead-gray. B.B. decrepitates violently, fuses easily, sinking into the charcoal, and leaves metallic lead. Chem. com. 42 lead, 37 antimony, and 21 sulphur. Wolfsberg in the Harz.

453. BOULANGERITE.—$Pb'^3\,Sb'''^2$.

Fine granular, columnar, radiating, or fibrous. Slightly sectile. H.=3; G.=5·8...6. Silky, metallic. Blackish lead-gray, with darker streak. B.B. fuses easily, forming a coating of protoxide of lead; soluble in warm h. acid. Chem. com. 55·4 lead, 25·9 antimony, and 18·7 sulphur. Molières in France, Ober-Lahr, Lapland, and Siberia. *Plumbostib*, with arsenic, and *Embrithite*, seem varieties; Nertschinsk.

454. GEOKRONITE.—$Pb'^3\,(Sb''', As''')$.

Rhombic; P polar edges 153° and 64° 45', ∞P̆ 2=119° 44', mostly massive, or lamellar. Cleavage, ∞P̆ 2; fracture conchoidal or even; sectile. H.=2...3; G.=6·45...6·54. Pale lead-gray, with a slight tarnish. B.B. fuses easily and volatilizes. Chem. com. 67 lead, with 1 to 2 copper and iron, 16 antimony, with 4·7 arsenic, and 17 sulphur. Sala in Sweden, Mérédo in Spain, and near Pietro-santo in Tuscany. *Kilbrickenite*, massive, granular, or foliated; County Clare in Ireland.

455. STEINMANNITE.—Pb', Sb'''.

Tesseral; O; also botryoidal and reniform. Cleavage, hexahedral rather imperfect; sectile. H.=2·5; G.=6·833. Lead-gray. B.B. decrepitates violently; on charcoal fuses readily, leaving lead and silver. Przibram.

456. PLUMOSITE, Feather Ore.—$Pb'^2\,Sb'''$.

Rhombic (?); acicular or capillary, in felt-like masses. H.=1...3; G.=5·7...5·9. Dull or glimmering. Dark-lead or steel-gray, sometimes iridescent. B.B. and with acids acts like zinckenite; fuses even in the flame of a candle. Chem. com. 51·8 lead, 29·7 antimony, and 19·5 sulphur. Wolfsberg, Andreasberg, and Clausthal; Neudorf in Anhalt, Freiberg, and Schemnitz.

457. ENARGITE.—$3\,Cu'^3+As.''$

Rhombic; ∞ P 97° 53', P∞ 100° 58', mostly massive and granular. Cleavage, ∞P perfect, brachy- and macro-diagonal less so; brittle. H.=3; G.=4·43...4·45. Iron-black. In the closed tube yields first sulphur, then fuses and gives out sulphuretted arsenic. B.B. with borax, gives a bead of copper. Chem. com. 48·3 copper, 19·1 arsenic, and 32·6 sulphur. Morocacha in Peru.

458. DUFRENOYSITE.—$\cancel{C}u'^3\,As''+Cu'^2\,As''$.

Tesseral. Crystals ∞O . 2O2. Fracture uneven; brittle. H.=2...3; G.=4·48. Steel-gray; streak reddish-brown. In the closed tube gives a reddish-brown sublimate. B.B. fuses easily, leaving a grain of copper readily soluble in warm acid. Chem. com. 38·4 copper, 2·8 lead, 1·3 silver, 30·5 arsenic, and 27 sulphur. Binnenthal, St Gotthardt.

459. SKLEROKLASE.—$Pb'^2\,As'''$.

Rhombic; P̆∞ 115° 16', P̆∞ : P̄ ∞ =134° 59'. Crystals broad prismatic, acicular or fibrous; very brittle and friable. G.=5·39...5·55. Bright metallic. Pale lead-gray, steel-gray, and iron-black; streak reddish-brown. Chem. com. 57·12 lead, 20·74 arsenic, 22·14 sulphur, with traces of silver, copper, and iron. St Gotthardt, with Dufrenoysite, for which it was analyzed.

460. WOLFSBERGITE.—$\cancel{C}u'\,Sb'''$.

Rhombic; ∞P 135° 12', ∞P̆2 111°. Crystals tabular; also fine granular. Cleavage, brachydiagonal very perfect, basal imperfect; fracture conchoidal or uneven. H.=3·5; G.=4·748. Lead-gray to iron-black, sometimes iridescent; streak black, dull. B.B. decrepitates, fuses easily, and with soda gives a grain of copper. Chem. com. 25·4 copper, 49 antimony, and 25·6 sulphur. Wolfsberg in the Harz.

461. BERTHIERITE.—Fe', Sb'''.

Massive; columnar or fibrous, with indistinct cleavage. H.=2...3; G.=4·0...4·3. Dark steel-gray, yellowish or reddish; easily tarnished. B.B. on charcoal fuses easily, with fumes of antimony, to a black magnetic slag; soluble in h. acid. Chem. com. sulphurets of iron and antimony in variable proportions, or 9·8 to 16 iron, 52 to 61·6 antimony, and 29·1 to 31 sulphur. Auvergne and Anglar in France, Bräunsdorf in Saxony, Tintagel and Padstow in Cornwall. In France used as an ore of antimony.

462. BISMUTHINE—Bi''.

Rhombic; ∞P 91° 30'. Crystals long prismatic or acicular, with strong striæ; also granular or columnar, foliated or radiated. Cleavage, brachydiagonal perfect, macrodiagonal less distinct; sectile. H.=2...2·5; G.=6·4...6·6. Light lead-gray to tin-white, with a yellowish or iridescent tarnish. B.B. on charcoal fuses easily in the inner flame, sputters, and yields a yellow coating with a grain of bismuth; soluble in nitric acid. Chem. com. 81·2 bismuth and 18·8 sulphur. Riddarhyttan, Bastnaes, Johann-Georgenstadt, Altenberg, Joachimsthal; Haddam in Connecticut; near Redruth, Botallack, Dolcoath, and Herland in Cornwall, and Caldbeckfell in Cumberland.

Mineralogy.

463. Aciculite, Needle-ore.—$\mathrm{Pb'^4\,Bi''' + \cancel{C}u'^2\,Bi'''}$.

Rhombic; long thin crystals imbedded in quartz, often bent or broken, with strong vertical striæ. Cleavage imperfect; fracture conchoidal or uneven; rather brittle. H.=2·5; G.=6·7...6·8. Blackish lead-gray or steel-gray, with a brownish tarnish. B.B. fuses very easily, smokes, stains the charcoal white and yellow, and leaves a metallic globule; soluble in nitric acid. Chem. com. 35·8 lead, 11 copper, 36·7 bismuth, and 16·5 sulphur. Beresof in Siberia.

464. Kobellite.—$\mathrm{3\,Pb'^3\,Bi''' + Fe'^3\,Sb'''^3}$.

Radiated columnar; soft. G.=6·29...6·32. Blackish lead-gray to steel-gray; streak black. B.B. fuses (at first boiling, then quietly), and stains the charcoal white and yellow, and leaves a white grain of metal; soluble in con. h. acid, evolving sulphuretted hydrogen. Chem. com. 46 sulphuret of lead, 33·3 sulphuret of bismuth, 5·7 sulphuret of iron, and 15 sulphuret of antimony. Hvena in Nerike, Sweden.

465. Silvanite.—$\mathrm{Ag\ Te^4 + Au\ Te^3}$.

Rhombic; crystals generally small, short acicular, and often grouped in rows like letters. Cleavage in two directions, one very perfect; sectile, but friable. H.=1·5...2; G.=7·99...8·33. Steel-gray to tin-white, silver-white, and pale bronze-yellow. B.B. on charcoal forms a white coating, and fuses to a dark-gray globule, with soda reduced to a malleable grain of argentiferous gold; soluble in nitrochloric acid, depositing chloride of silver; and in nitric acid, leaving gold. Chem. com. 59·6 tellurium, with 0·5 to 8·5 antimony, 26·5 gold (in some 30), and 13·9 silver, with 0·2 to 19·5 lead. Offenbanya (*Graphic Tellurium*), Nagyag (*Yellow Tellurium*).

Family IV.—Gray Copper Ore.

Crystallization rhombic and tesseral. H.=1...4, the ores of copper being above 3, the ores of silver below 3; G.=4·2...6·3. Colour steel or lead-gray, in a few inclining to black or brown. All soluble in nitric acid. B.B. fusible, often easily, with fumes of sulphur or arsenic. Mostly sulphurets of copper and silver, with sulphurets of arsenic or antimony.

*466. Fahlore, Gray Copper. $\mathrm{(\cancel{C}u', Ag', Fe', Zn', Hy')^4\,(Sb''', As''')}$.

Tesseral and tetrahedral. In crystals $\frac{O}{2}, -\frac{O}{2}, \infty O, \frac{2O2}{2}$ (fig. 247, and figs. 19, 20). Macles (fig. 248), not uncommon; most abundant massive and disseminated. Cleavage,

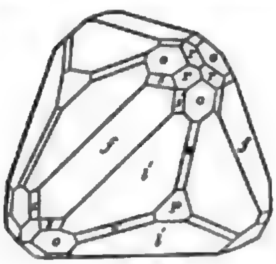


Fig. 247.

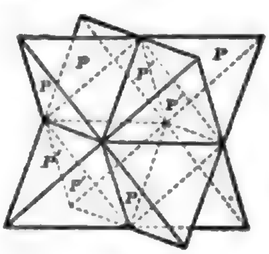


Fig. 248.

octahedral imperfect, with traces in other directions; fracture conchoidal, uneven, or fine granular; brittle. H.=3...4; G.=4·5...5·2. Steel-gray to iron-black; streak black (dark-red when containing zinc). B.B. on charcoal boils slightly, and fuses to a steel-gray slag, usually magnetic, and with soda gives copper. In nitric acid the powder forms a brownish-green solution. Chem. com. very variable; but 15 to 40 copper, 0 to 31 silver, 1 to 6 iron, 1 to 7 zinc, 0 to 7·5 mercury, 12 to 29 antimony, 0 to 10 arsenic, and 23 to 27 sulphur; those with much arsenic are paler coloured; those with little or no arsenic dark-coloured; those with 17 to 31 silver are the silver fahlore (Freiberg). Harz, Müsen, Freiberg, Camsdorf, Alsace, Kremnitz, Kapnik; Crinnis and other Cornish mines near St Austle; Airthrie near Stirling, and Sandlodge in Zetland. Ore of copper and silver.

467. Tennantite.—$\mathrm{(\cancel{C}u', Fe')\,As'''}$.

Tesseral; like fahlore. Cleavage, ∞O very imperfect; brittle. H.=4; G.=4·3...4·5. Blackish lead-gray to iron-black; streak dark reddish-gray. B.B. decrepitates, burns with a bluish flame and odour of arsenic, and fuses to a magnetic slag. Chem. com. 49 copper, 4 iron, 19 arsenic, and 28 sulphur. Redruth and St Day, Cornwall, and Skutterud. *Copperblende*, with brownish-red streak; G.=4·8; contains 8·9 zinc; Freiberg.

468. Bournonite.—$\mathrm{Pb'^4\,Sb''' + \cancel{C}u'^2\,Sb'''}$.

Rhombic; ∞P (*d*) 93° 40′, $\breve{P}\infty$ (*n*) 96° 13′, $\bar{P}\infty$ (*e*) 92° 34′, 0P (*r*), $\infty\breve{P}\infty$ (*s*), $\infty\bar{P}\infty$ (*k*), as in fig. 249. Crystals generally thick tabular, very often macled by a face of ∞P, and several times repeated; also granular or disseminated. Cleavage, brachydiagonal imperfect, traces in other directions; fracture uneven to conchoidal; rather brittle. H.=2·5...3; G.=5·7...5·9. Lustre brilliant metallic. Steel-gray, inclining to lead-gray and iron-black. B.B. usually decrepitates and fuses easily to a black globule, staining the charcoal first white, then yellow, and with soda leaves a grain of copper. In nitric acid a blue solution. Chem. com. 41·8 lead, 12·9 copper, 26 antimony, and 19·3 sulphur. Harz (Neudorf), Bräunsdorf, Kapnik, Servoz, Alais and Pontgibaud, Redruth and Beeralston.

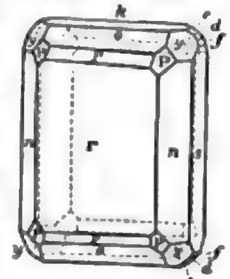


Fig. 249.

469. Wölchite.—$\mathrm{Cu'^4\,Sb''' + Pb'^3\,As'''}$ (?).

Rhombic; in short prisms. Cleavage, brachydiagonal rather distinct; fracture imperfect conchoidal; brittle. H.=3; G.=5·7...5·8. Blackish lead-gray. B.B. on charcoal fuses with effervescence to a lead-gray metallic grain. Chem. com. 29·90 lead, 17·35 copper, 1·40 iron, 16·65 antimony, 6·04 arsenic, and 28·60 sulphur. Wölch, near St Gertraud, Carinthia.

470. Freieslebenite.—$\mathrm{Ag'^3\,Sb''' + Pb'^3\,Sb'''}$.

Monoclinohedric; C=87° 46′; ∞P 119° 12′, $P\infty$ 131° 41′, in prisms with curved reed-like faces and strong vertical striæ. Macles intersecting; also massive. Cleavage, ∞P perfect; fracture conchoidal or uneven; rather brittle. H.=2...2·5; G.=6·2...6·4. Steel-gray to dark lead-gray; streak the same. B.B. on charcoal fuses to a grain of silver. Chem. com. 22·5 silver, 32·4 lead with copper, 26·8 antimony, and 18·3 sulphur. Rare. Freiberg in Saxony; also Kapnik and Ratiborschitz (?).

471. Stephanite.—$\mathrm{Ag'^6\,Sb'''}$.

Rhombic; ∞P (*o*) 115° 39′, P (*P*) middle edge 104° 20′, 2 $\breve{P}\infty$ (*d*) middle edge 107° 48′, 0P (*s*), $\infty\breve{P}\infty$ (*p*), (fig. 250), thick tabular or short prismatic. Macles frequent, repeated three or four times; also massive. Cleavage (*d* and *p*), both imperfect; fracture conchoidal or uneven; sectile. H.=2...2·5; G.=6·2...6·3. Iron-black to blackish lead-gray, rarely iridescent. B.B. on charcoal (odour of arsenic) fuses to a dark-gray globule; with soda, a grain of silver. Chem. com. 70·9 silver, 13·5 antimony, and 15·6 sulphur, but with 0 to 5 iron, or 0·5 to 4 copper, and 0 to 3·3 arsenic. Freiberg, Schneeberg, Johann-Georgenstadt, and Annaberg; Joachimsthal and Przibram, Schemnitz, the

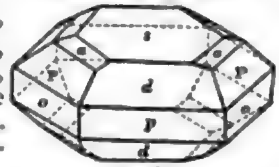


Fig. 250.

Harz, Mexico, Peru, Siberia, and Cornwall. Valuable ore of silver.

472. POLYBASITE.—$(Ag', Cu')^9 (Sb''', As''')$.

Hexagonal; P 117°. Crystals 0P . ∞P and 0P . P, tabular, and often very thin; also massive. Cleavage, basal imperfect; sectile, and easily frangible. H.=2...2·5; G.=6·0...6·25. Iron-black. B.B. decrepitates slightly and fuses very easily. Chem. com. 64 to 72 silver, 3 to 10 copper, 16 to 17 sulphur, 0·2 to 8 antimony, and 1 to 6 arsenic. Freiberg, Joachimsthal, Schemnitz, and Guanaxuato. An ore of silver.

473. STERNBERGITE.—$Ag' + 2\,Fe'''$ (?).

Rhombic; P middle edge 118°, section (*or* ∞P) 119° 30′. Crystals usually thin tabular, in macles or in fan-like and spheroidal groups. Cleavage, basal very perfect; sectile, and flexible in thin laminæ. H.=1...1·5; G.=4·2...4·25. Dark pinchbeck-brown, often a violet-blue tarnish; streak black. B.B. on charcoal fuses to a magnetic globule covered with silver, with borax, a grain of silver; decomposed by nitrochloric acid. Zippe found 33·2 silver, 36 iron, and 30 sulphur; or nearly 1 atom silver, 4 iron, and 6 sulphur. Joachimsthal, Schneeberg and Johann-Georgenstadt.

Flexible Sulphuret of Silver is identical; Hungary and Freiberg.

474. STANNINE, Tin Pyrites.—$Cu'^2 Sn'' + (Fe', Zn)^2 Sn''$.

Tesseral; in cubes very rare, generally massive and granular. Cleavage, hexahedral very imperfect; fracture uneven or small conchoidal; brittle. H.=4; G.=4·3...4·5. Steel-gray (yellowish from copper pyrites); streak black. B.B. on charcoal fuses, forming round the assay a white coating; with soda, a grain of copper; easily decomposed by nitric acid, leaving tin peroxide and sulphur; the solution is blue. Chem. com. 26 to 32 tin, 24 to 30 copper, 5 to 12 iron, 2 to 10 zinc, and 30 sulphur. Huel Rock near St Agnes, St Michael's Mount, and Carn Brea, Cornwall; and Zinnwald. Bell-metal ore.

475. WITTICHITE, Cupreous Bismuth,—$Cu'^3 Bi'''$.

Rhombic (?); massive. Cleavage, vertical distinct; fracture uneven and fine granular; sectile. H.=3·5; G.=5. Steel-gray, pale lead-gray tarnish; streak black. B.B. fuses very readily, frothes, and stains the charcoal yellow; with soda, a grain of copper. Chem. com. 38·5 copper, 42 bismuth, and 19·5 sulphur. Wittichen in Schwarzwald, Huel Buller in Cornwall.

476. BISMUTHIC SILVER.

Acicular, capillary, or massive; sectile and soft. Pale lead-gray, darker tarnish. B.B. fuses easily, and forms a large deposit on the charcoal. Klaproth found 33 lead, 27 bismuth, 15 silver, 4·3 iron, 0·9 copper, and 16·3 sulphur. Schapbach Valley in Baden.

FAMILY V.—BLENDES.

Crystallization mostly tesseral; cleavage distinct. H.=3·5...4·5; G.=3·5...4·9. Lustre adamantine or resinous; more or less *translucent*. Colours and streak red, yellow, brown, or black. All soluble in acids. B.B. often decrepitate, but fuse with difficulty.

*477. BLENDE, Zinc-blende.—Zn'.

Tesseral and tetrahedral; $\frac{O}{2}, -\frac{O}{2}$ (sometimes as O), ∞O, $\frac{3O3}{2}$ and ∞O∞. Macles remarkably common, united by a face of O (fig. 251) and several times repeated; frequently massive and granular. Cleavage, ∞O very perfect; very brittle. H.=3·5...4; G.=3·9...4·2. Semitransparent to opaque; adamantine and resinous. Brown or black, also red, yellow, and green. B.B. decrepitates often violently, but only fuses on very thin edges; soluble in con. nitric acid, leaving sulphur. Chem. com. 66·8 zinc and 33·2 sulphur, but generally with 1 to 15 iron, 0 to 3 cadmium. Very abundant, the Harz, Freiberg, Przibram, Schemnitz, Kapnik, North America, Peru, Cornwall, Derbyshire, Cumberland, Leadhills, and Stotfield, near Elgin. Used as an ore of zinc, but with little success.

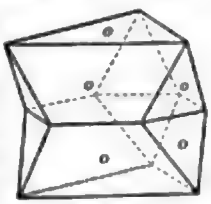


Fig. 251.

478. VOLTZINE.—$4\,Zn' + \dot{Z}n$.

Hemispherical, curved-lamellar incrustations. Fracture conchoidal. H.=4·5; G.=3·66. Brick-red to yellow or brown. Opaque or semitranslucent; vitreo-resinous; pearly. B.B. like zinc-blende; soluble in h. acid. Chem. com. 82·8 sulphuret and 17·2 oxide of zinc. Pontgibaud in Auvergne, and Joachimsthal.

479. ALABANDINE.—Mn'.

Tesseral; O and ∞O∞; usually massive and granular. Cleavage, hexahedral perfect; fracture uneven; rather brittle. H.=3·5...4; G.=3·9...4. Opaque; semimetallic. Iron-black to dark steel-gray, brownish-black tarnish; streak dark green. B.B. fuses on thin edges to a brown slag; soluble in h. acid. Chem. com. 63·6 manganese and 36·4 sulphur. Nagyag and Kapnik, Mexico and Brazil.

480. HAUERITE.—Mn''.

Tesseral; O, ∞O∞, and ∞O. Crystals single or in spherical groups. Cleavage, hexahedral perfect. H.=4; G.=3·463. Semitranslucent on very thin edges; metallic-adamantine. Reddish-brown to brownish-black; streak brownish-red. In the closed tube yields sulphur, and leaves a green mass, which B.B. becomes brown on the surface, and is soluble in h. acid. Chem. com. 46·28 manganese and 53·72 sulphur. Kalinka, near Neusohl in Hungary.

481. GREENOCKITE.—Cd'.

Hexagonal and hemimorphic; P 87° 13′, 2P 124° 34′. Crystals 2P . 0P . ∞P . P, or P . 2P . ∞P; attached singly. Cleavage, ∞P imperfect, basal perfect. H.=3...3·5; G.=4·8...4·9. Translucent; brilliant resinous, or adamantine. Honey or orange-yellow, rarely brown; streak yellow. B.B. decrepitates and becomes carmine-red, but again yellow when cold; fused with soda forms a reddish-brown coating on charcoal; soluble in h. acid. Chem. com. 77·6 cadmium, and 22·4 sulphur. Bishoptown in Renfrewshire.

FAMILY VI.—RUBY-BLENDES.

Crystallization rhombohedric, monoclinohedric, or rhombic. Cleavage rarely distinct. H.=1·5...2·5; G.=3·5...8·2. Lustre adamantine. Colour yellow, red or gray; streak deep red, rarely brownish or yellow. Soluble in nitric acid. B.B. fusible and reduced often with fumes, or sublime.

*482. PYRARGYRITE, Red Silver.—$Ag'^3 Sb'''$.

Rhombohedric; R (*P*) 108° 42′, $-\frac{1}{2}$R 137° 58′, 0R, −2R (*r*), R³, ∞P2 (*s*), and ∞R (*l*). Crystals prismatic (figs. 252, 253); macles common of various kinds; also massive, dendritic, or investing. Cleavage, R rather perfect; fracture conchoidal to uneven and splintery; slightly sectile, sometimes almost brittle. H.=2...2·5; G.=5·75...5·85. Translucent on the edges to opaque; crimson-red to blackish lead-gray; streak cochineal to cherry-red. B.B. on charcoal

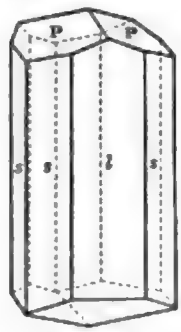


Fig. 252.

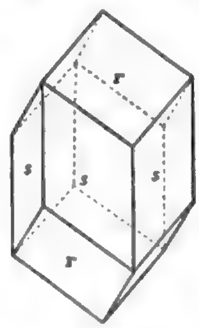


Fig. 253.

fuses easily, gives out sulphurous acid and antimony fumes, and leaves a grain of silver; soluble in nitric acid, leaving sulphur and antimony protoxide; solution of potash extracts sulphuret of antimony. Chem. com. 59·8 silver, 22·5 antimony and 17·7 sulphur. Andreasberg, Freiberg, Johann-Georgenstadt, Annaberg, Schneeberg, and Marienberg; Przibram, Schemnitz and Kremnitz, Markirchen, Kongsberg and Mexico; Huel Brothers and Huel Duchy in Cornwall.

483. PROUSTITE.—$Ag'^3\ As'''$.

Rhombohedric, like pyrargyrite, except R, 107° 50′. G. 5·5…5·6. Semitransparent to translucent on the edges. Cochineal to crimson red; streak aurora-red to cochineal-red. B.B. arsenical odour, and leaves a brittle metallic grain difficultly reduced to pure silver; soluble in nitric acid, with remainder of sulphur and arsenious acid; solution of potash extracts sulphuret of arsenic. Chem. com. 65·4 silver, 15·1 arsenic, and 19·4 sulphur. In the same localities with pyrargyrite, and both valuable ores of silver. Red orpiment has a lower specific gravity and yellow streak; cinnabar volatilizes before the blowpipe.

484. MIARGYRITE.—$Ag'\ Sb'''$.

Monoclinohedric; C=81° 36′, P 90° 53′, −P 95° 59′. Crystals pyramidal, short prismatic, or tabular (fig. 254); also massive. Cleavage, indistinct traces; fracture imperfect conchoidal or uneven; sectile. H.=2…2·5; G.=5·3…4. Opaque; thin splinters dark blood-red, translucent; metallic adamantine. Blackish lead-gray to iron-black and steel-gray; streak cherry-red. B.B. with soda, a grain of silver; with acids, like pyrargyrite. Chem. com. 35·9 silver, 42·9 antimony, and 21·2 sulphur. Bräunsdorf near Freiberg.

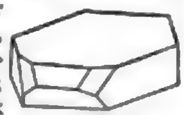


Fig. 254.

Rittingerite.—Monoclinohedric; C=88° 26′, ∞P 126° 18′. Crystals small tabular. Cleavage basal imperfect; brittle. H.=2·5…3. Translucent honey-yellow to red. Colour iron-black, on 0P brown tarnished; streak orange-yellow. B.B. melts easily, with arsenic fumes, leaving much silver. Joachimsthal.

485. XANTHOKON.—$Ag'^3\ As''' + Ag'^3\ As^{\ddot{\ddot{}}}$.

Rhombohedric. Crystals very thin hexagonal tables, with R : 0R 110° 30′, —2R : 0R 100° 35′. Cleavage, R and 0R more or less perfect; rather brittle, very easily frangible. H.=2…2·5; G.=5·0…5·2. Translucent and transparent; adamantine. Orange-yellow or yellowish-brown; streak slightly darker. In the closed tube fuses very easily, becomes lead-gray. Chem. com. 63·4 silver, 14·7 arsenic, and 21·9 sulphur. Himmelsfürst Mine at Freiberg.

Fireblende.—In thin tabular crystals (like heulandite), with one perfect cleavage; sectile and slightly flexible. G.=4·2…4·3. Hyacinth-red. B.B. like pyrargyrite. Contains sulphur, antimony, and silver. Freiberg and Andreasberg.

486. KERMES.—$Sb'''^2\ \dddot{Sb}$.

Monoclinohedric (?). Crystals acicular, capillary, and diverging; also radiating fibrous. Cleavage, very perfect along the axis of the crystals, less perfect at right angles; sectile. H.=1…1·5; G.=4·5…4·6. Semitranslucent; adamantine. Cherry-red; streak similar. B.B. acts like stibine; soluble in h. acid; in solution of potash the powder becomes yellow and dissolves. Chem. com. 75·3 antimony, 19·8 sulphur, and 4·9 oxygen; or 70 sulphuret and 30 protoxide of antimony. Bräunsdorf near Freiberg, Przibram, and Allemont.

Zundererz, or Tinder-ore, soft, flexible, tinder-like masses, dirty cherry-red or blackish-red, is a mixture; Andreasberg.

487. CINNABAR.—Hg'.

Rhombohedric; R 71° 48,′ 0R ⅓R, ⅔R, ∞R. Crystals rhombohedric or thick tabular; also disseminated and granular, compact, or earthy. Cleavage, ∞R rather perfect; fracture uneven and splintery; sectile. H.=2…2·5; G.=8…8·2. Semitransparent or opaque; adamantine. Cochineal-red, with lead-gray and scarlet-red tarnish; streak scarlet-red. In the open tube sublimes, partly as cinnabar, partly as metallic mercury; perfectly soluble in nitrochloric acid, but not in hydrochloric acid, nitric acid, or solution of potash. Chem. com. 86·2 mercury and 13·8 sulphur. Idria in Carniola, Almaden and Almadenejos in Spain, Wolfstein and Moschellandsberg in Rhenish Bavaria, Hartenstein in Saxony, Szlana and Rosenau in Hungary, Ripa in Tuscany; New Almaden in California, Mexico, and Peru. Principal ore of mercury; also used as a pigment. *Fibrous and Hepatic Cinnabar* are mixtures.

488. REALGAR, Red Orpiment.—As''.

Monoclinohedric; C=66° 5′ (*P*), ∞P (*M*) 74° 26′, (P∞) (*n*) 132° 2′, ∞P2 (*l*) 113° 16′. Crystals prismatic (fig. 255); also massive and investing. Cleavage, basal and clinodiagonal rather perfect, prismatic imperfect; fracture small conchoidal to uneven or splintery; sectile. H.=1·5…2; G.=3·4…3·6. Semitransparent or opaque; resinous. Aurora-red; streak orange-yellow. In the closed tube sublimes as a dark-yellow or red mass; B.B. on charcoal fuses and burns with a yellowish-white flame; acids act on it with difficulty. Chem. com. 70 arsenic and 30 sulphur. Kapnik, Nagyag, Felsobanya, and Tajowa, Andreasberg, St Gotthardt, Vesuvius and the Solfatara.

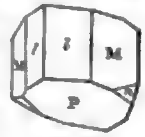


Fig. 255.

489. DIMORPHINE.—As'''.

Rhombic, in two types; more common short prismatic, with ∞P 96° 34′ and P̄∞ 103° 50′; the other more pyramidal. Very fragile. H.=1·5; G.=3·58. Splendent adamantine; translucent or transparent. Orange-yellow; streak similar. Chem. com. 75·5 arsenic, and 24·5 sulphur. Solfatara, Naples.

490. ORPIMENT.—As'''.

Rhombic; ∞P 117° 49′, P̄∞ 83° 37′. Crystals short prismatic (fig. 256), disseminated, columnar or foliated. Cleavage, brachydiagonal very perfect, striated vertically; sectile, and in thin laminæ flexible. H.=1·5…2; G.=3·4…3·5. Semi-transparent or opaque; resinous or pearly. Citron-yellow to orange-yellow. In the closed tube yields a dark-yellow or red sublimate; fused with soda it yields metallic arsenic; soluble in nitrochloric acid, in potash, and in ammonia. Chem. com. 61 arsenic and 39 sulphur. Tajowa near Neusohl, Servia, Wallachia, Natolia, Felsobanya, Kapnik, and Andreasberg; the Solfatara, and Zimapan in Mexico.

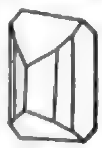


Fig. 256.

ORDER VII.—THE INFLAMMABLES.

Named from the substances all burning before the blowpipe, whereas the former minerals only fused or gave out fumes, and left a residue. Few of them are crystallized, and many rather organic remains or rocks than simple minerals. In chemical composition they are either simple elements, as sulphur and carbon, or mostly formed not on the plan of the mineral kingdom, but of organic nature. Except the diamond, their hardness is low, or less than 2·5; and their specific gravity also 2·2, or under.

FAMILY I.—SULPHUR.

*491. SULPHUR.—S.

Rhombic; P polar edges 106° 38′, 84° 58′, middle edge 143° 17′; ∞P 101° 58′, 0P, ⅓P, P̄∞. Crystals pyramidal (fig. 257), single or in druses; also reniform, spherical, stalactitic, disseminated, incrusting, or pulverulent. Cleavage, basal and ∞P imperfect; fracture conchoidal to uneven or splintery; rather brittle. H.=1·5

...2·5; G.=1·9...2·1. Transparent or translucent on the edges; resinous or adamantine. Sulphur-yellow, passing into brown and red, or into yellowish-gray and white. In the closed tube it sublimes; at 227° Fahr. fuses, and at 518° takes fire and burns with a blue flame, forming sulphurous acid. Chem. com. sulphur, occasionally more or less mixed with other substances.


Fig. 257.

Sicily, at Girgenti, Cataldo, &c.; the Lipari Islands, the Solfatara near Naples, Poland, Iceland, Java, Sandwich Islands, Peru, and Chili; from springs at Aix-la-Chapelle, and in Scotland.

492. Selen-sulphur.

Orange-yellow or yellowish-brown. Fuses readily in the closed tube, and volatilizes. B.B. on charcoal burns, and gives out fumes of selenic and sulphurous acids. Consists of sulphur and selenium. Vulcano, Lipari, and Kilauea in Hawai.

Native Selenium.—Brownish-black or lead-gray. Thin splinters red translucent. H.=2; G.=4·3. Culebras in Mexico.

Family II.—Diamond.

493. Diamond.—C.

Tesseral and tetrahedral-semitesseral; $\frac{O}{2}$ and $-\frac{O}{2}$, mostly conjoined, ∞O, ∞On, mO, mOn; or the octahedron, rhombic dodecahedron, and hexakisoctahedron (figs. 2, 3, 7, and 5). The crystals have often curved faces, and occur loose or imbedded singly. Macles common, united by a plane of O, like fig. 251. Cleavage, octahedral perfect; fracture conchoidal; brittle. H.=10; G.=3·5...3·6. Transparent or translucent when dark-coloured. Refracts light strongly; brilliant adamantine. Colourless, but often white, gray, or brown tints, also green, yellow, red, blue, and rarely black. Becomes positive electric by friction; burns in oxygen gas, and forms carbonic acid. Chem. com. pure carbon. Hindostan on the east of the Deccan, between Pennar, Sonar, and the delta of the Ganges (lat. 14° to 25°); Borneo and Malacca; Brazil in the district of Serro do Frio in Minas Geraes; also in Borneo, Malacca, the Ural, Georgia, and North Carolina, and the Sierra Madre, south-west from Mexico.

Family III.—The Coals.

494. Graphite, Plumbago.—C.

Hexagonal or monoclinohedric; but only thin tabular or short prismatic crystals of 0P. ∞P. Usually foliated, radiating, scaly, or compact. Cleavage, basal perfect; very sectile, flexible in thin laminæ. Feels greasy. H.=0·5...1; G.=1·9...2·2. Opaque; metallic. Iron-black. Leaves a mark on paper. Is a perfect conductor of electricity. B.B. burns with much difficulty; and heated with nitre in a platina spoon only partially detonates. Chem. com. carbon, but mixed with iron, lime, alumina or other matter. Pargas, Arendal, Passau, Spain, Ticonderoga in New York, Ceylon, Borrowdale in Cumberland, Glenstrathfarrer in Inverness-shire, Kirkcudbright, and Craigman in Ayrshire. At the latter it is evidently common coal altered by contact with trap. Is used for making pencils, and to form crucibles.

*495. Anthracite.—Glance-Coal.

Massive and disseminated; rarely columnar, or fibrous and pulverulent. Fracture conchoidal; brittle. H.=2...2·5; G.=1·4...1·7. Opaque; brilliant metallic. Iron-black or grayish-black; streak unaltered. Perfect conductor of electricity. Burns difficultly with a very weak or no flame, and does not cake; in the closed tube yields a little moisture, but no empyreumatic oil; detonates with nitre. Chem. com. carbon above 90 per cent., with 1 to 3 oxygen, 1 to 4 hydrogen, and 0 to 3 nitrogen; and ashes chiefly of silica, alumina, lime, and peroxide of iron. Very common in some parts of the English, Scottish, and Irish coal-fields; in the Alps, as the Valais, Piedmont, Savoy, and Dauphiné; in the Pyrenees, and in various parts of France; in Silesia, Bohemia, Saxony, and the Harz; and in the United States, as in Rhode Island, Massachusetts, and above all in Pennsylvania. Used for manufacturing metals, and for economic and household purposes.

496. Common Coal, Black, Stone, Bituminous Coal.

Compact, slaty, or confusedly fibrous; often dividing into columnar, cubical, or rhomboidal fragments. Fracture conchoidal, uneven, or fibrous; rather brittle or sectile. H.=2...2·5; G.=1·2...1·5. Vitreous, resinous, or silky in the fibrous variety. Blackish-brown, pitch-black, or velvet-black. Burns easily, emitting flame and smoke, with a bituminous odour; heated in the closed tube with powdered sulphur gives out sulphuretted hydrogen. Chem. com. 74 to 90 carbon, with 0·6 to 8 or 15 oxygen, 3 to 6 hydrogen, 0·1 to 2 nitrogen, 0·1 to 3 sulphur, and 1 to 11 earthy matters or ash, in 100 parts.

Slate-coal has a thick slaty structure, and an uneven fracture in the cross direction. *Cannel coal*, a resinous, glimmering lustre, and a large or flat conchoidal fracture; breaks into irregular cubical fragments, but more solid, and takes a higher polish than the other varieties. It burns with a bright flame, and yields much gas. *Coarse* or *foliated coal*, massive or lamellar, breaks into cubical or irregular angular masses, with a more splendent lustre, and less compact texture than the former, and more easily frangible. *Earthy coal*, loose powdery masses, often brown or dirty in colour, and apparently semi-decomposed. Abundant in many lands, as in England, South Wales, Scotland, and Ireland; in Belgium and France, in Germany and Southern Russia. The United States possess immense fields in the valley of the Mississippi. Also found in China, Japan, Hindostan, Australia, Borneo, and several of the Indian Islands. Its uses are too well known to need notice.

497. Brown Coal.—Lignite, Jet.

Distinctly vegetable in origin, the external form, and very often the internal woody structure, being preserved. The texture is compact, woody, or earthy. Fracture conchoidal, woody, or uneven; soft and often friable. G.=0·5...1·5. Lustre sometimes resinous, mostly glimmering or dull. Brown, black, or rarely gray. Burns easily with an unpleasant odour; colours solution of potash deep-brown; heated with sulphur evolves much sulphuretted hydrogen. Chem. com. 47 to 73 carbon, 2·5 to 7·5 hydrogen, 8 to 33 oxygen (with nitrogen), and 1 to 15 ashes. *Jet* is pitch-black, with conchoidal fracture and resinous lustre. Brown coal occurs at Bovey Tracy in Devonshire, in Yorkshire, Antrim, Brora, Mull, and Skye; Germany, Hungary, France, Italy, and Greece. The *Surturbrand* of Iceland seems a variety. Used as fuel, but much inferior to common coal.

*498. Peat.

A mass of more or less decomposed vegetable matter of a brown or black colour, closely connected with coal, and, like it, rather a rock than a simple mineral. Contains 50 to 60 carbon, 5 to 6 hydrogen, 30 to 39 oxygen, 0 to 2 nitrogen, and 1 to 14 ashes in 100 parts. Common everywhere in the colder parts of the earth.

Family IV.—The Mineral Resins.

*499. Bitumen, Naphtha.—CH^2.

Liquid. Colourless, yellow, or brown; transparent or translucent. G.=0·7...0·9. Volatilizes in the atmosphere with an aromatic bituminous odour. Chem. com. 84 to 88 carbon, and 12 to 16 hydrogen.

Naphtha.—Very fluid, transparent, and light-yellow. Tegern Lake in Bavaria, Amiano near Parma, Salics in

the Pyrenees, Rangun in Hindostan, Baku on the Caspian Sea, China, Persia, and North America. Used for burning and preparing varnishes. *Petroleum.*—Darker yellow or blackish-brown; less fluid or volatile. Ormskirk in Lancashire, at Coalbrookdale, Pitchford, and Madeley in Shropshire; St Catherine's Well, south of Edinburgh; Isle of Pomona; and in many other parts of Europe and the United States.

*500. ELATERITE, Elastic Bitumen, Mineral Caoutchouc. } $C H^2$.

Compact; reniform or fungoid; elastic and flexible like caoutchouc; very soft. G. = 0·8...1·23. Resinous. Blackish, reddish, or yellowish brown. Strong bituminous odour. Chem. com. 84 to 86 carbon, 12 to 14 hydrogen, and a little oxygen. Derbyshire, Montrelais near Nantes, and Woodbury in Connecticut.

501. ASPHALTUM.

Compact and disseminated. Fracture conchoidal, sometimes vesicular; sectile. H. = 2; G. = 1·1...1·2. Opaque, resinous, and pitch-black; strong bituminous odour, especially when rubbed. Takes fire easily, and burns with a bright flame and thick smoke; soluble in ether, except a small remainder, which is dissolved in oil of turpentine. Chem. com. 76 to 88 carbon, 2 to 10 oxygen, 6 to 10 hydrogen, and 1 to 3 nitrogen. Limmer near Hanover, Seyssel on the Rhone; Val Travers in Neufchatel, Lobsann in Alsace, in the Harz; Cornwall, Haughmond Hill, Shropshire; East Lothian, Burntisland in Fifeshire; Dead Sea, Persia, and Trinidad.

502. PIAUZITE.

Massive; imperfect conchoidal; sectile. H. = 1·5; G. = 1·22. Dimly translucent on very thin edges; resinous. Blackish-brown; streak yellowish-brown. Fuses at 600° Fahr., and burns with an aromatic odour, lively flame, and dense smoke; soluble in ether and caustic potash. Piauze in Carniola.

503. IXOLYTE.

Massive; conchoidal fracture. H. = 1; G. = 1·008. Resinous. Hyacinth-red; streak ochre-yellow. Rubbed between the fingers it emits an aromatic odour, and becomes soft at 119°, but is still viscid at 212°. Oberhart near Gloggnitz in Austria.

*504. AMBER, Succinite.—$C^{10} H^8 O$.

Round irregular lumps, grains, or drops. Fracture perfect conchoidal; slightly brittle. H. = 2...2·5; G. = 1...1·1. Transparent to translucent or almost opaque; resinous. Honey-yellow, but from hyacinth-red or brown to yellowish-white; also streaked or spotted. When rubbed emits an agreeable odour, and becomes negatively electric. It melts at 550°, emitting water, an empyreumatic oil, and succinic acid; it burns with a bright flame and pleasant odour, leaving a carbonaceous remainder; only a small part is soluble in alcohol. Chem. com. 79 carbon, 10·5 hydrogen, and 10·5 oxygen. Derived from an extinct coniferous tree, and found in the diluvial formations of many countries, especially Northern Germany and shores of the Baltic, Sicily, Spain, and Northern Italy; rarely in England, as on the shores of Norfolk, Suffolk, and Essex, and at Kensington near London. Used for ornamental purposes, and for preparing succinic acid and varnishes.

505. RETINITE, Retinasphalt.

Roundish or irregular lumps. Fracture uneven or conchoidal; very easily frangible. H. = 1·5...2; G. = 1·05...1·15. Translucent or opaque; resinous or glistening. Yellow or brown. Melts at a low heat, and burns with an aromatic or bituminous odour. Chem. com. in general carbon, hydrogen, and oxygen, in very uncertain amount. Bovey, Halle, Cape Sable, and Osnabrück.

506. WALCHOWITE.—$C^{12} H^9 O$.

Rounded pieces, with a conchoidal fracture. H. = 1·5...2; G. = 1·035...1·069. Translucent, resinous. Yellow with brown stripes; and a yellowish-white streak. It fuses at 482°, and burns readily; soluble partially (7·5 per cent.) in ether, and in sulphuric acid forms a dark-brown solution. Chem. com. 80·4 carbon, 10·7 hydrogen, and 8·9 oxygen. Walchow in Moravia.

507. COPALINE, Fossil Copal, Highgate Resin. } $C^{40} H^{64} O$.

Irregular fragments. H. = 1·5; G. = 1·046. Translucent resinous, and light-yellow or yellowish-brown. Burns easily with a bright-yellow flame and much smoke; alcohol dissolves very little of it, which is precipited by water; becomes black in sulphuric acid. Chem. com. 85·54 carbon, 11·63 hydrogen, 2·76 oxygen. Highgate near London. A similar resin from Settling Stones in Northumberland, found in flat drops or crusts on calc-spar, is influsible at 500° Fahr.; G. = 1·16...1·54: and contains 85·13 carbon, 10·85 hydrogen, and 3·26 ashes; or $C^4 H^3$.

508. BERENGELITE.—$C^{40} H^{62} O^8$.

Amorphous; conchoidal fracture. Dark-brown, inclining to green; yellow streak. Resinous; unpleasant odour, and bitter taste. Fuses below 212°, and then continues soft at ordinary temperatures; easily soluble in alcohol. Chem. com. 72·40 carbon, 9·28 hydrogen, 18·31 oxygen. St Juan de Berengela in South America.

509. GUYAQUILLITE.—$C^{20} H^{26} O^3$.

Amorphous; yielding easily to the knife, and very friable. G. = 1·092. Pale yellow. Slightly resinous. Fluid at 212°, viscid when cold; slightly soluble in water and largely in alcohol, forming a yellow fluid with a bitter taste. Chem. com. 77·01 carbon, 8·18 hydrogen, and 14·80 oxygen. Guyaquil in South America.

Bogbutter, from the Irish peat mosses, is similar; melts at 124°, easily soluble in alcohol, and contains 73·70 carbon, 12·50 hydrogen, and 13·72 oxygen.

510. HARTINE.—$C^{20} H^{34} O^2$.

Spermaceti-like masses. G. = 1·115. White; without taste or smell. Becomes soft at 392°, and at 410° melts to a clear yellow fluid; burns with a bright flame; it is not soluble in water, very little in ether, and less in alcohol. Chem. com. 78·26 carbon, 10·92 hydrogen, 10·82 oxygen. Oberhart in Austria.

511. MIDDLETONITE.—$C^{20} H^{22} + HO$.

Round masses or thin layers. Brittle, but easily cut with a knife. G. = 1·6. Resinous. Reddish-brown by reflected, deep-red by transmitted light; streaked, light-brown. It becomes black on exposure to the atmosphere. Chem. com. 86·44 carbon, 8·01 hydrogen, 5·56 oxygen. In the main coal seam at Middleton near Leeds, and at Newcastle.

512. OZOKERITE.—CH.

Amorphous, sometimes fibrous. Very soft, pliable, and easily fashioned with the fingers. G. = 0·94...0·97. Glimmering or glistening; semitranslucent. Yellowish-brown or hyacinth-red by transmitted, dark leek-green by reflected light. Pleasant aromatic odour; fuses easily (at 144°, *Schrötter*; at 183°, *Malagutti*) to a clear oily fluid, again becoming solid when cold, and at higher temperatures burns with a clear flame, seldom leaving any ashes; readily soluble in oil of turpentine, with great difficulty in alcohol or ether. Chem. com. 85·7 carbon, and 14·3 hydrogen. Slanik and Zietriska in Moldavia, and near Garning in Austria. Also Urpeth coal mine near Newcastle-on-Tyne.

513. HATCHETINE, Mineral Tallow.

Flaky, like spermaceti; or sub-granular, like bees' wax; soft and flexible. G. = 0·6. Translucent; weak pearly. Yellowish-white, wax-yellow, or greenish yellow. Greasy; inodorous; readily soluble in ether. Chem. com. 85·91 carbon, and 14·62 hydrogen, or similar to ozokerite. Glamorganshire (fusible at 115°); Loch Fyne near Inverary. Also Merthyr-Tydvil (melts at 170°), and Sooldorf in Schaumburg.

514. Fichtelite.—$C^4 H^3$.

Crystalline lamellæ, which swim in water, but sink in alcohol. White and pearly. Fuse at 115°, but again become crystalline on cooling; very easily soluble in ether, and precipitated by alcohol. Chem. com. 89·3 carbon and 10·7 hydrogen. In pine trees in a peat moss near Redwitz in Bavaria.

515. Hartite.—$C^6 H^5$.

Resembles spermaceti or white wax; lamellar, and probably monoclinohedric. Sectile, but not flexible. H. = 1; G. = 1·046. Translucent; dull resinous. White. Melts at 165°, and burns with much smoke; very soluble in ether, much less so in alcohol. Chem. com. 87·50 carbon, and 12·10 hydrogen. Oberhart in Austria.

516. Könlite.—$C^2 H$.

Crystalline foliæ and grains. Soft. G. = 0·88. Translucent; resinous. White, without smell. Fuses at 120° to 137° Fahr; soluble in nitric acid, and precipitated by water in a white crystalline mass. Chem. com. 92·31 carbon and 7·69 hydrogen. Uznach near St Gallen, Redwitz in Bavaria.

517. Scheererite.—CH^2.

Monoclinohedric; tabular or acicular. Soft and rather brittle. G. = 1·0...1·2. Translucent; resinous or adamantine. White, inclining to yellow or green. Feels greasy, has no taste, and when cold no smell, but when heated a weak aromatic odour. Insoluble in water; but readily in alcohol, ether, nitric, and sulphuric acid. Chem. com. 75 carbon, and 25 hydrogen. Uznach. *Branchite*, white, translucent, feels greasy, and fuses at 167°, is similar; Monte Vaso in Tuscany.

518. Idrialite.—(Idrialine = $C^{42} H^{14} O$).

Massive; fracture uneven or slaty. Sectile. H. = 1·0...1·5; G. = 1·4...1·6 (1·7...3·2). Opaque; resinous. Grayish or brownish-black; streaked blackish-brown, inclining to red. Feels greasy. Burns with a thick smoky flame, giving out sulphurous acid, and leaving some reddish-brown ashes. Chem. com. idrialine (= 91·83 carbon, 5·30 hydrogen, and 2·87 oxygen) and cinnabar, with a little silica, alumina, pyrite, and lime. The idrialine may be extracted by warm olive oil or oil of turpentine, as a pearly shining mass. Idria.

Family V.—Inflammable Salts.

519. Mellite, Honey Stone.—$\dddot{Al}\,\bar{M}^3 + 18\dot{H}$.

Tetragonal; P 93° 6′. Crystals, P alone, or with 0P, P∞, and ∞P∞, usually single; also massive and granular. Cleavage, P very imperfect; fracture conchoidal; rather brittle. H. = 2·0...2·5; G. = 1·5...1·7. Transparent to translucent; distinct double refraction; resinous or vitreous. Honey-yellow to wax-yellow or reddish; streak whitish. In the closed tube it yields water. B.B. carbonizes without any sensible odour, at length burns white, and acts like pure alumina; easily soluble in nitric acid or solution of potash. Chem. com. 40·53 mellic acid ($\bar{M}$ = $C^4 O^3$), 14·32 alumina, and 45·15 water. Artern in Thuringia, Lauschitz in Bohemia, and Walchow in Moravia.

520. Oxalite, Humboldtine.—$2\dot{Fe}\,\ddot{C}^3 + 3\dot{H}$.

Capillary crystals; also botryoidal or in plates, and fine granular, fibrous, or compact. Fracture uneven or earthy; slightly sectile. H. = 2; G. = 2·15...2·25. Opaque; weak resinous or dull. Ochre or straw yellow. B.B. on charcoal becomes first black then red; easily soluble in acids. Chem. com. 42·7 oxalic acid, 41·4 iron protoxide, and 15·9 water. Kolosoruk near Bilin, Duisburg, and Gross Almerode in Hessia.

521. Whewellite.—$\dot{Ca}\,\ddot{C} + 7\dot{H}$.

Monoclinohedric; C = 72° 41′, ∞P 100° 36′. Cleavage, basal perfect; very brittle. H. = 2·5...2·8; G. = 1·833. Transparent to opaque; vitreous. Colourless. Chem. com. 49·31 oxalic acid, 38·36 lime, 12·33 water. Hungary (?).

522. Conistonite.—$\dot{Ca}\,\ddot{C} + 7\dot{H}$.

Rhombic; ∞P 97° 5′. Slightly sectile. H. = 2; G. = 2·052. Transparent to translucent; vitreous. Colourless. Soluble without effervescence in n. acid. Chem. com. 28·1 oxalic acid, 21·8 lime, and 50·1 water. Coniston in Cumberland.

Though properly not a simple mineral, the characters of water in its two conditions may be noted here.

*523. Water.—HO.

Fluid and amorphous. G. = 1·000 when pure, but sea-water 1·027 and 1·0285 at 62° Fahr. When pure it is without taste or smell, and colourless in small quantities, but in larger masses green or blue. Chem. com. hydrogen-oxide, with 88·9 oxygen and 11·1 hydrogen. Attains its greatest density at 39°·1, boils at 212°, and at 32° Fahr. freezes and changes to

Ice.

Rhombohedric; R 117° 23′ (120°); usually six-sided tables of 0R . ∞R; also acicular crystals, macled in delicate groups or stars with six rays. Cleavage, probably basal. H. = 1·5; G. = 0·9268 (*Ossann*), 0·918 (*Brunner* at 32° Fahr., and quite pure). Transparent; vitreous. Colourless, but in large masses greenish or bluish. Refracts double.

The water found on the earth is never pure, but contains more or less of various substances,—atmospheric air, carbonic acid, nitrogen gas; silica, alumina, and salts (carbonates, sulphates, nitrates, phosphates) of lime, magnesia, soda, potash, protoxides of iron and manganese; or chlorides, and fluorides of the metallic bases; and in the sea and some saline springs also iodine and bromine. (J. N—L.)

ALPHABETICAL INDEX OF MINERAL SPECIES.

Acmite 110
Aciculite 463
Aeschynite 357
Agalmatolite 133
Alabandine 479
Albite 4
Allanite 178
Allophane 125
Alluandite 270
Alstonite 210
Altaite 445
Alum 225
Aluminite 219
Alunite 218
Alunogene 227
Amalgam 398
Amber 504
Amblygonite 34
Analcime 43
Anatase 353
Anauxite 86
Andalusite 149
Andesin 5
Anglesite 304
Anhydrite 215
Anorthite 8
Anthosiderite 172
Anthracite 495
Antigorite 90
Antimony 399
  Ochre 374
  Silver 396
Apatite 199
Apophyllite 51
Arcanite 250
Argentite 438
Arragonite 191
Arsenic 401
Arsenic-antimony 400
Arseniosiderite 277
Arsenite 389
Asphaltum 501
Atacamite 296
Augite 101
Aurichalcite 283
Automolite 157
Axinite 145
Azurite 281, 29

Babingtonite 111
Barytes 207
Baryto-Calcite 211
Berengelite 508
Berthierite 461
Berzeline 443
Berzeliite 222
Bieberite 236
Biotite 70
Bismuth 405
Bismuthine 462
Bismuthite 325
Bismuth-ochre 373
Bitumen 499
Bleinierite 316
Blende 477
Bole 127
Boltonite 103
Boracite 203
Borax 242
Bornite 428
Botryogene 230
Boulangerite 453
Bournonite 468
Braunite 365
Breithauptite 421
Breunnerite 188
Brewsterite 49
Brochantite 298
Bromite 330
Bronzite 106
Brookite 351
Brucite 99, 169

Calaite 30
Calamine 269
Caledonite 308
Calomel 327
Cancrinite 23
Cassiterite 342
Celestine 212
Cerite 180
Cervantite 388
Cerussite 303
Chabasite 55
Chalcolite 300
Chalcophyllite 284
Chalcopyrite 427
Chalcotrichite 383
Childrenite 201
Chiolite 197
Chloanthite 424
Chlorite 75, 76
Chloritoid 73
Chlorophæite 174
Chondrodite 169
Chonikrite 96
Chromite 335
Chrome-ochre 390
Chrysoberyl 159
Chrysocolla 290
Chrysolite 168
Cinnabar 487
Clausthalite 433
Clay 118
Clinochlore 77
Clintonite 83
Coal, Brown 497
  Common 496
Cobalt, earthy 369, 371
Cobaltine 413

Mineralogy.

Cobalt-ochre 371
Coccinite 329
Columbite 344
Conistonite 522
Copaline 507
Copiapite 231
Copper, Native ... 406
Coquimbite 232
Cordierite 166
Corundum 158
Cotunnite 313
Couzeranite 7
Crednerite 367
Crocoisite 322
Cronstedtite 81
Cryolite 196
Cryptolite 268
Cuprite 382
Cuproplumbite ... 432
Cyanite 147
Cyanose 234

Damourite 68
Datholite 206
Dechenite 318
Delvauxine 272
Dermatin 139
Diadochite 271
Diallage 106
Diallogite 255
Diamond 493
Diaspore 151
Dimorphine 489
Dioptase 279
Dipyr 21
Dolomite 187
Domeykite 429
Dreelite 208
Dufrénite 263
Dufrenoysite 458

Edingtonite 58
Ehlite 296
Elaterite 500
Embolite 331
Emerald 164
Enargite 467
Epidote 144
Epistilbite 50
Epsomite 253
Erinite 286
Erythrine 301
Euchroite 289
Euclase 163
Eudialite 42
Eukairite 442
Eulytine 176
Euxenite 348

Fahlore 466
Faujasite 57
Fergusonite 349
Fichtelite 514
Fischerite 31
Fluocerine 195
Fluocerite 194
Fluor-spar 192
Franklinite 336
Freieslebenite 470
Fuller's earth 124

Gadolinite 177
Galena 431
Galmei 260
Garnet 140
Gaylussite 241
Gehlenite 24
Geokronite 454
Gersdorffite 419
Gismondine 63
Glauberite 217
Glaucophane 146
Glottalite 66
Gmelinite 56
Gold 394
Goslarite 235
Göthite 340
Graphite 494
Green earth 121
Greenockite 481
Grünauite 418
Guyaquillite 509
Gymnite 95
Gypsum 214

Hæmatite 337
Haidingerite 221
Halloysite 123
Harmotome 52
Hartine 510
Hartite 515
Hatchetine 513
Hauerite 480
Hausmannite 364
Hauyne 38
Helvine 142
Herderite 200
Herschelite 61
Hessite 446
Heulandite 48
Hisingerite 171
Hopeite 198
Hornblende 100
Humboldtilite 25
Hureaulite 269
Hydrargillite 152
Hydroboracite 205
Hydroborocalcite 204
Hydromagnesite ... 190
Hydrophite 91
Hyperstheue 104

Idocrase 143
Idrialite 518
Ilmenite 341
Inverarite 426
Iodite 328
Iridium 393
Irite 338
Iron 407
Isopyre 115
Ittnerite 40
Ixolyte 503

Jamesonite 450
Johannite 237

Kammererite 98
Kaolin 117
Karpholite 27
Keilhauite 184
Kastor 13
Kerate 326
Kermes 486
Kerolite 132
Kirwanite 28
Klinoclase 290
Kobellite 464
Kollyrite 129
Konlite 516
Krokydolite 113
Kupferindig 441

Labradorite 6
Lanarkite 307
Lanthanite 257
Lapis-lazuli 41
Latrobite 10
Laumonite 64
Lazulite 29
Lead 403
Leadhillite 305
Lead-ochre 379
Leonhardite 65
Lepidomelane 72
Leucite 35
Leucophane 162
Leucopyrite 411
Levyne 54
Libethenite 293
Lievrite 170
Limonite 339
Linarite 309
Linneite 416
Liroconite 287
Lithomarge 130
Loweite 252

Magnesite 189
Magnetite 334
Malachite 282
Malakon 155
Manganese, Arseniuret of 430
Cupreous 388
Manganite 363
Manganocalcite ... 256
Marcasite 409
Margarite 84
Mascagnine 249
Matlockite 312
Meerschaum 137
Meionite 18
Melanochroite 323
Melanterite 229
Mellite 519
Mendipite 311
Mengite 358, 267
Mercury 397
Miargyrite 484
Mica, Lithia 69
Potash 67
Middletonite 511
Millerite 425
Miloschin 131
Mimetesite 315
Minium, Native ... 378
Mirabillite 228
Mispickel 412
Modumite 415
Molybdena-ochre 372
Molybdenite 448
Monazite 267

Nagyagite 444
Natrolite 44
Natron 238
Naumannite 437
Nepheline 22
Nephrite 102
Nickeline 302, 422
Nitratine 215
Nitre 244
Nitrocalcite 246
Nitromagnesite ... 247
Nontronite 173
Nosean 39
Nuttalite 19

Obsidian 16
Oerstedtite 155, 183
Okenite 52
Oligoclase 9
Olivenite 288
Onkosin 135
Onofrite 435
Opal 2
Orpiment 490
Orthoclase 3
Osimium-iridium 392
Ottrelite 74
Oxalite 520
Ozokerite 512

Palagonite 20
Paladium 391
Parisite 258
Peat 498
Pechurane 359
Pectolite 53
Periclase 153
Perowskite 356
Pestlite 11
Pharmacolite 220
Pharmakosiderite 278
Phenakite 165
Phillipsite 60
Phlogopite 71
Pholerite 87
Phosgenite 310
Phosphorochalcite 291
Piauzite 502
Picrosmine 92
Pimelite 128
Pissophane ...... [illegible]
Pitticite 274
Plagionite 452
Platina 390
Plattnerite 360
Plinthite 120
Plombgomme 321
Plumosite 456
Pollanite 362
Pollux 14
Polybasite 472
Polyhalite 216
Polykrase 355
Polymignite 354
Porcelain-spar ... 36
Prehnite 26
Proustite 483
Psilomelane 366
Pycnite 161
Pyrallolite 114
Pyrargyrite 482
Pyrite 408
Pyrochlore 182
Pyrolusite 361
Pyromorphite ... 314
Pyrope 141
Pyrophyllite 85
Pyrosclerite 97
Pyrosmalite 80
Pyrrhotine 410

Quartz 1

Rammelsbergite... 423
Realgar 488
Redruthite 440
Retinite 505
Rhodonite 107
Ripidolite 75, 76
Rock-salt 224
Rock-soap 119
Romeite 332
Rosellan 88
Rutile 362

Sal-ammoniac ... 248
Salt, Common ... 224
Samarskite 346
Sassoline 243
Scapolite 17
Scheelite 333
Scheeletine 320
Scheererite 517
Schiller-spar 79
Schrötterite 126
Scolezite 46
Scorodite 276
Selencopperlead... 434
Selen-sulphur 492
Senarmontite 387
Serpentine 89
Siderite 254
Sillimanite 148
Silvanite 465
Silver 395
Bismuthic 476
Skleroklase 459
Smaltine 414
Soapstone 134
Sodalite 37
Sordawalite 112
Spadaite 94
Sphene 350
Spinel 156
Spodumene 12
Stannine 474
Staurolite 150
Steinmannite 455
Stephanite 471
Sternbergite 473
Stibine 449
Stiblite 375
Stilbite 47
Stilpnomelan 82
Stromeyerite 439
Strontianite 213
Struvite 223
Sulphur 491
Susannite 306
Syepoorite 417
Sympleaite 275

Tachylite 116
Tagilite 294
Talc 78
Tantalite 346
Tscheffkinite 179
Tectizite 233
Tellurite 381
Tellurium 402
Tennantite 467
Tenorite 384
Teratolite 128
Tetradymite 447
Thenardite 251
Thermonatrite ... 239
Thomsonite 46
Thorite 175
Thrombolite 292
Tiemannite 436
Tin 404
Tirolite 285
Topaz 160
Tourmaline 167
Triphylline 266
Triplite 264
Tritomite 181
Trona 240
Tungsten-ochre ... 376

Ullmannite 420
Uranite 299
Uranium-ochre ... 377

Valentinite 386
Vanadinite 317
Vauquelinite 324
Villarsite 93
Vivianite 262
Volborthite 297
Voltaite 226
Voltzine 478

Wad 370
Wagnerite 33
Walchowite 506
Water 523
Wavellite 32
Whewellite 521
Willemite 261
Witherite 209
Wittichite 475
Wöhlerite 185
Wolchite 469
Wolfram 343
Wolfsbergite 460
Wollastonite 108
Wulfenite 319

Xanthokon 485
Xenotime 202

Yellow-earth 122
Yttrocerite 193
Yttrotantalite ... 347

Zeagonite 62
Zincite 385
Zinckenite 451
Zircon 154
Zwieselite 265
Zygadite 15

II. GEOLOGY.

INTRODUCTION.

It is not easy to give an accurate and comprehensive definition of the science of geology; for its nature is so complex and various, that it is difficult, in a few words, either to specify its object or to assign its limits.

It is, indeed, not so much one science, as the application of all the physical sciences to the examination and description of the structure of the earth, the investigation of the processes concerned in the production of that structure, and the history of their action.

We might, perhaps, without impropriety, classify all the physical sciences under two great heads, namely, Astronomy and Geology. The one would comprehend all those sciences which teach us the nature, the constitution, the motions, the relative places, and the mutual action of the Astra, or heavenly bodies; while the other singled out for study the one Astrum on which we live, namely, the earth.

Giving this wide meaning to geology, it would include all the sciences which treat of the constitution and the distribution of the inorganic matter of our globe, as well as those which describe to us the living beings that inhabit it. These sciences are—first, that of chemistry and mineralogy (which may be called one), which teaches us what are the elements of which terrestrial matter is composed, and what are the laws which govern the combinations of those elements into all the variety of known substances, solid, fluid, or gaseous, and the forms, properties, and qualities of those substances; secondly, the science of natural history or (biology, the science of life), including botany and zoology in their widest acceptation; and thirdly, that of meteorology and physical geography (which may also be looked on as one), which describes to us the form and disposition of land and water, and air, and the distribution of the temperatures and motions that affect them.

The sciences commonly included under the head of physics, those which teach us the nature and laws of magnetism, electricity, light, heat, force, and motion, would be common ground to geology and astronomy, serving to bind together all human knowledge of matter and its laws into one great whole.

Let it not be supposed that the giving this high place to geology, arises from a wish unduly to exalt it at the expense of the other sciences. Our object is to show that this large view of geology is not only a true, but a necessary one, and that if we do not sometimes look at it from this aspect, we cannot fully describe, nor can the reader rightly understand and appreciate what geology is.

That it is true, is shown by the very fact of the late appearance of geology in the world of science. It was not till some very considerable advances had been made in all the physical sciences which relate directly to the earth, that geology could begin to exist in any worthy form. It was not till the chemist was able to explain to us the true nature of the mineral substances of which rocks are composed; not till the geographer and the meteorologist had explored the surface of the earth, and taught us the extent and the form of land and water, and the powers of winds, currents, rains, glaciers, earthquakes, and volcanoes; not till the biologist (naturalist) had classified, and named, and accurately described the greater part of existing animals and plants, and explained to us their physiological and anatomical structure, and the laws of their distribution in space;—that the geologist could, with any chance of arriving at sure and definite results, commence his researches into the structure and composition of rocks, and the causes that produced them, or utilise his discoveries of the remains of animals and plants that are inclosed in them. He could not till then discriminate with certainty between igneous and aqueous rocks, or between living and extinct animals, and was therefore unable to lay down any one of the foundations on which his own science was to rest.

Geology.

Neither would it be a satisfactory classification if we were to limit the range of geology to any period of the earth's history; to assign to it, for instance, all time previous to the existence of the human race, and, uniting all the natural sciences under it up to that time, consider it then to be brought to an end, or to split up and diverge into the many independent sciences that concern our contemporary existences, whether organic or inorganic. For not only is there no trace of any hard boundary line between the human and the pre-human period of the earth's natural history; but there appears in each one of the separate natural sciences a perfect blending and continuity from the remotest geological era to the present time. The present is but a part of the past. The inorganic objects we see around us are the result of processes going on in past time, such as are still at work producing the same results; the living beings around us are either the direct descendents of those that lived formerly, or their substitutes and representatives, the living and the extinct forming parts of one great connected series and chain of species, genera, and orders, each of which parts would be incomplete without the other. There is therefore no possibility of making any division in geology such as we are now considering it, or assigning any limit to its range from the earliest period of the earth's ascertainable history to the present moment.

Moreover, as there is no natural science to which the geologist has not to appeal for information upon some point or other in his researches, so there is none which can be fully and completely studied without the help of the geologist, or without including facts or theories which are commonly and rightly reckoned parts of his peculiar intellectual domain. If he has to call upon the professors of each one of the physical sciences in turn, for assistance in his own investigations, he is sure, sooner or later, to repay the obligation by the discovery of a number of facts that enlarge the boundaries of the science he has applied to, or the statement of many problems whose solution throws light upon parts of it that have been hitherto imperfect and obscure.

It is not intended that the reader should infer from what has been said, that in order to be a geologist, he must be thoroughly acquainted with the whole circle of the physical and natural sciences. Such universal acquirement few men have the power to attain to, and of these still fewer retain the ability and the will to make original advances in any particular branch.

No man, however, can be a thorough geologist without being acquainted, to some extent, with the general results of the other sciences, and being able both to understand them when stated in plain untechnical language, and to appreciate their application to his own researches. Such a general acquaintance involves neither profound study, nor requires any great power of mind above the average of hu-

man intellect. It is, indeed, what every well-educated man ought to possess.

The necessary preliminary to the science of geology is not the possession of great and accurate knowledge of the whole circle of the natural sciences by any individual persons, but that this knowledge must exist somewhere. Some man or men must have this knowledge, and must be able to combine it, either piecemeal or at once, with the special knowledge of the geologist, before the latter can hope to solve the many difficult and profound problems that arise in the course of his researches.

It may be said with perfect truth, that the geologist is less able than any other student of science to pursue his investigations alone, and independently of the assistance of others; but this is, in fact, only saying in other words that which we are insisting on, namely, that geology in its highest and widest sense embraces all the physical and natural sciences, and is, as it were, made up of them.

If, however, this wide scope be properly given to the term geology, and it be made to include every physical science that treats of anything belonging to the earth, what, it may be asked, is the special business to which the geologist devotes himself as distinct from the follower of other sciences? What is that which he does, and the others do not? Above all, what is that which he teaches to the rest in return for the knowledge communicated to him?

The answer to these questions will show us that there is another and a more restricted sense of the word geology than the wide and general one in which we have been using it. This sense is rather the one formerly attached to the word geognosy, by which we may understand the knowledge of the nature and position of the different masses of earthy or mineral matter of which different districts and countries are composed without reference to the history of their production. This was the early and simple meaning of the word geology, when considered as synonymous with geognosy, namely, the examination and description of the different varieties of rocks and the minerals they contained. Geology was looked upon in the light of a geographical mineralogy, and even yet it is regarded more or less under this aspect by many persons. No one, indeed, could have anticipated, from the mere study of masses of stone and rock, where, to a partial and local view, all seems confusion and irregularity, the wonderful order and harmony which arise from more extended observation and the almost romantic and seemingly fabulous history which becomes at length unfolded to our perusal. To discover the records on which this history is founded, and to understand their meaning aright, frequent, long-continued, and wide-spread observation and research in the field, and patient and conscientious registration and comparison of the observed facts in the closet, are absolutely necessary.

This collection and co-ordination of facts it is which is the proper and peculiar business of the geognost. The ditch, the "cutting," the quarry, and the mine; the cliff, the gully, the mountain-side, and the river-bank; these are his "*subjects*,"—that which he has to study, to examine, to dissect, to describe the minutiæ of the structures they expose, and to classify and arrange the facts they may afford, depicting their lineaments on maps and sections, and recording them in written descriptions. The business of the geognost, then, is to make out, from indications observed at the surface and in natural and artificial excavations, the internal structure, the *solid geometry*, of district after district, and country after country, until the whole earth has been explored and described. If, while so doing, he notes all those facts which may enable him or others to understand and explain how that structure has been produced, he then becomes a geologist.

It might at first be thought that in order to make out the solid structure of lands and countries it would only be necessary to understand the nature of the mineral matters of which they were composed, and that for this purpose no knowledge of organic or living beings would be required. It is, however, one of the most remarkable results of geological science that an acquaintance with organic, and especially with animal forms, is at least as necessary for a geologist as a knowledge of minerals, and that a correct knowledge of organic remains (portions of fossil plants and animals) is a more certain and unerring guide in unravelling the structure of complicated districts than the most wide and general acquaintance with inorganic substances.

The cause of this necessity, puzzling and paradoxical enough, perhaps, at first sight, may be briefly stated as follows. When we come to examine the structure of the crust of the globe, we find that its several parts have been produced in succession, that it consists of a regular series of earthy deposits (all called by geologists rocks) formed one after another during successive periods of time, each of great but unknown duration. Now, the mineral substances produced at any one period of this vast succession of ages do not appear to have had any essential difference from those formed at another. We cannot, therefore, with any certainty, discover the order of time in which the series of rocks was formed, or the order of superposition which they consequently preserve with regard to each other, from an examination of their mineral character or contents only. The animals and plants, however, living at one period of the earth's history were different from those living now, and different from those living at other periods. There has been a continuous succession of different races of living beings on the earth following each other in a certain regular and ascertainable order, and when that order has been ascertained, it is obvious that we can at once assign to its proper period of production, and therefore to its proper place in the series of rocks, any portion of earthy matter we may meet with containing any one, or even any recognisable fragment of one, of these once living beings.

Just as when we find under the foundation-stone of any ancient building a parcel of coins of any particular sovereign, we know that the erection of that building took place during his reign; so when we find a fragment of a known "fossil" in any piece of rock, we feel sure that that rock must have been formed during the period when the animal or plant of which that fossil is a part was living on the globe, and could not have been formed either before that species came into existence or after it became extinct.[1] In cases, therefore, where the original order of the rocks has been confused by the action of disturbing forces, or where the rocks themselves are only at rare and wide intervals exposed to view, their order of deposition and consequent succession of place may be more easily and certainly ascertained by the examination and determination of their fossil contents than by any other method.

Practically, it has been found that while a very slight acquaintance with the most ordinary forms of some ten or a dozen of the most frequently occurring minerals is all that a geologist must *inevitably* learn of mineralogy, the number of fossil animals and plants, with the forms and the names of which he will have to make himself familiar, will often have to be reckoned by hundreds.

This branch of geological knowledge is now known under the name of Palæontology.

Perhaps, however, the tendency of late years has been to neglect to too great an extent the bearing of mineralogical

[1] The very rare and exceptional cases in which ancient coins may have been deposited in the foundation of a recent building, or fossils originally in one rock may have been washed out and buried in another, need not more than a passing notice.

knowledge on geology. There are many subjects on which we have still to ask the chemist and mineralogist to enlighten us.

One deficiency which is particularly obvious in Britain is the want of a good and precise nomenclature of rocks, and especially of igneous rocks. Since the publications of Jameson and Macculloch no attempt has been made in English to supply this deficiency, and to bring up our lithological nomenclature to the present state of chemical and mineralogical knowledge. Neither was the want succinctly supplied in any other language till the appearance of the *Gesteinslehre* of Bernhard Cotta. By the assistance of this and other works we hope, to some slight extent, to supply the deficiency in this treatise.

DISTRIBUTION OF THE SUBJECT.

In order to reduce the great subject of geology to something like order, it appears advisable to divide it into three heads, for which we may use the terms—1. Geognosy; 2. Palæontology; and, 3. The History of the Formation of the Series of Stratified Rocks.[1]

By Geognosy may be understood the study of the structure of rocks independently of their arrangement into a chronological series, and it might be divided into two parts—Lithology and Petrology. By Lithology is meant the study of the internal structure, the mineralogical composition, the texture, and other characters of rocks, such as could be determined in the closet by the aid of hand specimens.

Under Petrology we may arrange the larger characteristics of rocks, the study of rock-masses, their planes of division, their forms, their positions and mutual relations, and other characters that can only be studied in "the field," but without entering on the question of the geological time of their production.

The subject of Palæontology will be left for a separate article, but under the head of "History of the Formation of the Series of Stratified Rocks," a condensed abstract of that history will be given, in the form of a chronological classification, mentioning some of the principal and typical groups of rocks known to have been produced at different parts of the earth during each of the known great periods of its existence.

PART I.—GEOGNOSY.

SECT. I.—LITHOLOGY.

CHAP. I.—ON THE ORIGIN AND CLASSIFICATION OF ROCKS.

Lithology, or the study of the mineral structure of rocks, is based on mineralogy. The number of minerals, however, which enter so essentially into the composition of rocks, as to be called their constituents, is very few when compared with the whole number of minerals known to the mineralogist.

The principal rock constituents are the following,—One simple substance, namely, carbon; one primary compound, silica or quartz, to which, perhaps, rock-salt may be added; and the following secondary compounds, made up of two or more primary compounds, namely, carbonate of lime (calcite or calc spar), sulphate of lime (gypsum), and a number of silicates, which may be grouped under four heads, as the Felspars, the Hornblendes or Augites, the Micas, and the Zeolites.

Crystallization.—One of the most obvious properties of minerals is their crystallization. All crystals are, as it were, built up of minute crystalline particles of like forms, and have been produced by the successive external additions of these minute particles.

It is clear, then, that these particles must have been free to move and arrange themselves; in other words, they must have been in a *fluid*, or *nearly fluid* state. But this fluidity may have been the result either of *solution* in water or other liquids, or of *fusion* by heat. Whenever, then, we find a crystal or a mineral particle that has an internal crystalline structure, we may feel assured that it has once been either *dissolved* or *melted.*

But if this be true as regards individual crystals or crystalline particles, it must be true also of rocks that are made up of such crystals or such particles.

Now some minerals, as, for instance, carbonate of lime, are readily soluble in water containing carbonic acid gas, or in liquid acids; if, therefore, we meet with a rock composed of crystalline particles of carbonate of lime, we could easily believe that it had once been dissolved in water and deposited from that solution.

As regards the solid acid silica, it is also soluble in water containing carbonic acid gas or some other substances, and also when in certain chemical states, and in water at a high temperature. We can therefore easily understand the deposition of crystals of silica or quartz from aqueous solutions.

For the production of many silicates, however (as, for instance, the artificial silicates, porcelain, slag, and glass), great heat is necessary, and the consequent fusion that takes place. We know, also, with regard to many, if not most of the natural silicates, that they are practically insoluble in water, or in any other fluids which are found abundantly in nature.

When, then, we meet with rocks composed altogether of crystals, or crystalline particles, of such silicates, we are compelled to conclude that those rocks were once in a state of fusion from heat.

But in each of these cases we should find gradations from some rocks in which the crystalline particles were large and distinct, through others where they became less and less, and were eventually only discernible with a lens, into some at last which appeared quite *compact* and homogeneous. The very fact of the gradation, however, would teach us that what was true of the crystalline rocks might also be true of *compact* rocks of the same mineral composition, and that therefore crystalline and compact limestone, quartz crystals and compact flints, might equally have been dissolved in water, and crystalline and compact silicates equally been melted by heat. In the latter case the artificial silicate glass again assists us, since we know that the very same mass which, if cooled under given circumstances, will form a perfectly homogeneous glass, will, if allowed to cool more slowly, become opaque and stony, and that ultimately it will begin to granulate, that is, its constituents will begin to separate from each other and form distinct crystals in the mass.

Chemical Rocks.—These considerations at once prepare us for the belief that many rocks have been chemically formed, that is, have consolidated from fusion or solution in obedience to chemical laws. Those that have become consolidated from fusion we may call Igneous rocks; those that have consolidated from solution Aqueous rocks.

[1] Stromatology (from στρῶμα, stratum) might perhaps be used to express this portion of geology.

Geology.

Chemically-formed aqueous rocks may be either crystalline or compact.

Chemically-formed igneous rocks may be either crystalline, compact, or glassy.

Both kinds may have occasionally concretionary, nodular, sparry, fibrous, or other textures, according to local modifying circumstances.

In chemical crystalline rocks, whether aqueous or igneous, the external forms of some of the crystals are often very imperfect and sometimes even irregular. Crystals of one mineral having been first formed, prevented the regular formation of the crystals of the other minerals; or the whole mass having crystallized together, the crystals were mutually hindered from attaining their full development by the growth of their neighbours, and all became thus locked and interlaced together in a congeries of mutually imbedded and intertangled crystalline particles.[1]

These crystalline particles, although not perfect crystals, have yet some faces and angles of perfect crystals, being evidently formed in the position where we now find them. They are *innate* or *ingrown* crystalline granules.

Loaf-sugar, sugar-candy, crystallized alum, are familiar examples of this structure, and will serve to explain what is meant by the *innate* crystalline structure of marble or of granite.

Mechanical Rocks.—When, however, we began to study rocks with a view to examine into their mineral constitution, we should soon become aware of another essential difference in them. We should find some rocks the particles of which were large and distinct, but not at all crystalline; or if crystalline internally, we should see that their external form was not regular like a crystal, but exhibited evident marks of mechanical fracture and attrition, of wearing away, or rounding.

The particles of the rocks which are now alluded to, whether internally crystalline or internally compact, are not mutually imbedded and interlaced, like those of chemical rocks, and have no such appearance of having *grown* where we now find them, but have evidently been brought together from different places, and adhere to each other either in consequence of having been squeezed together by mechanical pressure, or because they are cemented by some other substance which serves to bind and unite them to each other.

In these rocks the particles are generally more or less rounded and smoothed externally, as if water-worn.

This water-worn form and derivative origin is very obvious with respect to some of these rocks, which consist of *pebbles* or rounded fragments of other rocks, compacted together in *sand*, which is clearly the result of the rounding process.

In many cases the very rock from which the pebbles were derived can be pointed out, and the distance, therefore, which they have been carried is known. In other cases the fact of mechanical transport is equally obvious, though the original site may be unknown.

From those cases where the particles are large and their form distinctly visible, there is every gradation through those where they become less and less, till at length they are not discernible by the lens. We have, then, compact derivative rocks just as we have compact chemical ones.

To all such derivative rocks we may with great propriety assign the term Mechanical, as showing that their materials have been mechanically transported to their present sites.

The machinery employed in this transportation must clearly be either currents of water or currents of air, and the mechanical rocks, therefore, must be all either Aqueous or Aerial rocks, the latter being very few and unimportant compared with the former.

Even with regard to igneous rocks, which must in themselves be purely chemical compounds, they still may have their mechanical accompaniments whether they were formed in the air or in the water, as we see in the case of the ashes, cinders, and fragments blown from the mouths of volcanoes.

Organic Rocks.—There is yet another source from which some rocks are derived, inasmuch as some are found to be wholly, or almost wholly, composed of fragments of animals or plants. These rocks may be termed Organic, in the sense of organically-derived rocks.

The portions of the plants or animals may be either little altered from their original condition, or very much altered and altogether mineralized. In the first case, they belong perhaps more particularly to the mechanically, in the latter, to the chemically, formed rocks.

Mixtures.—As, moreover, chemical precipitates are liable from many causes to be adulterated with mechanical impurities, and mechanical deposits to be impregnated with chemically acting gases or liquids, and as both mechanical admixtures and chemical actions and reactions may play a part in the formation of rocks made of organic materials, we can easily see how all three classes of rocks may occasionally be mingled together and pass into each other, and how many aqueous rocks may have been formed by the union of two or of the three agencies, and appear to belong to one or the other class according to the point of view from which we observe them.

We have now arrived, then, at the conclusion that different rocks had an aqueous, an igneous, or an organic origin, solely from the consideration of the nature of the mineral particles composing them. This conclusion, however, by no means depends entirely on such considerations. The aqueous rocks are known to be so, not only from their being composed of soluble minerals, or of minerals that have been water-worn, or parts of plants and animals that have either lived in water or been carried down into it, but also because their materials are arranged in regular layers and beds or *strata*, obviously the result of their having been regularly *strewed* out over the bottom of the seas and lakes in which they have been deposited. They are hence often called Sedimentary and Stratified rocks.

The igneous rocks, on the other hand, are many of them such as we see now to be poured forth from the mouths of volcanoes in the state of molten lava; others again are closely allied to these, and there is a regular chain of gradation from these through their whole series.

Those which least resemble actual lava are found sometimes to have been injected, in the form of veins and tortuous strings, into the cracks and crevices of other rocks, or to have cut through them in great wall-like masses called "dykes" just as lava does. In many of these cases they have exerted just such an influence on the rock they came in contact with as great heat would have exercised. The neighbouring rocks have in fact been burnt, and are sometimes greatly altered from their original state as seen at a distance from the igneous rocks.

Metamorphic Rocks.—This fact, together with the consideration of the chemical actions and reactions that may be set up in the mass of rocks by the percolation of various fluids or gases, and the mechanical or chemical forces that may be brought into play by the action of pressure and other agencies, naturally disposes us to ask the question,—Whether many rocks as we now see them may not be in a

[1] The paragenesis of minerals in chemically-formed rocks is a subject that has not yet received the attention it deserves. The peculiar association of minerals, and the relative order of their crystallization, as shown by their mutual indentation and envelopment, would, if accurately observed and described, doubtless explain much that is still obscure as regards the formation of such rocks, as also that of the contents of mineral veins.

very different state from that in which they were originally formed? We should ultimately find reason to answer this question in the affirmative, and introduce another class under the head of Metamorphic (or transformed) rocks, to include those which had, by means of subsequent alteration, acquired any essentially different characters from their original ones.

Guided by these considerations, we may class all rocks whatever under the four great heads of *Igneous*, *Aqueous*, *Aerial*, and *Metamorphic*.

The *Igneous* are almost entirely chemically-formed rocks, but some of their varieties have their mechanical accompaniments.

The *Aqueous* rocks are either chemical, mechanical, or organic, those of mechanical origin being far the most abundant, although not the most important kinds.

The *Aerial* are all mechanical.

The *Metamorphic* are either those in which the original structure and composition are still obvious, or those in which those characters are altogether obscured and replaced by others produced either by heat, or pressure, or both conjoined.

We shall commence with the description of the igneous rocks, because these may be looked upon as those most essentially original and self-subsisting, or most independent of the others.

Before entering on the technical description of rocks, however, it will be as well, perhaps, to define exactly, what we mean by the term rock.

A *mineral* is an inorganic substance that has a definite chemical composition, and a regular and symmetrical form; each of the particles of which it is made up exactly resembling all the other particles.

A *rock* is a mass of mineral matter consisting of many individual particles, either of one species of mineral, or of two or more species of minerals, or of fragments of such particles. These particles need not at all resemble each other either in size, form, or composition; while neither in its minute particles, nor in the external shape of the mass, need a rock have any regular symmetry of form.

Geologists are accustomed also to include under the term rock, all considerable accumulations of mineral matter, whether they be hard or soft, compacted or incoherent. In this sense soft clay, loam, or loose sand, may be called "a rock."

Chap. II.—IGNEOUS ROCKS.

The igneous rocks are divided by Sir C. Lyell and others into two classes—the Volcanic and the Plutonic. Such a classification is theoretically correct, as separating those formed at the surface, in air or water, from those formed deep in the earth; but practically we often meet with rocks that it is difficult to place with certainty in either class. It is, moreover, often advisable to avoid terms that involve theoretical or foregone conclusions. For these reasons we should prefer, with Sir R. I. Murchison and others, to arrange the igneous rocks under three heads—Volcanic, Trappean, and Granitic; taking the middle term, Trappean, as one of convenience only, to include some that are possibly volcanic, some that are more essentially granitic, with many intermediate or undetermined rocks between the two.

Igneous rocks differ among each other—

1*st*, As being made up of different minerals.

2*d*, As having different textures.

The three principal varieties of textures are the crystalline (or granular), compact, and glassy.

When a rock is distinctly granular, so that the crystals of its mineral constituents are clearly discernible, they may be determined by simple inspection. In the compact and vitreous textures, however, the determination of the mineral constituents of a rock can only be arrived at by chemical analysis. This will enable us to find out of what substances the rock consists, and what are their proportions; and the consideration of these proportions, and the comparison of them with those forming different minerals, will enable us to determine with greater or less certainty of what minerals the rock is composed, or, at all events, what minerals it would probably form if they were allowed to develop themselves.

It has been shown from the processes of the manufacture of glass, that the very same molten mass of silicates would form transparent glass, opaque slag, or crystalline stone, according to circumstances. As these different conditions of texture receive different names, so may the different textures of natural substances receive different names, notwithstanding that in some cases they consist of essentially the same ingredients.

As some slags become porous, or vesicular, and thus pass into cinders, so some igneous rocks likewise assume a vesicular or cindery texture.

When the pores or vesicles become filled with a crystalline nucleus or kernal of any mineral, either by subsequent infiltration, or during the process of consolidation, so that the dispersed crystalline patches look like almonds stuck into the mass, the rock is said to be amygdaloidal.

When single detached crystals are disseminated through a compact base, or large crystals through a fine-grained base, the rock is said to be porphyritic. The term Porphyry, then, which has been often used as a designation for a particular class of rocks, will here be used chiefly, or solely, to distinguish this variety of texture, which is one that may occur in every kind of igneous rock.

From what has been said before, it may be inferred that all igneous rocks without exception are composed of minerals which are silicates.

These minerals may be said to belong to two great classes,—silicates of magnesia and silicates of alumina,—the species or varieties of each resulting from their various mixtures with silicates of potash, soda, lime, iron, manganese, &c. The silicates of magnesia, &c., constitute the hornblendic, or pyroxenic, or augitic minerals; the silicates of alumina, &c., forming the feldspathic ones. The micaceous minerals, which we may look on as resulting from mixtures of the two, or as holding an intermediate place between them, are in reality of minor importance so far as unaltered rocks are concerned.

The feldspars are the basis of all igneous rocks, those in which no feldspar of any kind is present being very few and unimportant, even if they exist at all. The hornblendic and augitic minerals hold the next most important place; and the volcanic and trappean rocks may be divided into two great series depending on the amount of those minerals which are mingled with the feldspars. Those rocks in which feldspar alone occurs, or in which it greatly predominates, may be called the feldspathic rocks; those in which the hornblendic or augitic minerals play a considerable part may be called hornblendic or pyroxenic rocks. It must, however, be clearly borne in mind that feldspar in some form or other is always the basis of the latter, while hornblende and augite in any form are often entirely absent from the former.

I.—THE VOLCANIC ROCKS.

These are often spoken of under the general term of Lava. They include, however, some that would be more commonly described as trap rather than lava, and others, such as tuff and ashes, which could not strictly be called by either name.

The volcanic rocks have been classified by Abich under three heads,—*Trachyte*, *Dolerite*, and *Trachy-dolerite*. Bunsen, also, in his Memoir on the Volcanic Rocks of Iceland, gives a similar classification, describing his *normal*

Geology.

trachytic rocks as one end of the series, and his *normal pyroxenic* rocks as the other end, with many intermediate varieties between the two.

Bunsen gives us the following as the mean value of the composition of his two normal rocks:—

	Normal Trachytic. Trachyte.	Normal Pyroxenic. Dolerite.
Silica	76·67	48·47
Alumina and protoxide of iron	14·23	30·16
Lime	1·44	11·87
Magnesia	0·28	6·89
Potash	3·20	0·65
Soda	4·18	1·96
	100·00	100·00

He then shows that, by analysing any intermediate variety of rock, and determining the proportion of any one of these ingredients (taking the silica as the easiest and best), the proportion of the other ingredients may be calculated, and thus may be determined the quantities of these two normal substances which have been mixed together to form the rock in question.

In the following descriptions of the volcanic rocks we are largely indebted to Cotta's *Gesteinslehre*, to the Introduction to Daubeny's *Volcanoes*, and to the last chapter of the third volume of D'Archiac's *Histoire des Progrès de la Géologie*.

The Trachytes are so called from the Greek word τραχὺς, rough, as they commonly have a rough prickly feel to the finger. They are usually light-coloured, pale gray, or white, but sometimes dark gray and nearly black. They are composed principally of feldspar,—the feldspar being one of the varieties that is rich in silica, such as orthoclase, adularia, or albite, and not any of those in which the bases are more abundant, such as labradorite or anorthite.

As Trachyte is made into a class as well as a species of rock, we may similarly elevate Dolerite.

The Dolerites, so called from the Greek δολερὸς, deceptive, are usually of a dark green or black colour, weathering brown externally. They are commonly heavier than the Trachytes, as containing a less proportion of silica and a greater one of the heavier bases.

They are composed partly of a feldspathic and partly of an augitic or pyroxenic mineral, the feldspar being commonly, though not perhaps invariably, one of the more basic silicates, such as anorthite or labradorite.

The Trachytes, or Feldspathic Lavas.

1. *Trachyte*, properly so called, has either a fine-grained or quite compact texture, a harsh feel, and sometimes a cellular and scorified appearance. It varies in colour from a pale gray to dark iron gray, and is sometimes reddish, from the presence of iron. It is composed of a confused aggregation of crystals of feldspar, often minute and needle-shaped, but with others larger and more distinct.

This feldspar is said to be commonly potash albite (or pericline), and glassy feldspar (or adularia), in which some of the potash is replaced by soda. Crystals of mica and hornblende are often present, and sometimes even of augite, the whole either confusedly united without cement, or embedded in a feldspathic paste, either cellular or compact.

2. *Trachytic porphyry* has seldom a scorified aspect, looking often more like a plutonic than a volcanic rock, as that of the Pic de Sancy, and the Roc de Cacadogne, of Mont Dor, which at first sight resembles granite in external appearance.

Crystals of glassy feldspar, sometimes small, but sometimes as much as half an inch long, white or flesh-coloured, are set in a compact light-coloured feldspathic paste, with brown mica, and sometimes also with crystals of quartz.

"Many varieties of trachytic porphyry contain a number of very small globules, which seem to consist of melted feldspar, having often in their centre a little crystal either of quartz or mica. The assemblage of these globules leaving minute cells between them, sometimes gives to the rock a scorified aspect." (Daubeny.) Chalcedony occurs in small geodes,[1] and sometimes intimately mixed with the paste in which the crystals are imbedded.

Geology.

Trachytic porphyry passes sometimes by insensible gradations into—

3. *Pearlstone*, which is composed of a number of globules from the size of a nut to that of a grain of sand, of a vitreous or enamelled aspect, and pearly lustre, adhering together without any paste.

These sometimes lose their lustre and size, and pass into a compact stony mass, or change into globules of feldspar, compact, or radiated—the whole rock being composed of them. Many variations occur; the whole sometimes becoming fibrous, cellular, spongy, and passing gradually into pumice.

4. *Domite* is a grayish white, fine-grained, compact, earthy, and often friable variety of trachyte. It frequently contains flakes of brown mica.

It appears to be a decomposed trachyte, in which the feldspar is affected, but the mica not. The passage of muriatic (hydrochloric) acid is, by some, supposed to have affected this transformation. It is a remarkable rock, but not one of general occurrence beyond the district of the Puy de Dôme, in France.

5. *Andesite*, a trachytic rock, found at Chimborazo and other parts of the Andes; has white crystals resembling albite in a crystalline base of a dark colour. It has various degrees of compactness and consistency, and has a coarse conchoidal fracture.

Small crystals of glassy feldspar occur, though rarely, but those of hornblende are common; and augite is also present sometimes. From the predominence of hornblende it sometimes passes into a diorite or greenstone.

6. *Clinkstone or Phonolite* is a compact homogeneous rock, with a scaly or splintery fracture, sometimes conchoidal, of a grayish green, or ashy gray colour, both weathering white externally. It is often rendered porphyritic by scattered crystals of glassy feldspar, but these are commonly not very distinctly separable from it, appearing only as brilliant surfaces here and there in the mass. Hornblende, augite, and magnetic iron are rare in it. According to Gmelin it consists of a mixture of glassy feldspar, with a zeolite in variable proportions. It may, therefore, be formed from trachyte by the addition of sea-water; the soda of which, combining with some of the orthoclase, would make glassy feldspar, while the water, combining with the other constituents, would form a zeolite. (*Abich, in D'Archiac*, vol. iii., p. 604.)

Clinkstone commonly splints into thin slabs, and is often so finely laminated as to be used for roofing slate. The slabs give a metallic sound when struck with the hammer, whence its name. It is sometimes perfectly columnar; the columns splitting across into slabs, which are also used as slates. It may, however, perhaps be doubted, whether many of the so-called volcanic clinkstones really contain water according to the definition, and whether they are not a flaggy, or laminated variety of compact trachyte.

7. *Obsidian*, or *Volcanic glass*, is the vitreous condition of a trachytic rock. It is said to be necessary for its natural production that the rock should be composed of minerals rich in silica, or "trisilicates;" the simple "silicates" or "bisilicates" of alumina, being incapable of forming obsidian.[2] (*Daubeny*, p. 16, 2d edition.)

8. *Pumice* is the cellular and filamentous form of obsidian, and the same remarks as to origin will apply to it.

[1] Geodes are rounded concretions, generally hollow, and containing crystals. They are sometimes called "potato stones" from their size and shape.

[2] Without disputing the truth of the origin here assigned to all naturally formed obsidian, it is yet equally true, that basalt can be artificially converted into obsidian, by simple melting and rapid cooling. Messrs Chance of Birmingham now melt the basalt of the Rowley Hills by simple heat without the addition of any foreign ingredient, and cast it into blocks and ornamental mouldings for architectural purposes. Portions which are allowed to cool rapidly,

Abich divides pumice into two groups; the cellular, being dark green, poorer in silica and richer in alumina, derived from clinkstone, trachyte, or andesite; and the filamentous, white, containing more silica, and derived from trachytic porphyry.

The Dolerites, or Augitic Lavas.

9. ***Dolerite.***—A crystalline, granular, distinct mixture of labradorite and augite with some titaniferous magnetic iron ore, and also often with some carbonate of iron and carbonate of lime. General colour dark gray.

The labradorite forms white or light gray tabular crystals, and the augite black columnar ones. Both can easily be distinguished by the naked eye, especially in the coarser varieties. The magnetic iron forms small octohedral scarcely visible grains, which can be recognised only by the magnet. (*Cotta.*)

Cotta mentions a variety from Aulgasse near Liegfried, which contains 28 per cent of the carbonates, three-fourths of that being carbonate of iron.

10. ***Anamesite*** is properly only a fine-grained dolerite, so fine-grained that we can only distinguish the fact of the granular texture, and no longer recognise the individual minerals. Its colour is dark gray or greenish or brownish black. It forms the intermediate step between dolerite and

11. ***Basalt,*** which is a compact, apparently homogeneous, nearly or altogether black rock, with a dull conchoidal fracture. It often contains crystals or grains of augite, olivine, or magnetic iron, and is sometimes vesicular or amygdaloidal.[1]

The knowledge of the composition of basalt dates from 1836, when Gmelin showed that it was, like phonolite, an intimate mixture of one part that was decomposable in acid and another not decomposable. The decomposable portion is partly of the nature of a zeolite, partly of that of labradorite; the undecomposable portion is augite. (*Cotta.*)

Basalt, therefore, as it contains water in its zeolitic portion, bears the same relation to dolerite that clinkstone does to trachyte.

The three rocks above mentioned differ rather in texture than in mineral composition. In the two following rocks another feldspathic mineral is substituted for the labradorite.

12. ***Nepheline Dolerite*** is a crystalline granular mixture of nepheline, augite, and some magnetic iron. (*Cotta.*)

13. ***Leucite Rock*** is a crystalline granular, porphyritic-like, or even a compact, aggregate of leucite, augite, and some magnetic iron; generally gray. (*Cotta.*)

Trachy-dolerite, or Intermediate Lavas.

These rocks, from their very nature, do not admit of any precise definition or nomenclature. The rocks already named and described are mixtures of various minerals. When those mixtures are in anything like definite proportions, and the minerals are well characterized, the rocks assume a particular character, and are capable of definition. When, however, the mixtures become indefinite, and the minerals begin to pass one into another, or are so intimately blended that they cannot be distinguished, attempts at definition only lead to confusion instead of order, and encumber the memory rather than assist it.

Instead of separating these blending rocks, then, and distinguishing them by different names, it is better to follow the example of Abich, and unite them under one term, such as that proposed by him of—14. *Trachy-dolerite.*

Neither is this a mere evasion of a difficulty, since the things themselves are so similar, both in substance and in origin, that the creation of distinct names would be merely making distinctions where no real or essential difference exists.

It may be useful, here, perhaps, to give Abich's table of the specific gravity, and the per centage of silica of some of the above rocks, arranging them according to the latter character.

	Specific Gravity.	Per centage of Silica.
1. Porphyritic trachyte..........	2·5783	69·46
2. Trachyte	2·6821	65·85
3. Glassy andesite.........	2·5851	65.55
4. Domite..............................	2·6334	65·50
5. Andesite	3·7032	64·45
6. Phonolite...........................	2·5770	57·66
7. Trachy-dolerite	2·7812	57·66
8. Dolerite..............................	2.8613	53·09

From this it appears that the per centage of silica in porphyritic trachyte is equal to that of albite; in trachyte and andesite, equal to that of orthoclase; and in dolerite, equal to that of labradorite. Trachy-dolerite, intercalated among the rocks, as andesite and oligoclase are between potash albite, and labradorite among the feldspars, shows the passage from one to the other. Lastly, with only two exceptions, the above table shows us that the specific gravity increases as the per centage of silica diminishes; and Abich, therefore, says that the determination of these two characters, joined to the observation of the mineralogical constituents, will suffice to determine with precision to which kind any volcanic rock belongs.

There is yet another variety of volcanic rocks to be considered, that, namely, called Tuff or Peperino.

15. ***Tuff*** (ash) is ordinarily the ashes, dust, and powder, mixed with little lapilli and coarser fragments, blown from a volcanic focus, and falling either on to the land or into the sea. If it fall on the land it may become compacted into a rock, either by the simple pressure of its own weight, or in consequence of the percolation of water containing mineral matter in solution. This water may either be rain falling with the ashes, or rain or other water subsequently gaining access to them. If the ashes fall into the sea they become subject to the conditions under which all other mechanically-formed aqueous rocks are produced. In this case tuffs often contain fossil shells.

Abich describes the trachytic tuffs of the neighbourhood of Naples as of two sorts,—one inferior, of a clear straw-colour, characterized by fragments of glassy feldspar, augite, and hornblende; the other, or upper tuff, being white, in thinner beds, and with much pumice.

Bunsen, in his description of the volcanic rocks of Iceland, seems inclined to attribute a metamorphic origin to tuffs, and to derive them from the decomposition or alteration of the pyroxenic rocks of that island. He calls them palagonitic tuffs, the mineral palagonite (a hydrated silicate of alumina and lime) being an essential constituent of these tuffs both in Iceland and in Etna, as shown by Walterhausen.

He refers to Darwin's observations on a basaltic lava which has flowed over limestone at Port Praya (C. de Verde Islands), and says that the lava, when in contact with the limestone, possesses all the characters of palagonite.

Without denying that some tuffs may have been formed from the decomposition *in situ* of actual lava, we are still inclined to look upon that as the exception rather than the rule, and to believe that tuff in general is a mass of volcanic "ash," deposited mechanically, however it may have been subsequently modified either by igneous or aqueous agencies.

Some geologists confine the term tuff to trachytic masses, and use the word "peperino," to designate those derived from pyroxenic (or augitic) rocks.

Tuff and peperino, from the nature of their origin, must have a great variety of character, from a fine-grained compact stone to a coarse breccia or conglomerate, and from a loose incoherent accumulation to a hard tough stone.

Immense piles of volcanic sand and gravel, and great breccias composed of large semi-angular fragments, also not unfrequently occur, which would hardly be called tuff, but

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form obsidian, undistinguishable by any external character from that of volcanic districts. Specimens may be seen in the Museums of Jermyn Street, London, and Stephen's Green, Dublin.

[1] According to Cotta, the rock of the Giant's Causeway, &c., in the north of Ireland, ought to be called anamesite rather than basalt.

which must not be altogether omitted in our enumeration of volcanic rocks.

II.—TRAPPEAN ROCKS.

We have before said that we adopt this designation as a convenient one only, and for the same reason we would extend it. The word "trap" has hitherto been considered to be strictly applicable only to hornblendic or augitic rocks. It is derived from the Swedish *trappa*, a stair,—those rocks being supposed usually to assume a step-like form. The term, as thus derived, is, however, no more exclusively applicable (except from custom) to the hornblendic than to the feldspathic igneous rocks, and has been often used vaguely to designate any igneous rocks which could not be said to be distinctly granitic on the one hand, or absolutely volcanic on the other. In this vague and general sense we shall here use it, its very vagueness being its recommendation as best adapted to receive a class of rocks that do not admit of any strict definition or circumscription.

As the volcanic rocks are divisible into three heads,—Feldspathic, Augitic, and Intermediate,—so we may conveniently divide trappean rocks into three similar heads,—*Feldspathic, Hornblendic*, and *Intermediate*. For the two first of these the general designations, Felstone and Greenstone, may be used,—felstone corresponding to trachyte, and greenstone to dolerite. It is not easy to make a combination of words answering to Abich's trachy-dolerite, but the intermediate rocks exist in abundance which would be comprised under such a designation.

Felstone is a name taken from the German *Feldstein*, and proposed by Professor Sedgwick to designate a class of igneous rocks to which many titles have been given, but which have never, we believe, been yet properly examined and described. Compact feldspar, petrosilex, and cornean, are among these names, as well as the hornstone of some geologists, though that name has also been applied to chert.

Feldstone or Feldspathic Traps.

16. *Felstone* is a compact, smooth, hard, flinty-looking rock.

It has two principal varieties,—the pale green, passing into a greenish or yellowish white; and the blue or gray, varying from pale to dark gray. The gray or blue variety weathers white, its external margin being white sometimes to the depth of a line, sometimes to that of an inch or two. Some blocks that appear wholly white have a small blue patch in the centre. The green or greenish white variety is often very translucent at the edges; the gray is commonly opaque. The fracture is generally smooth and straight, seldom conchoidal; but in some of the blue or gray varieties it is rough and splintery. It often splits into small slabs, and sometimes, especially the green kinds, into laminæ.

The fragments sometimes ring with a metallic sound like clinkstone, and many so called clinkstones (such as those of the Roche Sanadoire and Tuilliere in the Mont Dor district, and those of the Velay) are almost undistinguishable by any external characters from many of the felstones of Wales and Ireland.

In many felstones, both in North Wales and South Ireland, lines and striæ, resembling lines of lamination or deposition, of slightly different colours, can be traced through the mass of the rock, sometimes straight, sometimes more or less wavy and tortuous, like the variously hued lines and bands in a slag from an iron furnace, and resulting, probably, like them, from the motion of the mass when in a pasty and semi-fluid condition.

In the most smooth and compact varieties, the lens will often disclose small shining facets of crystals of feldspar, and these become larger and more numerous till we reach the completely granular and crystalline felstones. Small crystals or crystalline portions of quartz also are occasionally present in most varieties.[1]

Sometimes the rock becomes nodular and concretionary, the nodules varying in size from that of a pea to that of a man's fist, either scattered in a compact or powdery base, or touching each other and making up almost the whole mass of the rock. The substance of these nodules is sometimes the same as that of the base, but in some instances they are hollow, and contain crystals of quartz and other minerals, and also a soft, dark green earth. In this respect it seems to resemble the rock previously described as pearlstone, though it never has any pearly or other lustre.

Felstone as thus described is probably a mixture of a feldspar with silica in a state of paste. We may look on it as a compact form of trachyte, more or less altered by pressure, or other agencies, and containing a larger proportion of silica.[2] It passes from that state to one in which the minerals are crystallized out more or less completely, becoming first a granular and crystalline felstone, and then a granular aggregate of crystals of feldspar and quartz, passing into a quartziferous porphyry.

This latter is the rock known in Cornwall as elvan, and we think, as a convenient designation, "elvanite" might be adopted as a name for it and its varieties.

17. *Pitchstone* appears to be a variety of felstone, having a more vitreous character, and a resinous lustre; whence it derives its name. It is of many colours, varying from black to green, gray, and yellow. The black varieties look, however, more like hornblendic or augitic mixtures than purely feldspathic rocks.

Clinkstone is frequently spoken of as a trappean as well as a volcanic rock, but it is probable that many of the rocks so described would not come within the definition of clinkstone given before, and are only platy, flaggy, and laminated (perhaps even "cleaved") varieties of felstone. There may, however, be other true trappean clinkstones, the hydrated varieties of felstone, just as volcanic clinkstone is a hydrated trachyte.

18. *Felstone porphyry*, or *Feldspar porphyry*, is a rock consisting of a base of compact felstone, with distinct scattered crystals of feldspar embedded in it. The base is commonly either of a dull green, gray, or red colour, and

[1] Felstone, as here described, is a very abundant rock among some of the older formations in the British Islands, making up whole mountain masses; but it appears to be little known or remarked on the Continent, as Cotta speaks of it as only rarely seen and in small quantity, and but two specimens of it occurred in a collection of 660 igneous and altered rocks purchased from Krantz of Bonn.

[2] Professor Haughton has recently analysed some specimens of Irish felstone, and has found in them such an amount of silica as confirms the view commonly entertained of this rock, that it is a mixture of feldspar and quartz. His results, as given to the Geological Society, Dublin, in a recent paper, are—

Felstone of Ballymurtagh, county Wicklow.

Quartz	45·54
Feldspar	54·16
	99·70

Felstone of Knockmahon, county Waterford.

Quartz	40·81
Feldspar	57·19
	98·00

Felstone of Benaunmore, near Killarney.

Quartz	20·51
Feldspar	77·85
	98·36

This superabundance of silica in these old igneous rocks, so far beyond that which is found in any trachyte, is certainly a very curious subject for speculation.

Could they ever have flowed at the surface with their present constitution? Has their composition been changed, by aqueous metamorphosis or otherwise, since their formation?

the imbedded crystals are commonly white or flesh colour, or some other shade generally contrasted with the base by being of a paler hue.

19. *Quartziferous Porphyry (Elvanite)* has the same base, or a granular one of the same materials, with disseminated crystals or crystalline grains of quartz.

Greenstone, or Hornblendic Trap.

Greenstone is an old and well-known name for a numerous and important class of trappean rocks. It is a translation of the German *Grunstein*, and synonymous with the French *Diorite*.

20. *Greenstone*, or *Diorite*, consists of a mixture of feldspar (orthoclase) and hornblende, varying in texture from a fine-grained compact rock, in which the crystalline state of the minerals is barely discernible with a lens, to a coarsely crystalline aggregate. Its colour is generally a dull green, varying from light to dark green, sometimes almost black. In some varieties, on the other hand, where the feldspar is very white and in great quantity, the rock might almost be described as white, speckled with dark green spots. It weathers to a dull dark-coloured brown, the weathered blocks being generally massive and well rounded, and covered with patches of white lichen. On breaking open the weathered part of a greenstone and testing the rock with acid, we almost invariably find that it will effervesce along the inner border of the weathered portion. Many Greenstones, also, even when apparently unweathered, effervesce with acids along the minute cracks and pores in the mass.

The feldspar of greenstones is commonly presumed to be orthoclase, but is, perhaps, often albite; and in some of the rocks which come under this head augite or hypersthene is substituted for hornblende. Mica, of a dark brown colour, sometimes occurs (as in some of the Wicklow greenstones), either in distinct plates, or as coating the surfaces of small crevices or those of the other crystals.

M. Delesse says that many rocks hitherto classed as greenstone contain no hornblende, their green colour being the result of the greenness of some of the feldspar composing them. These, then, would probably come under the head of one of our crystalline felstones.

Greenstone, like felstone, becomes sometimes porphyritic, in consequence of one or other of its constituents forming distinct crystals in a compact mixture of the rest, or larger disseminated crystals in a granular crystalline base. When the greenstone is quite compact and dark coloured, it is not, perhaps, very easy to distinguish it from basalt by any external characters.

21. *Melaphyre* is a name for a black porphyritic rock, containing crystals of augite or oligoclase, in a base of augite and labradorite or oligoclase.

Under the general head of Greenstones and Melaphyres, Cotta describes the following rocks:—

22. *Diabase.*—A crystalline granular, sometimes porphyritic, or even a slaty, mixture of augite and labradorite or oligoclase, mostly with some chlorite.

23. *Calc-diabase.*—A finer-grained, or entirely compact diabase, with round grains of calcspar.

24. *Gabbro, Euphotide, Diallage rock.*—A crystalline granular mixture of labradorite or saussurite, and diallage or smaragdite.

25. *Hypersthenite, and Hypersthene rock.*—A crystalline granular mixture of labradorite and hypersthene.[1]

26. *Augite rock, Lherzolite.*—A coarse-grained to compact rock, consisting essentially of augite alone. Rare. Lhebers in the Pyrenees.

27. *Norite* is a name of Esmark's for a rock yet undetermined; some of its characters seem to belong to diorite and some to gabbro.

28. *Diorite.*—A crystalline granular mixture of hornblende and albite; sometimes even slaty or porphyritic.

29. *Globular Diorite, Orbicular Greenstone, Corsican Granite.*—A crystalline granular mixture of grayish white feldspar (anorthite), dark gray hornblende, and some quartz, in which alternating concentric layers of hornblende and feldspar form globular concretions from one to three inches in diameter.

30. *Micaceous Diorite.*—A crystalline granular mixture of hornblende and oligoclase, orthoclase, quartz, and mica. Mostly dark, or quite black.

31. *Hornblende rock, Amphibolite*, consists essentially of hornblende alone, which forms sometimes a crystalline granular, sometimes a quite compact aggregate.

32. *Kersanton.*—A crystalline mixture composed essentially of hornblende and mica, in which, however, some feldspar is often mingled. In the latter case it effervesces slightly with acids.

33. *Eclogite.*—A crystalline mixture of green smaragdite and red garnet. The garnet occurs as porphyritic crystals in the fine-grained base of smaragdite.

34. *Disthene rock.*—Principally composed of disthene, with which, however, some garnet, mica, or smaragdite is mingled.

35. *Aphanite, Melaphyr.*—A compact or fine-grained, dark gray, brown, or black rock, which apparently consists principally of a feldspathic mineral intimately mixed with augite, hornblende, magnetic iron, and the like. Its exact mineralogical composition is not yet determined. It is sometimes vesicular, amygdaloidal, or porphyritic, and is even said to be sometimes slaty.

36. *Serpentine.*[1]—A compact, mostly green or brown rock, consisting essentially of the mineral serpentine only. Fracture splintery and dull, easily workable and unctuous to the touch. A variety of serpentine is Schiller rock, which contains crystals of Schiller spar.

37. *Garnet rock.*—A crystalline granular, but very unequal mixture of garnet, hornblende, and magnetic iron.

38. *Eulisite.*—A mixture of olivine-like oxide of iron, green augite, and brownish-red garnet.

39. *Epidote rock.*—A granular compact, or variolitic mixture of pistacite (green epidote) and quartz.

40. *Labradore rock.*—A crystalline aggregate of labradorite, with interspersed crystals or crystalline particles of dark hornblende. As a rule, it also contains small crystals of iron pyrites.

Basalt, like clinkstone, must also be enumerated among the traps as well as among the lavas, since it may be very difficult to say, with respect to some masses of basalt, that they were ejected from what might be truly described as a volcano.

Claystone, or *Wacke*, is sometimes spoken of as a trappean rock. It is probably either a compact basalt or greenstone, in a decomposed and earthy state, or an ash partially hardened and consolidated.

The traps, both felstone and greenstone, are accompanied, like the volcanic rocks, by their respective ashes or tuffs.

41. *Feldspathic ash*[2] is usually a rather coarse-grained flaky-looking rock, of a pale green, pale gray, or white colour. It has often a soapy feel to the touch, and would be then called chlorite-schist by many persons. It is commonly to be easily detached in flakes, which are quite translucent, and can be as easily ground down into powder. Other varieties are much harder and more compact; and there is, in fact, every gradation from a soft ash into a compact felstone, undistinguishable from solid trap.

Some of these solid-looking traps, however, show casts

[1] A magnificent mass of this rock, with crystals two or three inches wide, forms a hill at the head of St George's Bay, Newfoundland.

[1] We have included serpentine among the trappean rocks, as there may doubtless be injected masses entitled to the name. Many serpentines, however, are only metamorphosed magnesian limestones, a fact which was confirmed to us by Sir W. Logan in 1854, from his observations in Canada.

[2] Professor Sedgwick uses the term "schaalstein" to designate these ashes, translating it by "trap shales" instead of ash. If, however, we use the term "ash" in a technical sense as the translation of tuff, there does not appear any valid objection to it. The specimens of German "schaalstein" which we have seen are not the same as any of the British "ashes" we are acquainted with.

of fossils, and contain angular fragments of slate and other rocks, clearly betraying their mechanical origin. Some even contain crystals of feldspar, making the rock look like a porphyry, until closely examined, when the crystals are found to have their angles worn, and to have been more or less weathered and rounded before they were included in the base.

Along with these also, there generally occur angular or rounded fragments of felstone, slate, or other rocks, of every size up to blocks of 6 or 8 inches in diameter; the rock then becoming a trappean breccia or conglomerate, with either a hard and compact or a loose and flaky base.

Sand is sometimes mingled with this base; and there is then a passage from ash, through sandy ash and ashy sandstone, into pure sandstone.

It is rare to find a genuine ash that will not effervesce slightly with acids. The nodular concretionary structure, which we have previously mentioned as occasionally to be seen in some felstones, likewise occur in felstone ash. At least, the base in which the nodules lie is often of that flaky slightly coherent character which is characteristic of ash.

42. *Greenstone ash* is perhaps still more various in composition than that of felstone.

One well-marked variety is a quiet compact rock, of a pale greenish brown hue, speckled with small black spots.

Another is a flaky coarse-grained ash, like that of felstone, but of a darker green or olive colour. This sometimes contains embedded crystals of hornblende[1] that have had their edges rounded and worn, together with angular or rounded fragments of other rocks.

Another variety of greenstone ash is a dark hornblende slate, passing into hornblende schist; and it is very possible that many hornblende schists, actinolite schists, &c. are metamorphosed ash-beds.

It is obvious that rocks thus made chiefly or entirely of igneous materials would more easily be metamorphosed than purely siliceous, argillaceous, or calcareous rocks, and would then be converted into rocks having all the appearance of trap. If they contained crystals of feldspar or hornblende, such altered rocks could not be separated from porphyries.

Greenstone ash often effervesces with acids as well as felstone ash.

III.—THE GRANITIC ROCKS.

We have before said that all igneous rocks were composed of silicates, and pointed out that the varieties of the volcanic and trappean rocks were characterized by the relative amounts of hornblendic or augitic minerals (silicates of magnesia, &c.) which were mingled with their feldspathic constituents (silicates of alumina, &c.) These silicates are, in the volcanic and trappean rocks, generally one of the more basic varieties. The bases, then, in the compound, just previous to consolidation, must have been in comparatively great proportion to the acid (silica), so that none of the latter was left unused or uncombined, and consequently none was allowed to crystallize out separately as quartz. The granitic rocks, on the other hand, are distinguished by the relative abundance of silica which they contain. Not only are all the minerals composing them as highly silicated as possible, but there was moreover a superabundance of silicic acid (or silica) beyond that which could be taken up by the basic substances present in the mass. This silica, therefore, has been left uncombined, and on the cooling and consolidation of the rock was compelled to crystallize out by itself as quartz.

[1] Near Black Ball Head, county Cork, is a cliff of such a greenstone ash, in which crystals of hornblende, 3 inches wide, have been seen. They are dull and worn externally, but internally quite bright and glistening.

So long as granite was looked upon as necessarily the most ancient of rocks, this superabundance of silica and occurrence of quartz was considered to indicate a difference in the proportion or distribution of the constituents of the globe, in the more ancient geological periods, from that which exists at present. The mineral character of rocks was supposed to depend upon age. We shall touch upon this subject presently.

In the meantime we would observe that we have already seen that some felstones contain distinct crystals of quartz, and pass into quartziferous porphyry. Now, if a rock consisting of granular crystals of quartz and feldspar, in anything like equal proportion, began to contain flakes of chlorite, talc, or mica, it would then pass into a granite; if, instead of a micaceous mineral, it were to acquire any hornblendic one, it would then become a syenite.

Again, if a greenstone containing granular crystals of feldspar and hornblende were likewise to exhibit crystals of quartz, it would pass into a syenite; and should the hornblende give way to a mica, this also becomes a granite.

These transitions are not merely hypothetical, but have been observed and described; and we have, therefore, existing in nature, every kind of gradation, from a trachytic or doleritic lava, through a feldspathic or hornblendic trap, into genuine granite.

43. *Granite.*—True granite in its most ordinary form is one of the most easily described and certainly recognized of all rocks. It is a granular, crystalline aggregate of the three minerals feldspar, mica, and quartz. Its name is sometimes said to be derived from its granular structure, but Jameson derives it from "*geranites*," a term used by Pliny to designate a particular kind of stone.

Ordinary granite varies according to the composition of the feldspar and mica composing it,—according to the relative proportions of those minerals to each other and to the quartz—and according to the size of the crystals and the state of aggregation of the several constituents.

The feldspar of granite may be either orthoclase or potash feldspar, frequently flesh-coloured, but sometimes white; albite or soda feldspar, generally dead white; an intermixture of those two minerals; or lastly, a feldspar containing both potash and soda, which may be called soda-orthoclase or potash-albite, as the case may be. Other varieties of feldspar, except, perhaps in some instances, oligoclase, are seldom found in granite as constituents of the mass.

The mica of granite varies greatly in colour and lustre, being sometimes dark coppery-brown, passing into black, sometimes green, sometimes golden yellow, and sometimes a pure silvery white. Whether its chemical constitution be equally various is perhaps hardly yet sufficiently ascertained. The quartz is commonly colourless or white, but sometimes dark gray or brown.

The proportions of the three constituents vary indefinitely, with this limitation, that the feldspar is always an essential ingredient, and never forms less than a third, rarely less than half of the mass, and generally a still larger proportion.[1] Sometimes the mica, sometimes the quartz, becomes so minute as to be barely perceptible.

[1] Professor Haughton, in his paper on the Granites of Ireland (*Geological Journal*, London, vol. xii., p. 180), gives the following as the proportions of the Dublin and Wicklow granite:—

Mica	13·37
Feldspar	61·18
Quartz	24·98
	99·53

A detached granite boss, near Enniscorthy, had

Mica	3·60
Feldspar	89·69
Quartz	6·44
	99·73

The state of aggregation of the mass varies also greatly, some granites being very close and fine grained, others largely and coarsely crystalline. The colours of the rock are generally either red, gray, or white; the first when the feldspar is flesh-coloured, the latter when it is pure white, the intermediate gray tints depending chiefly on the abundance and colour of the mica, but sometimes on that of the quartz.

Large and distinct crystals of feldspar sometimes occur, disseminated at intervals through the mass, giving the rock a porphyritic texture. It is then called porphyritic granite.

Other minerals besides the three mentioned above, sometimes occur in granite. Among these are hornblende, actinolite, tourmaline, schorl, chlorite, and steatite.

When hornblende is abundant in rock, and the mica becomes scarce, or altogether disappears, it becomes a syenite.

44. *Syenite*, in its true form, is a granitic rock. It is named from the city of Syene, in Egypt, where it is formed of a crystalline aggregate of the four minerals feldspar, hornblende, mica, and quartz; the mica being in small and uncertain quantity. We have already, however, had occasion to remark, that syenite may be formed from either felstone or greenstone, and we may look upon it therefore either as a local variety of granite, or as a passage or transition rock between granite and the traps.

45. *Protogine.*—When talc occurs instead of mica, the granite has been called Protogine, from an erroneous supposition of its being always more ancient than granite.

The name, however, may be retained for the mineralogical variety, independently of any foregone conclusion to be drawn from it.

Instead of talc, chlorite sometimes occurs, as at Camarose, county Wexford, either in regular flakes or as a greenish coating to the surface of other crystals, but I am not aware of any name having been proposed for this variety. The granites of Cornwall and Devon sometimes contain so much schorl as to merit the name of schorl rock, and would doubtless have been christened with two or three different designations by continental geologists.

46. *Eurite* is a term applied to a fine-grained crystalline aggregate of quartz and feldspar, where the mica is either absent or occurs in such minute flakes as to be invisible.

It generally occurs as veins or as local masses in other granites, and rarely as veins traversing other rocks at a distance from granite. These, therefore, are probably veins of segregation or of injection during consolidation, and not of subsequent formation.

47. *Minette* is a name for a fine-grained rock, consisting principally of mica, but not having a schistose texture like mica schist.

48. *Pegmatite* is a crystalline aggregate of quartz and feldspar, in which the crystals are arranged as if with a design to produce a certain pattern, more or less resembling letters or characters (from πηγμα, a coagulation).

49. *Granulite* is a similar composition, in which the quartz occurs in thin flakes, so as to give almost a schistose texture to the mass.

50. *Elvan* or *Elvanite.*—Elvan is a Cornish term for a crystalline granular mixture of quartz and feldspar, forming veins that are either seen to proceed from granite, or occur in its neighbourhood, and may thus be readily supposed to proceed from it.

In the Newry and Mourne mountain district he found three granites having the following proportions:—

1. Wellington Inn:		2. S. of Newry.	3. Carlingford.
Mica	14 59	13 67	22 86
Feldspar	61·98	64·17	50·76
Quartz	23·23	21·96	26·08
	99·80	99·80	99·70

It has three varieties:—

(*a.*) An equably crystalline mixture of quartz and feldspar; generally fine-grained. This may either be considered as a granite destitute of mica, or as a granular felstone.

(*b.*) A compact felstone base with dispersed crystals, or crystalline particles of quartz, sometimes angular, sometimes rounded, and amygdaloidal. This may be considered as a quartziferous felstone porphyry.

(*c.*) A crystalline granular base of quartz and feldspar, with dispersed crystals of either quartz or feldspar.

The feldspathic portion of these rocks is often earthy, probably from decomposition.

We would propose *Elvanite* as a good euphonious term, and as being less cumbersome than the term of Quartziferous porphyry, for these rocks which differ in texture from Eurite, or Pegmatite, or Granulite.

Professor Haughton, in his paper in the Geological Journal before quoted, gives the following as the composition of some rocks, which we should consider *Elvanites.*

Croghan Kinshela, Wicklow.		Mourne Mountains.	
Albite	62	Albite	27·8
Quartz	38	Orthoclase	44·2
		Quartz	28·0
	100		100·0

The composition of the Carnsore granite is similar, being—

Felspar	78·5
Quartz	21·5
	100·0

But this, by its texture and coarsely crystalline grain, deserves to be considered as a true granite; and it moreover does contain occasionally a small proportion of mica.

As the granite rocks are all hypogenous or nether-formed, that is, have all been consolidated before reaching the surface of the earth, they are necessarily devoid of "ash," or of any mechanically-derived accompaniments whatever.

We have remarked above, that the relative quantity of silica had a marked effect upon the nature of the rock; that among the lavas, quartz only appeared in these trachyte porphyries which were beginning to resemble granite; and that among the traps it only appeared among those feldspar porphyries which were closely allied to, and passing into, granite, while from the true granites it is never absent. It has been attempted from this to prove that the more siliceous an igneous rock was, the more ancient it must be. Even Abich says that we may, perhaps, thus deduce a scale for the history of the formation of the earth;—those rocks which contain, as essential constituents, "trisilicates" of both their protoxide and peroxide bases, being "primitive;" while those which contain quartz are called "primitive Plutonic;" and those without quartz, "primitive volcanic."

M. Riviere also supposes orthoclase to be confined to the older, labradorite to the more recent rocks. The other bases, too, as magnesia and lime, have been supposed to characterise newer rocks than those of soda and potash, and soda itself to be newer than potash.

We would venture to suggest that these mineralogical differences depend upon space or locality rather than upon time; that the proportionate quantity of silica is referable to the depth at which an igneous rock has been cooled or consolidated, or to the nature of those it penetrated, rather than to the time at which it was formed. At great depths in the earth, pure silica itself may possibly be fused by the intense heat there to be met with; and the most refractory silicates may be equally molten at a somewhat less depth, and consolidate or crystallize on becoming cooler a little higher; while those portions of molten matter containing a greater quantity or variety of bases which act as more perfect fluxes may be kept fluid till they reach the surface, and thus consolidate only in the air or in the water.

Whether the whole quantity and variety of the more fusible bases formed part of the original deepest-seated molten mass, and were separated from it on the first cooling and crystallization of the simpler minerals, or whether a

Geology.

larger proportion of those bases was acquired during the passage of the molten rock through the higher part of the earth's crust, and thus the quantity of "flux" increased in proportion as the heat and pressure diminished, may be matter for speculation. We will not now stop to consider it farther than to warn the student not to take it for granted that the mineralogical and lithological composition or structure of any rock whatever has any necessary and determinate relation to its geological age. Granite might become solid at a temperature that would keep felstone or trachyte still fluid; and these might solidify at temperatures which would keep molten all greenstones, basalts, and dolerites, so that from the very same stream of igneous matter proceeding from the interior to the surface of the earth, the more readily fusible portions might be successively squeezed out, as it were, as the infusible ones solidified, and contracted in consequence of that solidification.[1] This action might take place in spite of the greater specific gravity of the more fusible minerals, since the difference in the specific gravities would probably be small compared with the power of the eruptive force.

It is true, indeed, that actual subaerial volcanoes, with cones and craters and *coulées*, or *streams* of lava, are only known as recent geological phenomena—as either now active or as having been so during a recent geological period. But we shall see hereafter reason to believe that the preservation of any volcanic cones belonging to the more ancient periods was not to be expected. The parts preserved from destruction and denudation are the more deeply-seated portions only, the *roots*, as it were, of the volcano, the very parts which we do not see while the volcano is active or entire, but which we do see in some (such as those of the Mont Dor) that are half ruined, and we then find these old lava roots to be essentially the same as the traps; and we have already seen that deeply-formed trap is not to be separated by any hard line from granite. If, therefore, we could follow any actual lava-stream to its source in the bowels of the earth, we should in all probability be able to mark in its course every gradation, from cinder or pumice to actual granite.

That this change of state from a granite into a trappean rock does actually occur is well known, and has been proved in a most interesting manner in Professor Haughton's paper before quoted. Near Carlingford (Ireland), a syenite, having the following composition:—

Hornblende	15·40
Orthoclase	67·18
Quartz	17·16
	99·74

comes in contact with, and sends veins into, a large district of limestone. The dykes proceeding from this syenite are converted into a kind of greenstone or dolerite by taking up a large quantity of lime from the adjacent limestone, which enters into combination with the silica, and lets the potash go free, so that their mineral composition becomes,—

Hornblende	14·16
Anorthite	85·84
	100·00

Anorthite, or a lime felspar, is thus formed by the combination of lime with the silica existing in the mass, which in parts not reached by the lime can only form orthoclase and quartz. Anorthite had not been previously mentioned as a constituent of any other rock than a lava, and yet we see it here occurring in a mass proceeding from a granitic syenite, and therefore we may well suppose lava in many cases to have similarly proceeded from a granitic compound.

M. Delesse, in the *Annales des Mines*, 1849, has some interesting observations on the magnetic power of the igneous rocks, and some of their constituent minerals, as also of some of the glasses formed from melting rocks. No practical results, however, being yet arrived at, we shall confine ourselves to this mention of the subject. (D'Archiac, vol. iii., p. 595.)

Bischof has some very important observations on the contraction of igneous rocks, as they pass from a fluid to a solid or crystalline state. (D'Archiac, p. 598.)

He experimented on basalt, trachyte, and granite, and found the following results:—

	Volume in the state of Glass.	In Crystalline state.
Basalt	1	0·9298
Trachyte	1	0·9214
Granite	1	0·8420
	In the Fluid state.	In Crystalline state.
Basalt	1	0·896
Trachyte	1	0·8187
Granite	1	0·7481

From this we see that granite contracts 25 per cent., or a quarter of its volume, in passing from a fluid to a crystalline state, and 16 per cent. in passing from a glassy to a crystalline state. These effects must have had a great importance "when the primary granites were first cooling," says M. D'Archiac; but their importance seems to us still greater to geologists who are examining the broken and contorted rocks on the flanks of existing granite chains,[1] and the phenomena of intrusion which we shall hereafter meet with in such situations. M. Deville and M. Delesse arrive at results rather different from Bischof's, and the latter gives the following table as comprising the limits within which the several rocks mentioned contract on passing from a fluid to a solid state.

Granite, leptynites, quartziferous porphyries, &c.	9 to 10 per cent.
Syenitic granite, and syenite	8 to 9 ...
Porphyry, red, brown, or green, with or without quartz, having a base of orthose, oligoclase, or andesite	8 to 10 ...
Diorites and porphyritic diorites (greenstones)	6 to 8 ...
Melaphyres	5 to 7 ...
Basalts and trachytes (old volcanic rocks)	3 to 5 ...
Lavas (volcanic and vitreous rocks)	0 to 4 ...

M. Delesse sums up his results as follows:—

"When rocks pass from a crystalline to a glassy state, they suffer a diminution of density which, all things being equal, appears to be greater in proportion to the quantity of silica and alcali, and, on the contrary, less in proportion to that of iron, lime, and alumina which they contain. In arranging the rocks in the order of their diminution of density, those which we regard as the more *ancient* are generally among the *first*, while the more *modern* are the *latter*; and in each case their order of diminution of density is almost exactly the inverse of their order of fusibility."

On this we would remark as before, that for "ancient" and "modern" might be substituted "deeply formed" and "superficially formed;" the most infusible and the most contractible rocks being those produced at the greatest depth and under the greatest pressure, while the highly fusible compounds escape to the surface, and suffer little contraction or solidification.

M. D'Archiac remarks, that if granite contracts on cooling only ten per cent., and that there be a thickness of 40,000 metres of it in the crust of the globe, crystallization alone would diminish the terrestrial radius at least 1430 metres, and consequently alter the form and rapidity of ro-

[1] The chemist is reminded of the fact, that if a mixture of metals, as for instance tin, bismuth, and lead, be melted, they will, as the mixture cools, have a tendency to solidify and crystallize separately as the temperature of the mass reaches their respective melting-points. This constitutes a great difficulty in large bronze castings.

[1] We would just warn the student here, that, without altogether denying that there may have been such a rock as a primitive granite, none of the granites now known at the surface can be shown to have an antiquity greater than that of some of the aqueous rocks with which they are associated.

tation of the earth. Such speculations are practically useful only in a negative sense, as showing the great improbability of anything like a shell of 40,000 metres having cooled and consolidated at once in the crust of the earth during any of the known geological epochs.

Chap. III.—AQUEOUS ROCKS.

We are compelled to look upon the purely igneous rocks as original productions. We can only speculate, and that very vaguely, on what was the condition of the materials which compose them, previously to their being placed, in a molten state, in the positions where they subsequently consolidated.

In our examination of the aqueous rocks, however, we can go a step farther back, and learn, either accurately or approximately, whence the materials composing them were derived, and what was their previous condition. This is true of all aqueous rocks, whether chemically, organically, or mechanically formed.

We will examine the mechanically-formed rocks first.

I.—MECHANICALLY-FORMED ROCKS.

Preliminary Remarks on their Origin.

The instruments used by nature in the production of these rocks are,—moving water, whether fluid or solid (ice), and moving air.

The Sea.—The sea is probably never and nowhere stagnant. Currents, moving with greater or less rapidity, keep the whole mass in circulation; so that we may look upon the ocean, through all its depths, and in all its gulfs, bays, and recesses, as one great slowly moving whirlpool.[1]

It is probable, however, that no currents produce any marked or appreciable effects upon solid rock at great depths of water. The mechanical powers of the sea are principally brought into action by the motion of its surface along the shores of all lands, and in its narrower and shallower channels. Sea-breakers along beaches, and at the foot of cliffs, act like ever-moving jaws constantly gnawing at the land. The currents caused by the ebb and flow of the tides along shallow shores remove some of the eroded materials; the great oceanic currents of circulation, where they strike upon coasts, carry off others, and transport all, either mediately or immediately, to greater distances.

In looking at the destructive action of water, however, we must never forget that by *destruction* we do not mean *annihilation*, but only *re-arrangement*. Rock forming "land," that is, rock above the level of the sea, is destroyed; but its materials are carried off and deposited, either in similar or in different combinations, to form rock below the level of the sea.

For instances of the erosive and destructive action of the breakers, and the abrading and transporting power of currents, during historic times, we must refer the student to Sir C. Lyell's *Principles of Geology*, chapters 20, 21.

Rain.—The sea, however, is not the sole agent of the destruction of that portion of rock at or above its level, which we call land. All rain falling upon land, and either running over its surface or draining through its interior, is constantly abrading and carrying off particles of pre-existing rock in the shape of mud, silt, and sand. From the gutters and the ditches, from the rills, the streams, and the brooks, these materials for the building of mechanically-formed rocks are almost unceasingly being carried into the rivers, and by them transported to the beds of lakes and seas. Rain soaking into ground, and issuing as springs on steep slopes or precipices, sometimes exerts a more wholesale destructive power, by gradually loosening and undermining very considerable masses of ground, and thus causing them to be *launched* forward, down the slope, producing what are called "landslips."

Ice and Snow.—When rain falls as snow, on the other hand, it exerts a conservative and protective effect as long as it retains its solid form, but, on melting, acts like rain, and even with greater intensity, inasmuch as a greater amount of water is often set loose and in motion over the land by the rapid melting of snow than would fall in the same space of time in the shape of rain directly from the clouds. The most extensive and powerful floods are those of the spring in mountainous districts, when the snows melt rapidly on the hills. If rain or other water soaks into rocks and fills up their interstices, either the small pores, or the crevices, joints, and fissures by which all rocks are traversed, and this water then freezes, this conversion into ice is accompanied by an expansion which exercises an almost irresistible mechanical force, the effect of which will be either the disintegration of the particles in the one case, or the breaking and rending asunder, and the displacement of the larger masses in the other. On mountain summits and sides subject to great vicissitudes of temperature, this agency exerts no mean effect. The hardest rocks will be broken up by it, and enormous blocks ultimately displaced and toppled over precipices, or set rolling down slopes to suffer still further fracture, and produce still greater ruin in their fall.

Glaciers.—When mountains are covered by perpetual snow, all the part so covered is protected by this envelope from all change. In such situations, however, the moving power of water takes another form, that of the glacier, or "river of ice." The lower border of the perpetual snow-mass passes into ice, from the alternation of melting and freezing temperatures, just as snow on the roof of a house forms icicles at its lower edge, when partly melted and re-frozen. This ice accumulates in the valleys, and is frozen into a solid or nearly solid mass, called a glacier. Glaciers sometimes fill up a valley 20 miles long, by 3 or 4 wide, to the depth of 600 feet. Although apparently solid and stationary, they really move slowly down the valley, and carry with them, either on the surface, frozen into their mass, or grinding and rubbing along the bottom, all the fragments, large and small, from blocks many tons in weight, down to the finest sand and mud, that rain, and ice, and the friction of the moving glacier itself, detach from the adjacent rocks. The cause of this motion is now generally believed to be that attributed to it by Professor J. Forbes, namely, a slight degree of plasticity, a *demi-semifluidity*, in the ice mass, by which it is enabled to actually flow down the valley, just as a viscous substance, such as partially melted pitch, would flow.[1]

The glaciers of the Alps, and probably those of other parts of the world, descend to a vertical depth of nearly 4000 feet below the line of perpetual snow, before they finally melt away, and leap forth as rivers of running water. The confused pile of materials, of all sorts and sizes, which they there deposit, is called the "moraine." This word is also applied to the lines of blocks that are being carried along on the surface of the glacier.[2] The river of water that proceeds from the end of a glacier is of course quite unable to move the large blocks which had been carried with ease by

[1] See Maury's *Physical Geography of the Sea*, and Johnstone's *Physical Atlas*, &c.

[1] Professors Tyndal and Huxley have recently disputed this idea of Professor J. Forbes's, and shown the motion of glaciers to be the result of the minute, almost molecular, *fracture* and *regelation* of the ice particles, which move as if they were sand continually thawing and re-freezing. (*Philosophical Magazine*, 1856.)

[2] See Professor J. Forbes's work on the *Glaciers of the Alps*, and also Johnstone's *Physical Atlas*; also the works of Agassiz, Charpentier, &c.

that of ice, and only transports the finer particles, as mud and sand.

Icebergs.—If, however, it so happen that a glacier come down into a lake, or into the sea, before it melt away, large fragments of it (icebergs) will be frequently floated off, with all their freight of rock-fragments of all kinds; and these loaded icebergs may then be carried great distances before they entirely dissolve. In this manner, large unworn angular blocks of rock may sometimes be dropped on the bed of the sea even hundreds of miles from their original site. The terminal moraine, instead of a pile at the foot of the glacier, is disseminated far and wide over the bottom of the surrounding seas.

River Valleys.—Rivers are not the producers of their own valleys; they are the results of those valleys, but they are their immediate results. The river could not be formed till after the valley, with all its tributary branches, had been marked out; but the valley could not even be marked out without the river, in most cases, instantly springing into existence, and commencing to modify, and deepen, and complete the valley.

Action of Rivers.—The re-direction of draining water into old channels will be more certain and frequent in proportion to the steepness of the ground and consequent rapidity of the flow of water; and channels once selected will there be more rapidly deepened, and more completely and permanently formed. Such deep valleys (ravines, as we should then call them) are scarcely to be obliterated, or otherwise altered than from deepening and enlargement, by any number or amount of changes, short of the removal of the mass of high ground which they traverse. As long as the mountains remain undestroyed, the valleys and ravines must obviously be continually enlarged, either vertically or laterally, by the action of the waters which traverse them.

The temporary damming up of rivers, and subsequent breaking down of the barrier and escape of the lake formed above it, produces sometimes the most remarkable instances of the power of moving water. Rocks as big as houses are thus set in motion, and carried sometimes for very considerable distances down the valleys. (See *Lyell* as above; also *Jameson's Mineralogy*, vol. iii., where all these causes of mechanical destruction, including that of ice and icebergs, are distinctly pointed out.)

We shall be able better to understand how rapidly the size of water-borne fragments increases in proportion to the velocity of the moving water, when we learn from Mr W. Hopkins, *that the power of water to move bodies that are in it increases as the sixth power of the velocity of the current.* Thus, if we *double* the velocity of a current, its motive power is increased *sixty-four times;* if its velocity be multiplied by 3, its motive power will be increased 729 times; if by 4, 2048 times; and so on.

In studying the mechanical force of water upon rock, also, it is necessary to bear in mind that all earths and stones lose fully a third of their weight when suspended in water. These considerations enable us to understand more readily the fact of blocks of rock many tons in weight having been removed from breakwaters and jetties, and carried sometimes many yards during great storms, as also of still larger blocks hurried along by floods, &c.

The rolling power of water upon stones lying in its bed depends greatly on their shape also, the same current being easily able to roll along pieces of rock in the form of rounded pebbles that it would be quite unable to move if they were in the shape of flat slabs; while, reversely, flat slabs or flakes would float more easily, or sink more slowly, than rounded or square-shaped fragments of the same weight and cubic contents. Flakes of mica, therefore, might be floated and transported onwards where grains of quartz, even though lighter than the mica, would sink; and, on the other hand, rounded quartz pebbles might be rolled forward where smaller and flatter pieces, in the shape of shingle, would be brought to rest.

Mr Babbage has lately treated of this subject, in a paper of which an abstract appeared in the *Journal of the Geological Society*, November 1856.

He there supposes the case of a river, the mouth of which is 100 feet deep, delivering four varieties of fine detritus into a sea which has a uniform depth of 1000 feet over a great extent, which sea is traversed by one of the great ocean currents, moving with a certain given velocity.[1]

He takes for granted that the four varieties of detritus are such as, from their size, shape, and specific gravity, would fall through still water, the first 10 feet per hour, the second 8 feet, the third 5 feet, and the fourth 4 feet. The combined effect of the downward motion of the detritus, and the onward motion of the water, would then bring the first variety to the bottom of the sea, at a distance of 180 miles from the river's mouth, and strew it over a space 20 miles long; the second variety would only begin to reach the bottom 225 miles from the river's mouth, and would be spread over 25 miles, and so on, as in the following table:—

No.	Velocity of fall per hour.	Nearest distance of deposit to river mouth.	Length of deposit.	Greatest distance of deposit from river mouth.
	Feet.	Miles.	Miles.	Miles.
1	10	180	20	200
2	8	225	25	250
3	5	360	40	400
4	4	450	50	500

We should thus have, proceeding from the same river, and poured into the sea, either simultaneously or at different times, four different and widely separated patches of mud or clay formed on the sea bottom.

Mr Babbage says, that this subject was suggested to him from his observing the *extreme slowness* with which a very fine powder, even of a very heavy substance, such as emery, subsides in water, and speaks of mud clouds being suspended in the depths of the ocean, where the density of the water increases, for vast periods of time.

The amount of mechanical work done by rivers can be estimated by examining their waters at different periods, and determining their solid contents. If this be done by simply evaporating the water, the result will be not only the mechanically suspended mineral matter, but also that which was chemically dissolved in the water. As the separation of these two, however, is rather troublesome, and not very important, it is not often attempted; neither, as a measure of the work done, would it be often necessary, since the chemical solution of mineral matter is perhaps more frequently than not the consequence of the mechanical erosion of it by the water.

Sir C. Lyell, in his *Principles*, gives the following as the results of various observations:—

The total mineral matter carried down by the Ganges into the sea, according to Everest, is 6,368,077,440 cubic feet per annum, part of which has been deposited at its mouth, forming a gentle submarine inclined plane of 100 miles long, and sloping from 4 fathoms to 60 fathoms in depth. Lyell says, that for the transport of this quantity, it would require a fleet of 2000 Indiamen, each of 1400 tons, to start every day throughout the year. This mass of matter would cover a square space 15 miles in the side every year with mud a foot deep, or would raise the whole surface of Ireland 1 foot in the space of 144 years. The Brahmapootra probably carries an equal quantity.

Mr Barrow calculated that the Yellow River (Hoang Ho) in China, carried down into the Yellow Sea 48,000,000 of cubic feet of earth *daily;* so that, assuming the Yellow Sea to be 120 feet deep, an English square mile might be converted into dry land every seventy days, and supposing its area to be 125,000 square miles, the whole would be made into terra firma in 24,000 years.

Herodotus remarked that "Egypt was the gift of the Nile," and that the sea probably once flowed up to Memphis, the old gulf having been filled up by the Nile mud, as the Red Sea would be filled up if the Nile were turned into it. The edge of the present delta is, however, now swept by a powerful current, which carries off all detritus delivered into it, and thus future increase is

[1] The supposed velocity of the river and ocean current is not stated in the abstract.

prevented. Otherwise the Nile would by this time have formed a long tongue of land projecting into the Mediterranean, just as the Mississippi has projected a tongue of land 50 or 60 miles long, into the Gulf of Mexico, having previously filled up the inlet which formerly penetrated from that sea deeply into North America, and received the rivers more than 100 miles inland from the present coast. According to Dr Riddell, the solid matter contained in the Mississippi is about 80 parts in the 100,000 of water by weight, or about 33 by volume; and Sir C. Lyell calculates, that it brings down 3,702,758,400 cubic feet annually, and that the present delta has required 67,000 years for its formation.

If we turn to the European rivers, Bischof states that Chandellon, by daily experiments during December 1849, found in the Maas, at Leige, a maximum of 47·4 parts of suspended matter alone, a minimum of 1·4, and a mean of 10 parts, in the 100,000 of water.

In the Rhine, at Bonn, Mr Leonard Horner found, August 1833, when it was unusually low and turbid, 31·02 of suspended and dissolved matter; and in November, when swollen, 51·45. Bischof found in March 1851, 20·5 of suspended matter alone; and at another time, when it was clear, only 1·73 of such parts; while Stiefensand, near Uerdingen, after a flood, found 78 parts of suspended matter in the 100 000 of water.

In the Danube, August 5, 1852, there were found 9·23 of suspended, and 14·14 of dissolved matter—total solids, 23·37 in the 100,000; while in the Elbe at Hamburgh, there were in June 1852 only found 0·9 of suspended, and 12·7 of dissolved matter.

In these experiments much depends on the state of the river, and also on the part of the river where the water is taken from, whether far from the bank, at the surface, or near the bottom; and so on.

Whether the matter thus carried down by rivers is deposited at their mouths, and forms a delta, or is carried off to a greater or less distance, depends on the tidal or oceanic currents which are to be met with at the mouth of the river. In lakes, deltas or flats are almost invariably met with at the mouths of rivers. In sheltered bays and gulfs, where there is no great rise and fall of tide, and consequently no great scour of the river's mouth, deltas are also formed; witness the Po, the Rhone, Nile, Mississippi, Orinoco, Indus, Ganges, Brahmapootra, &c. Where, however, there are strong ebb tides, or where the river mouth is swept by a strong oceanic current, the detritus is carried off directly into the sea, as in the case of the Amazon, the Rio de la Plata, the St Lawrence, and of most of the rivers of Britain and Western Europe.

It results from even such a hasty and rapid glance as we have just thrown over the principal mechanical powers of moving water that are daily and hourly at work around us, that we begin to acquire the notion that we are living in a vast workshop, and that all the earthy matters we see about us, the mud, the clay, the soil, the dust, the sand, the gravel, and the boulders, are only so much raw material in process of manipulation. They may be likened to the refuse and the chips of some vast manufactory. They are the building materials of stratified rocks, which are being carried from the quarry to the place of construction, much being dropped and scattered by the way. Every pebble, every grain of sand, every atom of mud, is a fragment of pre-existing rock, removed at some period of past time, and destined ultimately to enter into the structure of some other rock in the future.

This building metaphor might be carried still farther when we come to speak of the chemically-formed rocks, since many of the mechanical deposits are bound together by cements and mortars which are more or less identical in composition with those used in architecture.

Description of Mechanically-Formed Rocks.

51. *Conglomerate, Puddingstone, Breccia.*—In the preceding paragraphs, we have mentioned the method of formation of pebbles, gravel, and shingle, in rivers and along the sea-coasts. When those materials are compacted together into stone, they are called *conglomerate* or *puddingstone* if the pebbles are round, *breccia* if the fragments are sharp and angular

The degree of induration or consolidation in conglomerates varies greatly. Some seem to have been consolidated by simple pressure; and from these the pebbles may often be removed by a slight blow with the hammer, or even by the knife, the form or mould of the pebble remaining in the little film of sand which fills up all the interstices between the larger fragments. Sometimes the conglomerate has been bound or cemented together by calcareous, ferruginous, or siliceous infiltrations, the matrix in which the pebbles lie being as hard and indestructible as the pebbles themselves, a blow with a hammer breaking the pebbles as easily as the mass of the rock in which they are embedded. The size of the fragments in conglomerates and breccias varies greatly. In some rarer cases, blocks of as much as two feet in diameter occur; but the more ordinary sizes are from that of a man's head to that of walnuts. Below that size, the rock begins to pass into the coarser varieties of sandstone.

52. *Sandstone and Gritstone.*—The very process by which fragments of rock are rounded produces sand, as the waste resulting from their attrition. Pebbles themselves also are gradually broken or diminished into grains of sand. Sandstone is nothing else but sand, formerly loose and incoherent, subsequently compacted into solid stone. The grains both of sand and sandstone generally consist of quartz, sometimes clear and colourless, sometimes dull white, sometimes yellow, brown, red, or green. The red colours are usually the result of the covering of each little grain with peroxide of iron, which sometimes acts as a sort of cement to the stone, serving to bind the particles together. The green colours are commonly derived from silicate of iron; and the green and red are often intermingled, in consequence of the change of the iron from the condition of a silicate to that of an oxide or peroxide.

The size of the grains varies from that of a pea to the minutest particle visible to the naked eye; many sandstones and gritstones even requiring a lens in order to distinguish the particles of which they are composed.

The materials are equally various, as, along with grains of quartz, may occur grains and particles of any mineral substance whatever. Grains of feldspar, distinguishable by their dull white colour and peculiar appearance, occur abundantly in some sandstones, which may then be called feldspathic sandstones. Flakes and spangles of mica are rarely altogether absent; and in many sandstones they occur so abundantly, and in such regular seams, as to cause the rock surfaces to glitter, and the rock itself often to split into thin plates and slabs. These are called *micaceous sandstones.* When grains of limestone occur in any remarkable proportion, the rock may be called a *calcareous sandstone,* though this designation is often applied to sandstones the quartzose or other grains of which are bound together by a cement of carbonate of lime, either invisible to the eye or occurring as a network of little veins and strings of crystalline carbonate of lime running throughout the stone. Other varieties of sandstone are similarly named from the prominent character of some part of their contents.

Argillaceous sandstone is a term not often used, nor is it very often applicable, though many rocks contain various mixtures of sand and clay. In many sandstones, too, little flat rounded patches of clay, more or less indurated, often occur. Similar little patches of clay may be seen on sandy shores, either originally deposited there in little hollows, or rolled as clay pebbles from some bed of clay. In quarrying sandstone, these clay patches are commonly called "galls" by the workmen. In highly indurated grits, they sometimes assume the form of pebbles of *slate,* though the slaty structure may often have been assumed in consequence of the subsequent induration, and not before they were embedded in the sandstone.

There are many local terms used by quarrymen and miners for different varieties of sandstones, such as—

Rock, used generally in South Staffordshire to denote any hard sandstone.
Rotch, or *roche*, is generally used for a softer and more friable stone.
Rubble, means either loose angular gravel, or a slightly compacted brecciated sandstone.
Hasel is a North of England term for a hard grit.
Post is a similar term for any bed of firm rock, and is generally applied to sandstone.
Peldon is a South Staffordshire term for a hard, smooth, flinty grit.
Calliard, or *galliard*, is a northern term for a similar rock.
Freestone is a term in general use, which is often applied to sandstone, but sometimes to limestones, and even to granite, as in the counties of Dublin and Wicklow. It means any stone which works equally *freely* in every direction, or has no tendency to split in one direction more than another.
Flagstone, on the contrary, means a stone which splits more freely in one direction than any other, that direction being along the original lines of deposition of the rock. These stones are ordinarily sandstones, though often very argillaceous, and some flagstones are perhaps rather indurated clay in thin beds than sandstone. Thin-bedded limestones may likewise often be called flagstone.

Sandstones, like *conglomerates*, may have been consolidated either by simple pressure continued for a long period of time, by pressure combined with an elevation of temperature, by the infiltration of mineral matter in solution, or by the aqueous or igneous solution and subsequent reconsolidation of some of the particles composing it, or lastly, by a combination of two or more of these actions. Some of the loose tertiary sands of the North of France, such as the Sable de Fontainebleau, and the Sable de Beauchamp, exhibit these actions in a very remarkable way. The Sable de Fontainebleau is a pure white siliceous sand. It is covered in some places by beds of a freshwater limestone called the Calcaire de Beauce. Water containing carbonate of lime in solution, derived either from this limestone, or from other sources, percolates through the sand, and deposits the lime, binding the sand either into globular concretions, or even into rhombohedral crystals, such as carbonate of lime ordinarily forms.

Besides these smaller concretions, other large parts of the sand have been compacted together, either at the time of deposition, or subsequently, into a very hard white gritstone, which is extensively used as a paving-stone in the district where it occurs. This grès de Fontainebleau forms picturesque crags and precipices, all the more striking perhaps, from the loose and easily removed sand in which the beds and other irregularly formed masses of the consolidated rock occur. The cementing substance of the sandstone may in some cases be carbonate of lime, equally diffused through the mass. In other cases, however, the quartzose grains appear to be bound together by a siliceous cement, as if the percolating water had contained dissolved silica. This is obviously the case in one variety, a glittering rock being produced, greatly resembling ordinary quartzite, only more white and lustrous; this variety is called "grès lustrée," or lustrous grit.

The grès de Beauchamp consists of similar locally consolidated and semi-concretionary lumps of sandstone, occurring here and there in loose sand. On the plains north of Meulan, these lumps of gritstone are discovered by "sounding" or piercing the loose sands with an iron rod, and they are then extracted and broken into square blocks, and used for forming the roads of the country.

These tertiary grits are often as hard and intractable, and break with as splintery a fracture under the hammer of the geologist, as the grits he is accustomed to meet with among the oldest rocks of the British mountains.

When among the materials of a sandstone there occur any containing a notable proportion of alumina, which may be known by the earthy odour given out when the rock is breathed upon, we have the constituents for the formation of clay, and it only remains for those materials to be ground down into fine powder and mixed with water, either naturally or artificially, for clay to be produced.

53. *Clay.*—Perfectly pure clay is a hydrated silicate of alumina. This is the substance known as "kaolin," or "porcelain clay," derived from the decomposition of orthoclase, albite, or other feldspars, from which the silicates of potash, soda, &c., have been washed out. In some granitic districts, the granite being decomposed yields this substance, which is carried down by water, and deposited in hollows, the quartz and mica being often left behind in the state of loose sand.

Common clay, however, is often largely coloured with oxide of iron, and mingled with many impurities, besides being mixed in variable proportions with sand. Any very finely divided mineral matter, which contains from ten to thirty per cent. of alumina, and is consequently "plastic," or capable of retaining its shape on being moulded and pressed, would commonly be called clay.

These clays have a number of varieties, of which the following are the principal:—

Pipe-clay, free from iron, white, nearly pure.
Fire clay, nearly free from iron, and from all alkalies, often containing carbon, but this does not prevent its forming bricks that will stand the heat of a furnace.
Shale, regularly laminated clay, more or less indurated, and splitting into thin layers along the original laminæ or planes of deposition of the rock. The colliers' and quarrymen's terms for shale are *Bind*, or *Bluebind*, *Metal*, *Plate*, &c. When very fine, and containing a large proportion of carbonaceous matter, the collier calls it *Batt*[1] or *Bass*, the geologist carbonaceous or (bituminous) shale, and the coal merchant often "slate." In Scotland the collier's term for shale appears to be "blaes," or "blues," the shales being often bluish gray. When lumpy, they are called "lipey blaes." Black, argillaceous shales (or batts) are called "danks;" "fekes," or "gray fekes," seem to be sandy shales such as would be called "rock binds" in South Staffordshire. (See William's *Mineral Kingdom.*) In the South of Ireland carbonaceous shale is called "kelve," and indurated slaty shale is termed "pinsill," or "pencil," as it is used often for slate pencils.
Clunch is a common name for a tough, more or less indurated clay, often very sandy.
Loam is a soft and friable mixture of clay and sand, enough of the latter being present for the mass to be permeable by water, and to have no plasticity.
Marl is properly calcareous clay, which, when dry, naturally breaks into small cubical or dice-like fragments. Many clays, however, are commonly but erroneously called marls, which do not contain lime.
Argillaceous flagstone is an indurated sandy clay or clayey sandstone, which splits naturally into thick slabs or flags.
Clay slate is a metamorphosed clay, differing from shale in having a superinduced tendency to split into thin plates, which may or may not coincide with the original lamination of the rock. It will be more particularly described among the metamorphic rocks.

II.—CHEMICAL AND ORGANIC ROCKS.

Preliminary Observations on their Origin.

Before entering on the description of these rocks, it will be useful briefly to consider the nature and action of the forces concerned in their production. We shall take as our principal guide in this examination Bischof's *Chemical and Physical Geology*, as translated for and published by the Cavendish Society.

Carbonate of Lime.—Carbonate of lime is nearly insoluble in pure water, but if the water contain carbonic acid gas, the mineral is easily dissolved by it, either in consequence of some special solvent power in water so impregnated, or in consequence of the carbonate being converted into a soluble salt (never yet seen in a solid state) in the form of a bicarbonate of lime.

Rain water and snow contain small quantities of carbonic acid derived from the atmosphere, and acquire more in sinking through the soil.

If water, in sinking into the earth, meets with carbonic acid gas rising from the interior, it becomes saturated with it, and

[1] This term of "batt"—commonly applied in South Staffordshire to a lump of shaly coal which will not continue to burn in the fire, and therefore soon becomes ash, and is consequently of little worth—has gone out of general use in the English language except in composition, where it is retained in the word "brick-bat" for the broken end of a brick.

carbonated springs are produced. The waters of springs, rivers, and lakes, therefore, always contain some, and probably a very variable amount of carbonic acid gas. The waters of the European seas, according to Vogel and Bischof, contain from 7 to 23 parts by weight of carbonic acid gas in the 100,000 of water. But from experiments made in the French ship "Bonité," in the Indian Ocean, only from 0·4 to 3·0 parts by weight in the 100,000. (*Bischof*, vol. i., p. 113, &c.)

The quantity of carbonate of lime thus held in solution by water containing carbonic acid gas is likewise very variable. In springs it may occasionally reach the point of saturation, which is about 105 parts in the 100,000.

In the rivers of Great Britain and Western Europe, the quantity of mineral matter held in solution varies from 4 to 55 parts in 100,000 parts of water, the mean quantity being 22. Of this mineral matter one half is commonly carbonate of lime, the least proportion, or 35 per cent., being found in the Loire; the greatest, 82 to 94 per cent., in the Rhone at Lyons. The quantity of mineral matter in the Thames, near London, is 33 in the 100,000 parts of water, 15 of which, or 46 per cent., are carbonate of lime. Bischof calculates that if the mean quantity of carbonate of lime in the Rhine be assumed as 9·46 in the 100,000 of water, which it is at Bonn, then, according to the quantity of water estimated by Hagen to flow at Emmerich, enough carbonate of lime is carried into the sea by the Rhine, for the yearly formation of three hundred and thirty-two thousand millions of oyster shells of the usual size.

Notwithstanding the vast quantity of carbonate of lime thus carried down into the sea, observation shows that the quantity to be found in sea-water is commonly very small. In most analyses of sea-water it is not mentioned at all. Sea-water from Carlisle Bay, Barbadoes, contained 10 parts in 100,000; sea-water from between England and Belgium, only 5·7 parts in 100,000. In the open sea, at a distance from any land, it is said to be rarely if ever discoverable by analysis.

The smallness of the quantity to be found in sea-water, compared with that in almost all rivers, is doubtless owing to the quantity of carbonate of lime constantly abstracted from sea-water by marine animals, in order to form their shells and other hard parts.

Bischof states that the quantity of free carbonic acid gas contained in the sea, is five times as much as is necessary to keep in a fluid state the quantity of carbonate of lime to be found in it. He argues, therefore, that it is impossible for any carbonate of lime to be *precipitated in a solid form at the bottom of the sea by chemical action alone.*

Carbonate of lime is deposited on land by springs and rivers, in consequence of the evaporation of the water, and the consequent extrication of a portion of the carbonic acid gas that previously held the carbonate of lime in solution.

But it is clearly impossible for any evaporation of water and gas to occur to a sufficient extent in the sea for this precipitation to take place. We are almost compelled, therefore, to conclude with Bischof, that all our marine limestones have been formed by the intervention of the powers of organic life, separating the little particles of carbonate of lime from the water and solidifying them, in order to enable them to form part of a solid rock.

There is of course the possibility that the sea once contained a much greater proportion of carbonate of lime than it does now, though this does not appear likely when we recollect that in the earliest and least fossiliferous of our formations there is a much smaller proportion of limestone than in later and more fossiliferous rocks; and that even in the oldest[1] limestones organic remains are to be found. The purely chemical processes now open to our observation, in which limestone is being formed, are the following:—

54. *Stalactites* and *Stalagmites*, *Travertine* and *Calc Sinter*, are formed in places where water containing carbonate of lime in solution suffers from evaporation, and deposits the carbonate in a solid form. Each drop of water loses by evaporation both water and carbonic acid gas, thus becoming more saturated with the carbonate of lime, at the same time that it loses some of its solvent power. It is therefore forced to part with some of this carbonate of lime, which adheres in a solid form to the nearest part of the solid substance over which the water passes. In the case of *stalactite* and *stalagmite*, a coating of solid matter is thus formed, with long icicle-like pendants hanging from the roof of caverns or arches, and columns rising from the floor wherever the water continues to drop long enough in one particular spot. Vertical sheets of it may even be formed when the water oozes from a long joint or crevice in the roof. The part hanging from the roof is called stalactite; that on the floor stalagmite. The limestone thus formed is commonly white or pale yellow, subcrystalline, often fibrous, and when thin, semitransparent or translucent.

Stalactites may often be seen under the arches of bridges, vaults, or aqueducts, especially if the stone of which they are built be limestone. Sometimes they are even derived from the carbonate of lime contained in the mortar or cement used in their construction.

Travertine, or *Calcareous Tufa*, is deposited by exactly the same process on the margins of springs or on the banks of rivers and the sides of waterfalls, or wherever water containing carbonate of lime in solution is brought into circumstances where rapid evaporation can take place. Sticks and twigs hanging over brooks often become coated with it; and the incrustation of bird's nests, wigs, medallions, and other matters, by the action of what are called petrifying wells, is commonly known. In Italy large masses of solid and beautiful travertine are deposited by some of the springs, so that it is used as a building stone. The Colosseum at Rome is built of stone thus formed. The name travertine is derived from the Tiber, meaning simply Tiber-stone.

Pipes to convey water, especially water from boilers, frequently become choked up by the deposition of limestone. Bischof says that there are fifty springs near Carlsbad giving out 800,000 cubic feet of water in twenty-four hours, from which, according to Walchner's calculation, a mass of stone weighing 200,000 pounds could be deposited in that time.

Marine Limestones.—The marine depositions of carbonate of lime now taking place are best studied in coral reefs. In almost all tropical seas, incrusting patches or small banks of living coral are to be found along the shores, wherever they consist of hard rock, and the water is quite clear. In the Indian and Pacific Oceans, however, far away from any land, huge masses of coral rock rise up from vast and often unknown depths just to the level of low water. These masses are often unbroken for many miles in length and breadth; and groups of such masses, separated by small intervals, occur over spaces sometimes of 400 or 500 miles long, by 50 or 60 in width. The barrier-reef along the N.E. coast of Australia is composed of a chain of such masses, and is more than 1000 miles long, from 10 to 90 miles in width, and rises at its seaward edge from depths which in some places certainly exceed 1800 feet. These reef masses consist of living corals only at their upper and outer surface; all the interior is composed of dead corals and shells, either whole or in fragments, and the calcareous portions of other marine animals. The interstices of the mass are filled up and compacted together by calcareous

[1] In the highly altered limestones associated with gneiss and mica slate, we could hardly expect to find traces of fossils, even if they once contained them. Organic forms have, however, lately been discovered in altered limestone from the gneiss of Scotland.

Geology.

sand and mud, derived from the waste and debris, the wear and tear of the corals and shells, and by countless myriads of minute organisms, mostly calcareous also. The surface of a reef, where exposed at low water, is composed of solid-looking stone, which is often capable of being split up and lifted in slabs, bearing no small resemblance to some of our oldest limestones. These slabs and blocks, when broken open, are frequently found to have a semicrystalline structure internally, by which the forms and the organic structure of the corals and shells are more or less disguised and obliterated. The "bottom" in and among the reefs composing the great Australian barrier, at a depth of some twenty fathoms, often looked, when brought up in the dredge, very like the unconsolidated mass of some of the coarse shelly limestones to be found among the oolites of Gloucestershire. At other times the dredge came up completely filled with the small round foraminiferous[1] shells called orbitolites, and these organisms seemed in some places to make up the whole sand of the beach either of the coral islets or of the neighbouring shores. In the deep sea around, and in all the neighbouring seas, from Torres Straits to the Straits of Malacca, wherever "bottom" was brought up by the lead, it was found to be a very fine-grained impalpable pale olive-green mud, which was wholly soluble in dilute hydrochloric acid. This substance, when dried, would therefore be scarcely different from chalk, though it commonly was of a greener tinge. Raised coral reefs, in the islands of Timor and Java, were often internally as white and friable as chalk, though they had frequently a rougher and grittier texture, and weathered black outside. The weathered surfaces of these limestones, often at a height of 200 or 300 feet above the sea, with their embedded shells of all descriptions, including a tridacna of one or two feet in diameter, differed in no respect from some of the surfaces of the Great Barrier Reef, where exposed at low water. (*Voyage of H.M.S. Fly.*)

On the upper surfaces of some of the existing coral reefs small islands are formed; the coral sand being drifted by the winds and waves till it forms a bank reaching above high-water mark. In some of these islands the rounded calcareous grains are bound together into a solid stone by the action of rain-water, which, containing a small quantity of carbonic acid, dissolves some of the carbonate of lime as it falls, but being shortly evaporated, redeposits it again in the form of a calcareous cement. Some of this stone presented very distinct examples of the oolitic structure presently to be mentioned, little minute grains and particles being enveloped in one or two concentric coats, like the coats of an onion. That this stone was not consolidated under water was proved by nests of turtles' eggs being found embedded in it, evidently deposited by the animal when the sand was above water, and was loose and incoherent.

Guided by these facts and observations, we may form tolerably accurate notions of the mode of origin of all our marine limestones, and attribute to them an organic-chemical origin, taking into account, at the same time, how easily they may have been subsequently altered in texture by the metamorphic action either of water or of heat.

We must also bear in mind that, although the carbonate of lime may have been secreted and brought into a solid form from its aqueous solution by the action of animal life, yet that the original form it thus received has been retained in only a small part of it; the great mass having been subjected to the mechanical actions of erosion, trituration, and transport, to a greater or lesser extent, in the process of its conversion into calcareous sand and mud, and deposition as beds of limestone.

[1] See Dr Carpenter's papers on these creatures in the *Philosophical Transactions*.

Fresh-water Limestones.—Those limestones which have been formed in fresh-water lakes, and are called fresh-water limestones, may more nearly resemble travertine in their mode of origin, since there is nothing to forbid the supposition of the waters of lakes becoming so highly impregnated with dissolved carbonate of lime as actually to deposit it as a chemical precipitate. At the same time, most fresh-water limestones look more like the result of the deposition of a highly calcareous, rather clayey mud, than of a precipitate of pure carbonate of lime. They become then the extreme term of marl or calcareous clay, and may be the result of either the disintegration of shells, &c., or of the mechanical action of rivers on previously existing calcareous rocks, the calcareous mud thence derived being perhaps mingled with the detritus of other rocks in greater or less quantity.

Silica.—The aqueous deposition of silica is sometimes a purely chemical one, as in the case of the *siliceous sinter* deposited round the Geysers, or hot springs, of Iceland; and round the hot springs of St Miguel and Terceira, in the Azores; and the chalcedony round those of New Zealand. Cold-water springs also, in some instances, deposit siliceous matter; but in these the silica is generally combined with alumina, oxide of iron, and other bases. In all these cases, evaporation of the water takes place; and Bischof attributes the formation of quartz crystals in cavities, and of compact quartz in veins, to the total evaporation of water containing silica in solution, and trickling down the sides of such cavities. He shows the impossibility of ascending springs depositing the quartz, inasmuch as those must be full of water, and therefore total evaporation of successive films of water could not take place. He attributes the formation of quartz crystals in drusy cavities to a similar evaporation of water containing silica, that has filtered through the adjoining rock. Agates, chalcedony, &c., show very distinctly the successive deposition of films of silica.

Marine Flints.—To account for the deposition of silica on the bed of the sea, where evaporation is not possible, we are compelled, as in the case of limestone, to call in the aid of the powers of animal life. The minute shells of many of the infusoria are almost entirely composed of silica, which they have extracted from the water of the sea. Some kinds of rock, such as the tripoli, or polishing slate, are entirely made up of these microscopic substances, some beds thus formed being many fathoms in thickness and many miles in extent.

All seas, from the equator to the poles, abound with these minute organisms. They have been found living even in ice. The phosphorescence of the sea, also, is due to the presence of organic beings, a large proportion of which are siliceous-cased animalcules. The bottom of the mid-Atlantic, at a depth of 2000 fathoms, was found, in some of the late hydrographic surveys of the United States, to be covered by what appeared to be a fine clay; but this, on examination, was discovered to be entirely composed of the siliceous shells of infusoria.[1] According to Ehrenberg, there are formed annually in the mud deposited in the harbour of Wismar, in the Baltic, 17,946 cubic feet of siliceous organisms. Although it takes a hundred millions of these animalcules to weigh a grain, Ehrenberg collected a pound-weight of them in an hour. So prolific are they, moreover, that "a single one of these animalcules can increase to such an extent during one month, that its entire descendants can form a bed of silica 25 square miles in extent, and 1¾ foot thick. As a parallel to Archimedes, who declared he could move the earth if he had a lever long enough, we may say,—Give us a mailed animalcule, and with it we will in a short

[1] Maury's *Physical Geography of the Sea*, p. 210. The student is reminded that this fine clay is not formed of the debris of these shells, but of the unbroken shells themselves. This will give him an idea of their minuteness.

Geology.

Geology.

time separate all the carbonate of lime and silicia from the ocean."[1] The silica thus rendered solid, may either be deposited alone, or may be associated, as will most probably be the case, with the debris of calcareous matter forming marine limestones, and having an equally organic derivation. When thus diffused in the finest particles, pretty equally perhaps through the mass of calcareous mud, it may either be consolidated in this equally diffused state, producing a more or less siliceous limestone, or it may, in obedience to certain chemical laws, segregate itself from the calcareous matter, and form either distinct layers and veins, or concretionary balls and nodules. The presence of any body itself consisting largely of silica, such as many sponges, will facilitate and determine this process, affording a centre of attraction for the siliceous particles to collect around it from the adjacent matter.[2]

These views of the organic origin of most marine limestones and flints are corroborated by the fact, which we shall presently describe, of almost all great masses of limestone being accompanied by siliceous portions of a peculiar character, such as are not found in any other rocks except limestone.

Carbonate of Magnesia.—Magnesia occurs in sea-water in the form of chloride of magnesium and sulphate of magnesia. Of the solid salts dissolved in sea-water, 8 to 15 per cent. consists of chloride of magnesium, and 6 to 16 per cent. of sulphate of magnesia. (*Bischof*, vol. i., p. 99–105.) From the quantity of free carbonic acid in the sea, it is plain that these might be converted into carbonate of magnesia, but that if so, it would be kept in solution as a bicarbonate (sesqui-carbonate), as in the case of carbonate of lime. All that has been said, therefore, as to the necessity for calling in the aid of organic life to solidfy carbonate of lime from the waters of the sea, "holds good in regard to carbonate of magnesia, and the more so since this salt always separates later than carbonate of lime, even from fluids which have undergone a very high degree of evaporation." (*Bischof*, vol. i., p. 117.)

There is, however, this difficulty in this view,—the carbonate of lime is largely separated from the sea-water by being made to enter into the composition of the hard parts of marine animals in overwhelming proportion, whereas the per centage of carbonate of magnesia to be found in the hard parts of corals and mollusca does not exceed 1 or 2 per cent.[3] Neither do we know any class of animals that secrete any much greater quantity of magnesia as some of the infusorial animals secrete silica. Yet in many widely-spread magnesian limestones the quantity of magnesia is almost equal to that of lime, and the proportion is frequently as much as 20 to 30 per cent. According to Forchammer, the fucoid marine plants contain more than 1 per cent. of magnesia; but the remains of such plants are rarely if ever found in magnesian limestones. Magnesian limestones are, moreover, generally poor in organic remains, though this may be the result of their more perfect crystallization and mineralization in various ways, by which the organic structure has been obliterated, rather than of the absence of organic beings from the original deposit.

In whatever way effected, it is true that magnesian limestones, containing various proportions of lime and magnesia, have been *deposited* originally as magnesian limestone at the bottom of the sea, sometimes in large quantities, and over considerable areas.

It is equally true that pure carbonate of lime has in many cases been subsequently converted into dolomite or magnesian limestone by chemical metamorphic action.

The resemblance which magnesian limestones, even where the carbonate of magnesia is in comparatively small proportion, bear to true dolomites, and their likeness to a chemical precipitate rather than to a mere sedimentary deposit, induce us to pause before denying altogether that such precipitation of carbonates, whether of lime or magnesia, have taken place on the bed of the sea without the intervention of organic life.

Sulphate of Lime and Rock-salt (chloride of sodium) are undoubtedly chemical precipitates, and we are here again met by the same difficulty as before, in assigning a proximate cause for that precipitation in the open sea. If we could imagine a portion of sea-water separated from the ocean, and left as a shallow lagoon to gradually dry up, there would be no difficulty in the case.

Bischof gives the following as the average composition of the salts of the sea-water (vol. i., p. 379):—

	Per cent.
Saline contents of sea water	3·527
Consisting of—	
Chloride of Sodium (common salt)	75·786
Chloride of Magnesium	9·159
Chloride of Potassium	3·627
Bromide of Sodium	1·184
Sulphate of Lime (gypsum)	4·617
Sulphate of Magnesia (Epsom salts)	5·597
	100·000

He tells us too, that when sea-water is evaporated, the point of saturation for sulphate of lime is much sooner reached than that for rock-salt; 37 per cent. of the water being required to be removed in the one case, and 93 per cent. in the other. Gypsum, therefore, must always be deposited before rock-salt, and it is possible for the point of saturation to be reached for gypsum in many cases without that for rock-salt being attained. This may be the reason why, although the sea contains sixteen times as much salt as it does gypsum, that the latter more frequently occurs as a mineral deposit than the former, though not often in such great masses.

In isolated seas, such as the Dead Sea, where the water is entirely saturated with salt, evaporation doubtless causes a precipitation on its bed (*Bischof*, p. 400). Here, and in shallow lagoons, such as the limans of Bessarabia, south of Odessa, that dry up in summer, we have the formation of rock-salt going on before our eyes.

In fresh-water lakes, sulphate of lime may be deposited, either directly, the water becoming saturated with that substance, or in consequence of springs or rivers containing sulphuric acid, which convert into sulphates the carbonates of the marls and calcareous muds already deposited. In some instances chemical reactions, such as the oxidation of iron pyrites (bisulphuret of iron), and that of sulphuretted hydrogen, may be supposed to take place, producing sulphuric acid, which immediately acts on any carbonate of lime that it can reach.

Carbon may be looked upon as essentially an organic element. Wherever we find carbonaceous matter in rocks, therefore, we may suspect it to have been derived from organic substances. Even the diamond is now believed to be a crystallized gum, or other vegetable product; and graphite may in like manner be looked upon as a possible, if not a probable, result of the metamorphosis of either animal or vegetable substance into a mineral. Even the purest graphite contains traces of earthy matter, diminishing its claims to be considered an original independent substance.

Carbon enters into the composition of *animal* matter, but its most abundant source is the *vegetable* kingdom.

Again taking Bischof as a guide in the explanation of the conversion of the organic substance wood into the rock

[1] *Bischof*, p. 188.

[2] Mr Bowerbank has proved the presence of sponge particles in many flints and cherts, and refers them all to that origin.

[3] It was stated by Professor Rogers, at the meeting of the British Association at Cheltenham, that Silliman junior had recently found a very large per centage of magnesia in the composition of corals.

which we call coal, we abstract some of his results in the following remarks :—

Table of the Composition of Carbonaceous Substances.[1]

Substances.	Carbon.	Hydrogen.	Oxygen and Nitrogen.
Wood	49·1	6·3	44·6
Peat	54·1	5·6	40·1
Lignite........................	69·3	6·6	23·3
Coal	82·1	5·5	12·4
Anthracite	94·0	3·0	3·0

In addition to these elements, however, the four latter substances given above contain variable quantities of earthy impurities, which are given, as in

Peat..............from	4·6 to 10·0	per cent.
Lignite	0·8 to 47·2	...
Coal............... ...	0·24 to 35·5	...
Anthracite	0·94 to 7·07	...

Looking on these earthy matters as accidental and unessential, we learn from the examination of the above table, that the rocks anthracite, coal, and lignite, and the intermediate substance peat, consist of the same constituents as the organic substance wood, the differences between them being in the proportions in which these constituents occur.

No other rocks except the coals have a composition at all similar to this.

If we abstract from wood some 30 per cent. of its oxygen and nitrogen, and compress the remainder till it becomes more dense and compact, it must form coal.

If, therefore, we suppose wood (or vegetable matter) buried under accumulations of more or less porous rock, such as sandstone and shale, so that it might rot and decompose, and some of its elements enter into new combinations, either gaseous or liquid, those combinations always using up a greater quantity of oxygen and nitrogen than of carbon and hydrogen, or of oxygen and hydrogen than of carbon, we should have the exact conditions for the transformation of vegetable matter into coal.

This process might naturally take place in four ways :—

1*st*. By the separation of carbonic acid gas (consisting of two equivalents of oxygen and one of carbon $= CO^2$) and carburetted hydrogen (consisting of four equivalents of hydrogen to two of carbon $= C^2 H^4$) from the elements of the wood.

2*d*. By the separation of carbonic acid from the elements of the wood, and the oxidation of some of the hydrogen (*i.e.*, its conversion into water $= HO$) by combination with external oxygen.

3*d*. By the separation of both the carbonic acid and the water from the elements of the wood.

4*th*. By the separation of all three substances, carbonic acid, carburetted hydrogen, and water, from the elements of the wood.

The loss of carbon is greatest in the first case, and least in the third, being always greater in proportion to the quantity of carburetted hydrogen which is disengaged.

The great quantities of carbonic acid gas (choke damp) and carburetted hydrogen (fire damp) met with in coal mines, shows the fact of the large extrication of these substances, and corroborates, if need were, this explanation. Reservoirs of these gases in a highly compressed state are often found to be pent up in the crevices and cavities of coal beds, and are the cause, when tapped, of many of the accidents which take place. Some beds of coal are so saturated with gas, that, when cut into, it may be heard oozing from every pore of the rock, and the coal is called "singing coal" by the colliers.

Bischof shows, that "under circumstances otherwise similar, the conversion of vegetable substances into coal takes place in the same way, whether they are mixed with much or little earthy matter." He also believes, from Kremer's and Taylor's investigations into the nature of the ash of coal, that there was an *intimate mixture* of vegetable and earthy substances, and that coal containing earthy matter could not be formed from compact wood without previous decay having taken place (vol. i., p. 269). He seems to suppose that, in many instances, this decay has gone so far as to convert the vegetables into "mould," which has been drifted as a kind of vegetable mud, and when mixed with earthy matter, deposited under water in the place where we now find it as coal.

From these preliminary considerations, we learn that plants living in the air extract from it the invisible carbonic acid and other gases, and by the hidden processes of life, compel them to enter as solid and visible substances into the composition of their own bodies; and that animals[1] living in the sea, in like manner extract from it the invisible solutions of lime and other substances, and similarly compel them to become solid and visible parts of their own bodies. In each case the substances thus rendered visible and solid by the action of organic laws, become, after the death of the organism, subject to the ordinary laws governing inorganic matter, and after undergoing more or less alteration, are used as materials for assisting in the construction of the external crust of our earth.

Description of the Chemically and Organically formed Aqueous Rocks.

55. *Limestone* may be hard or soft, compact, concretionary, or crystalline, consisting of pure carbonate of lime, or containing silica, alumina, iron, &c., either as mechanical admixtures, or as chemical deposits along with it.

Different varieties of limestone occur in different localities, both geographical and geological, peculiar forms of it being often confined to particular geological formations over wide areas, so that it is much more frequently possible to say what geological formation a specimen was derived from, by the examination of its lithological characters, in the case of limestone, than in that of any other rock[2].

Compact limestone is a hard, smooth, fine-grained rock, generally bluish gray, but sometimes yellow, black, red, white, or mottled. It has either a dull earthy fracture, or a sharp, splintery, and conchoidal one. It will frequently take a polish, and when the colour is a pleasing one, is used as an ornamental marble.

Crystalline limestone may be either coarse or fine-grained, varying from a rough granular rock of various colours, to a pure white, fine-grained one, resembling loaf sugar in texture. This latter variety is sometimes called *saccharine*, sometimes *statuary marble*. The crystalline structure of limestone is either original, when it is often found that each crystal is a fragment of a fossil; or it has been superinduced by metamorphic action on a limestone formerly compact.

Chalk is a white, fine-grained limestone, sometimes quite earthy and pulverent, sometimes rather harder and more compact, as the chalk of the north of Ireland, and some of that of the north of France.

Oolite is a limestone in which the mineral has taken the form of little spheroidal concretions, and the rock looks like the roe of a fish, from which its name, signifying *egg*, or *roe*-stone, is derived. These little concretions have several concentric coats, sometimes hollow at the centre, some-

[1] See also a very clear explanation of this subject in Ronald's and Richardson's *Chemical Technology*, vol. i., p. 31.

[1] Although coral-reefs were dwelt on as the most obvious and abundant source of limestone at the present day, it was not intended to infer that they had always been so. The older limestones have none of the huge reef-making corals in them; the small corals they contain merely contributed to their formation, together with other animals that secreted carbonate of lime.

[2] No experienced British geologist would be likely to confound characteristic specimens of the limestones of the Silurian, Carboniferous, Oolitic, and Cretacious formations of Britain and Western Europe; while any one might easily mistake the argillaceous or arenaceous rocks of those different formations.

times enclosing a minute little grain of siliceous, or calcareous, or some other mineral substance. It is commonly of a dull yellow colour, but gray oolitic limestone is not unfrequent. Its peculiar structure gives it the character of a freestone, working easily in any direction; whence its value as a building stone.

Bath stone, Portland stone, Caen stone, are well-known examples of oolitic limestone.[1]

Pisolite is a variety of oolite, in which the concretions become as large as *peas*. It is a structure not confined to limestone, however, as other rocks or minerals occasionally assume it.

Many limestones are named from their containing some peculiar variety of fossil, as *nummulite, clymenia, crinoidal* limestone, and *shell limestone*, or *muschelkalk*.

Others have local names given them, as the *calcaire grossier* of Paris, a coarse limestone, some beds of which are used for building, while others are a mass of broken shells.

Cipolino, a granular limestone containing mica; *majolica*, a white, compact limestone; *scaglia*, a red limestone in the Alps. (Murchison and Nicol, in *Johnston's Physical Atlas*.)

Ireland especially abounds in a great variety of limestones used for ornamental marbles, such as the green serpentine-marble of Ballynahinch in Galway; the black marble of Kilkenny; the brown, red, and dove-coloured marble of Cork and Armagh; and many others less known, and some of them unworked, but equally beautiful with those that are. In Derbyshire and North Staffordshire, we have a similar abundance of ornamental marbles.

Fresh-water limestones have commonly a peculiarity of aspect, from which their origin may sometimes be suspected, even before examining their palæontological contents, or petrological relations. They are generally of a very smooth texture, and either dull white or pale gray, their fracture only slightly conchoidal, rarely splintery, but often soft and earthy.

Flint and Chert.—The association of flints with chalk is well known. Chalk flints occur as rounded nodular masses, of very irregular, and sometimes fantastic shape, and of all sizes, up to a foot in diameter. They are commonly white outside, but internally are of various shades of black or brown, sometimes passing into white. They have sometimes concentric bands of black and white colours internally, and exhibit markings derived from organic bodies round which they have often been formed. Flint occurs in chalk not only in nodules, but also in seams or layers, sometimes

Fig. 1.

Sketch of some beds of limestone containing nodules of white chert, at Middleton Moor, in Derbyshire, in which the irregular and fantastic shapes assumed by these nodules are well exhibited, as also their likeness to flints in chalk.

[1] This oolitic structure is by no means confined to what is known as the Oolitic formation. We have already mentioned its occurrence in coral limestone. It occurs also largely in the carboniferous limestone of Ireland, and may recur in the limestones of any formation.

short and irregular, sometimes regular, over a distance of several yards. These seams vary from half an inch to two inches in thickness, and are commonly black in colour.

Almost all large masses of limestone have their flints or siliceous concretions. These are frequently called *chert*, as in the carboniferous limestone, where the nodules and layers of chert exactly resemble the flints in chalk.

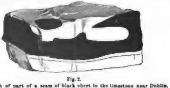

Fig. 2.

Sketch of part of a seam of black chert in the limestone near Dublin. These seams, like those in chalk, are sometimes quite regular for some distance, and then either suddenly terminate, split up, or are subject to other irregularities like those in the figure.

Even the tertiary limestones around Paris have their flints, the melanite of that locality being nothing but a siliceous concretion, found in the Calcaire St Ouen, and possibly other places.

Pure siliceous concretions occur even in the freshwater limestones and gypsum beds of Montmartre.

This invariable, or nearly invariable accompaniment of limestone and siliceous deposits,—those siliceous parts having a chemical, and not a mechanical formation,—strengthen the hypothesis of the organic origin of both, as previously described.

The silica diffused through the calcareous mud, of which the limestone was composed, has sometimes remained so diffused, instead of separating as nodules or layers, producing a *cherty* or *siliceous limestone*.

Clay, or argillaceous matter, has frequently been deposited with the calcareous, producing *argillaceous limestone*, which may be known by the earthy odour given out by it when breathed upon.

Carbonaceous matter, derived either from decaying vegetables, or perhaps more frequently from the decomposing animals of whose hard parts the rock is composed, produces in like manner the *black limestones*, which are in some instances called *bituminous limestones*. Little nests of pure anthracite, or other variety of carbonaceous matter, are sometimes found in the hollows of shells buried in limestone. The fetid smell, like that of sulphuretted hydrogen gas, given off by many limestones when struck with a hammer, is probably another result of the decomposition of animal matter, producing what is called "*fetid limestone*," or, by the Germans, "*stinkstein*."

When the argillaceous has been mingled with the calcareous matter in very large proportion, a subsequent separation of the two has often taken place, the lime having segregated itself from the mass in this case, as the siliceous separated from the calcareous matter in the case of flints and chert. Nodular lumps of limestone are then produced, divided from each other by little, often irregular, seams and layers of shale or clay. These concretionary lumps of limestone are sometimes merely scattered through the clay, but they often form regular seams or beds, the upper, or under, or both surfaces being uneven and nodular. It is sometimes difficult to say whether the little parting films and small seams of clay which occur between the beds have been deposited at different times from the calcareous matter, or having fallen together with it as an argillo-calcareous mud, have had their calcareous particles sucked out of them, as it were, by the segregating influence of chemical affinity.

It is by no means intended to infer that alternate deposits of thin layers of calcareous matter and purely argillaceous or arenaceous matter have not frequently occurred; we only wish to put the student on his guard against taking particular structures as proofs of original deposit, which, especially in so active and unstable a substance as carbonate of lime, may in many instances be the result of subsequent agency.

Geology.

It is comparatively rare to find such a mingling of quartzose sand and lime as could be called *arenaceous limestone*, though we have already seen that *calcareous sandstones* are not uncommon. Scattered pebbles, however, are sometimes found in chalk and other limestones; and a curious instance, first noticed by Professor Haughton, occurred at Crumlin, near Dublin, of angular fragments of granite, several inches in diameter, accompanied by granitic sand, being found embedded in limestone, four or five miles from any known granitic mass *in situ*. Such fragments may perhaps have been floated in the roots of trees and other vegetables, just as in the present day pebbles of hard stone, highly valued by the natives, are found in the roots of trees cast up upon the shore of archipelagoes of coral islands in the Pacific, as mentioned by Chamisso and Darwin.

Magnesian limestone.—Carbonate of magnesia is often found in marine limestones, mingled in various proportions with the carbonate of lime. Its occurence in small quantity frequently gives a sandy appearance and gritty feel to an otherwise smooth and compact limestone. When examined with a lens, this apparent sand is found to be made up of minute dolomitic crystals, commonly of a yellowish brown colour, and with a pearly lustre.

In a true magnesian limestone the crystallization and the pearly lustre is generally very distinct, though sometimes the crystals are minute. Its colour is commonly some shade of brown or yellow, occasionally tinged with red; gray and black varieties, however, occur sometimes over very large areas.

Magnesian limestone is very variable in lithological character. It is sometimes of a powdery, earthy, and friable texture; sometimes splits into thin slabs, some of which are flexible; sometimes forms singular concretionary masses, a number of balls touching each other, either like bunches of grapes, when it is called botryoidal, or like musket balls, or great piles of cannon shot. Many of these balls, on being broken open, are found to have a radiated structure. That all these curious forms have been produced subsequently to the deposition of the mass is shown by the fact of the lines of deposition or stratification proceeding through them regularly, without regard to the spherical outlines or radiated structure of the balls.

Magnesian limestone occurs in two forms, original and metamorphic. In some limestones the carbonate of magnesia has clearly been deposited together with the carbonate of lime, the whole having been originally formed as a magnesian limestone.

In other instances, it can be shown, from the geological conditions, that whether the rock originally contained magnesia or not, its present distribution and mode of occurrence, and its highly crystalline structure, are the result of agencies operating subsequently to the original formation of the rock, and affecting a number of different beds simultaneously, along certain narrow lines of fissure, to the neighbourhood of which the *dolomatised* condition of the rock is confined.

57. *Gypsum* occurs as a rock in various ways. It sometimes forms regular beds, sometimes irregular concretionary masses, sometimes veins and strings in the mass of other rocks.

Compact Gypsum or *Alabaster*[1] is one variety; granular, finely crystalline gypsum another. The thin beds and the veins and strings of gypsum are commonly fibrous, the fibres being at right angles to the beds. The gypsum of Montmartre, from which plaster of Paris is derived, is chiefly granular gypsum, each bed being composed of many layers of little crystals, slightly differing in colour and texture, and thus assuming a regularly laminated appearance. This would lead us to suppose that this rock, which is associated with fresh-water limestones and marls, was formed by the periodical deposition of layers of small crystals of sulphate of lime at the bottom of the water.

In August 1855 we observed in the quarries north of Montmartre one or two beds, six or eight inches in thickness, of beautifully crystallized sulphate of lime, in large perpendicular plates, interstratified with these little layers of crystals. All the beds were horizontal; and the layers of small crystalline grains were quite parallel to the stratification; but in the beds above mentioned, large tabular crystals and broad flakes of selenite, of rather irregular form, had struck directly across the bed, more or less nearly at right angles to it, the original horizontal lamination not being obliterated, but being in some places waved, as if slightly disturbed by the formation of the crystalline plates, the angles of these waves having evident relation to the faces and angles of the superinduced crystalline plates.

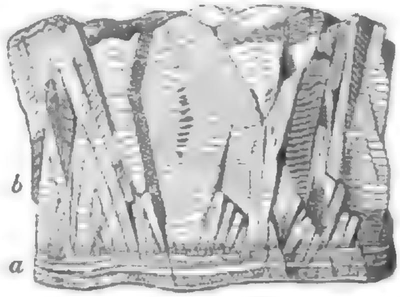

Fig. 3.

a. Layers of small crystalline granules of gypsum.
b. Crystalline plates of gypsum, traversed by the faintly seen and displaced original layers of granules. These lines are not sufficiently oblique in the woodcut; on the faces of some of the crystals they form angles of 35° with the plane of the beds.

This formed a good case, like that before-mentioned as occurring in the spheroidal concretions of magnesian limestone and other rocks, of a molecular change of structure having taken place in the mass of the rock subsequently to its formation. It yet remains for the chemist to explain to us the exact method of operation by which these changes are produced.

58. *Rock-salt* commonly occurs in Britain as a rudely crystalline, irregularly bedded mass, commonly stained of a dirty red by the mixture of feruginous clay and other impurities. Perfect cubical and transparent crystals occasionally occur, and curious spheroidal bands, of a white colour, are sometimes observable in the roof of a salt-mine. Bed-like masses of rock-salt are often 60 or 90 feet thick, thinning out probably in all directions, and thus taking the form of large cakes. In other countries, more numerous beds occur, but not making up larger masses. In some of these the salt is perfectly pure and white; but in all countries, and in all geological formations, the association of salt with gypsum, and with green, red, and variegated marls, is a frequent if not invariable occurrence. We have already seen how natural and almost inevitable is the occurrence of gypsum with rock-salt; but the accompaniment of red and variegated clays has not yet been explained. When it is, it will probably throw great light on the circumstances under which the rock-salt itself has been deposited. Dolomite is also often found in connection with rock-salt.

59. *Coal* is a rock the general aspect and nature of which is familiar to everybody. Its chemical composition has been spoken of above, and the resemblance of that composition to that of wood, and the way in which, by a slight alteration in the proportion of its component parts, and an accompanying physical consolidation, the one may be converted into the other. Coal is very commonly divided into bituminous and non-bituminous. Now bitumen is rather a vague term, including several combustible substances, such as asphalt or mineral pitch, elastic bitumen or mineral caoutchouc, naphtha, petroleum, &c. These bituminous substances are all either fluids, or are readily soluble in naphtha. It is, however, impossible to dissolve any appreciable portion of coal in naptha, which shows that it does not contain any actual bitumen, though it may contain the

[1] Alabaster is derived from Alabastron, a town of Egypt, where it was manufactured into boxes for ointment. The term "alabaster" was then applied to carbonate of lime, as well as sulphate of lime.

 constituents of it. The natural and artificial bitumens are the result of the decomposition of vegetable matter, and may be extracted also from coal by subjecting it to distillation. They always contain from 7 to 9¼ per cent. of hydrogen, combined with carbon and oxygen. The so-called bituminous coals, then, are those in which the mineralizing process has only proceeded to a certain extent, leaving a considerable proportionate amount of hydrogen and oxygen in their composition; while those called non-bituminous are those from which a greater quantity of the latter substances have been extracted, and a larger proportion of carbon left behind. If the decomposition of wood results in the formation of carbonic acid gas, which takes away both carbon and oxygen, or of carburetted hydrogen, which takes away a large proportion of carbon, the carbon in the remainder will not be in such excessive proportion, and the constituents of the resulting coal will more nearly resemble those of bitumen. In this sense they may be called bituminous coals. If, however, a large portion of the oxygen and hydrogen be extracted, either as water or in any other form, the proportion of carbon in the remainder becomes excessive compared with that in the composition of bitumen; and hence the coals may be called *non*-bituminous.

Coals vary greatly, not only in the proportions of their essential constituents, carbon, hydrogen, and oxygen, but also in the amount of earthy matter (forming ash) which has been accidentally and mechanically mingled with those constituents. We have seen that the per centage of ash is sometimes as much as 35 per cent. in coals that have been regularly analysed. In poorer varieties of coal, however, such as are never brought to market, but which are occasionally used in particular localities, this per centage is doubtless still greater; and we have in nature every gradation, from pure coal into a mere carbonaceous (commonly called bituminous) shale or "batt," which often contains enough inflammable matter to give out flame and support combustion for a time when burnt with better coals, but soon passes into a lump of ash, unaltered in form, and not retaining heat longer than a brickbat would under similar circumstances. These *batts*, shales, or slates, often accompany coal, being found not only either just above or just below it, but in it, in the form of thin seams, layers, or cakes, which are often not to be separated from it without some trouble.

Just as limestone is often mingled with clay, and passes through argillaceous limestone and calcareous clay (or marl) into clay itself, so coal passes through earthy or ashy coal, and carbonaceous shale, into common shale or clay, no very hard boundary-line being to be drawn between the many minor graduating varieties of the different substances.

Discarding the impure or imperfect coals, the recognisable varieties of true coal are sufficiently numerous. They may be grouped under three heads:—Anthracite, ordinary or pit-coal, and brown coal or lignite.

Brown coal or *lignite* sometimes shows the structure of the plants from which it is derived but little altered from their original condition; stems with woody fibre "crossing each other in all directions. It is of a more or less dark colour, soft and mellow in consistence when freshly quarried, but becoming brittle by exposure, the fracture following the direction of the fibre of the wood." (*Chemical Technology*, Ronalds and Richardson, vol. i., p. 32.)

"Other kinds present only occasional distinct indications of vegetable structure, and appear throughout as a stratified mass of a dark, nearly black colour, with an earthy fracture; while in some varieties the structure is still more dense, and the fracture is conchoidal."—*Ib.*

The latter varieties, as in the case of the Bovéy coal of Devonshire, are often scarcely distinguishable by any external characters from some varieties of ordinary coal.

Ordinary or *pit-coal* has many varieties; indeed these are often as numerous as the different seams of a coal-field, and even the different beds of a compound seam are readily distinguished from each other by the colliers, who give particular names to them; and even small blocks of these varieties can be recognised by them, and identified with the seam, or part of a seam, from which they are derived. Neither are these distinctions, which are only to be perceived after long practice, unimportant, since these varieties have distinct qualities, some of them being better adapted to smelting, and said to be "good furnace coal;" some of them to blacksmith's work, or "good shop coal;" others to various uses; while only a few, comparatively, are best fitted for domestic purposes, and are brought to market by the coal-merchant.

Some idea of the immense varieties of coal may be gained from an inspection of the report of the Admiralty coal Investigation (*Mems. Geolog. Survey*, vol. i.), as well as from the varying qualities of those which we are in the habit of using daily in our houses. "As many as seventy denominations of coal are said to be imported into London alone." (*Chem. Tech.*)

All these minute varieties are commonly included under four principal heads:—1. Caking coal; 2. Splint, or hard coal; 3. Cherry, or soft coal; and 4. Cannel, or parrot coal.

Caking coal is so named from its fusing or running together on the fire, so as to form clinkers, requiring frequent stirring to prevent the whole mass being welded together. It breaks commonly into small fragments with a short uneven fracture. The Newcastle coal, and many others from different localities are caking coals. They leave many cinders and a dark dirty ash.

Splint or hard coal is well known in the Glasgow coal-field. It is not easily broken, nor is it easily kindled, though, when lighted, it affords a clear, lasting fire. It can be got in much larger blocks than the caking coals.

"*Cherry or soft coal* is an abundant and beautiful variety, velvet black in colour, with a slight intermixture of gray. It has a splendent or shining resinous lustre, does not cake when heated, has a clear shaly fracture, is easily frangible, and readily catches fire." (*Chem. Tech.*) It leaves comparatively few cinders, and its ash is white and light. It requires little stirring, and gives out a cheerful flame and heat. The Staffordshire coals principally belong to this variety.

Cannel or parrot coal is called cannel from its burning with a clear flame like a candle, and parrot in Scotland from its crackling or chattering when burnt. Cannel coal varies much in appearance, from a dull earthy to a brilliant shiny and waxy lustre. It is always compact, and does not soil the fingers. Its fracture is sometimes shaly, sometimes conchoidal. The bright shining varieties often burn away like wood, leaving scarcely any cinders and only a little white ash. The duller and more earthy kinds leave a white ash, retaining nearly the same size and shape as the original lumps of coal. Cannel coal often takes a good polish, and can be worked into boxes and other articles. *Jet* is an extreme variety of cannel coal in one direction, as *batt* or carbonaceous shale is in another.

Anthracite is heavier than common coal, with a glossy, often iridescent lustre, and a more completely mineralized appearance. It rarely soils the fingers, has a distinctly sharp-edged conchoidal fracture, or else breaks readily into small cubical lumps. It is not easily ignited, but when burning gives out an intense heat, so as to sometimes melt the bars of the grate or furnace in which it is used. It does not flame, and gives off but little smoke, being in this respect similar to coke or charcoal.

In many ordinary coals, little flakes of mineral charcoal occur, retaining that part of the vegetable structure called the vascular tissue. They are called "mother of coal" by the colliers in some places. "It is frequently seen in the form of a thin silky coating, covering some of the surfaces of the coal." (Professor Harkness on Coal, *Edinburgh New Philosophical Journal*, July 1854. Microscopical examination exhibits not only the vascular but the cellular tissue of plants in the substance of many coals, as was shown by Mr Witham in his work on the structure of fossil plants, and by many observers since.

All coals have a peculiar structure, which bears a slight analogy to crystallization. They break or split not only along the bedding, but across it, along two set of planes

Geology.

at right angles to the bedding and to each other. The smooth, clean faces produced by one of these division planes are more marked and regular than that produced by the other, as may be seen by examining any lump of coal. The principal of these division planes are called by the colliers the *face* of the coal, the other being called the *back* or *end* of the coal. They preserve their parallelism sometimes over very wide areas; and the mode of working or getting the coal, and the direction of the galleries, is governed by the direction of the *face*. In some places these division planes are called "cleat," in others "slines."

It is a structure which is probably the result of the mineralizing process undergone in passing from an organic to an inorganic state, and may be likened perhaps to the "cleavage" of a mineral rather than to either the true "slaty cleavage of rocks, or to their "foliation" or "jointing"—structures that will be hereafter described.

III.—AERIAL ROCKS.

Although the amount of rocks, or accumulations of earthy matter, formed of materials which were brought into their present situation by the action of the wind, is comparatively of small importance, it is not expedient wholly to overlook this action. Along all low sandy coasts hills are formed of drift sand, which sometimes attain a considerable altitude, as much, for instance, as 200 or 300 feet. These hills are commonly called "dunes." They have been described as advancing on the low shores of France, in the Bay of Biscay, at the rate of 60 and 70 feet per annum, overwhelming houses and farms in their progress. Similar accumulations take place on the coast of Cornwall, where the sand, composed largely of fragments of shells and corals, becomes converted sometimes into a hard stone by carbonate of lime or oxide of iron. (De la Beche's *Manual*.

Lieutenant Nelson has described similar aerial accumulations in the Bermuda Islands, giving them the name of Æolian rocks.

Along the south coast of Wexford, as also in Smerwick harbour (county Kerry), and other parts of the British Islands, similar accumulations are in progress.

On the eastern coast of Australia, about Sandy Cape, this process is going on on a still larger scale. In Port Bowen, in the same neighbourhood, we once saw a very good instance of it. The rise and fall of the tide there is as much as 16 feet; and at low water great sand-banks are exposed, derived from the shallow sea outside and the waste of the porphyritic rocks on the coast. These sand-banks rapidly dry under the hot sun; and the trade-wind, which blows home upon the shore, then drifts the sand up upon the beach, and piles it into hills 50 or 60 feet high. Behind these hills is a large mangrove swamp, which is being gradually buried under the advancing sand, some of the mangrove trees only just peering above it, others half covered, and so on. The drift of sand through the gaps of these dunes was exactly like a snow-drift in a heavy storm whenever the wind blew freshly.

Large districts, with hills of 200 or 300 feet in height, are found also on the coasts of Western Australia, stretching sometimes 10 miles inland, formed of loose incoherent sand, once apparently drifted by the wind, though now brought to rest by the growth of a wide-spread forest of gum-trees. Parts of these sands, which consist greatly of grains of shells and corals, are compacted together into a stone, hard enough to be used for building, by the action of the rain-water dissolving some of the carbonate of lime, and redepositing it on evaporation. Curious cylindrical stems, from 1 inch to 18 inches in diameter, are there seen projecting from the soil, and have been taken for petrified trees, which they greatly resemble; but we observed, in 1842, a number of these supposed trees exposed in a little cove, south of the entrance of Swan River, ending downwards in tapering forms like stalactites; and we believe them, therefore, to have a stalactitic origin, due to the percolation of water down particular pipes and channels in the sand.

Nor is it along the coast only that such accumulations are taking place. In the interior of great dry continents, there are vast spaces covered with sand and sand-hills, which are shifted and carried about by the wind, just as some sand-banks are deposited now here, and now there, carried about by the water. We have but to recal to the mind of the reader the well-known stories of caravans crossing the desert being met and sometimes overwhelmed by moving columns of sand, and the way in which many of the temples of Egypt have been buried under such accumulations, for him to see that this action cannot be altogether overlooked. Egypt would probably have been long ago obliterated by drift-sand if it had not been for the Nile, and the strip of vegetation that accompanies and defends it. In the interior of Australia, Captain Sturt reports the existence of vast deserts of sand, with long lines of great sand-hills, 200 feet high, the base of one touching that of its neighbours, and all stretching in straight lines each way to the horizon.

It would be quite proper also to class among aerial rocks such accumulations of tuff as were derived from volcanic ashes falling on the land, and also the masses of pebbles, cinders, and fragments so derived, were it not more convenient to describe them in connection with the volcanic rocks, so as not to separate in our account those falling on the land from those deposited in water.

Soil.—The accumulation of decayed vegetable matter, mingled sometimes with animal, always with earthy mineral matter, which is called "soil" or "mould," is also an aerial process, deserving of more attention than it has yet received. Soils sometimes occur as distinct rocks, interstratified with other rocks.

Chap. IV.—THE METAMORPHIC ROCKS.

Preliminary Observations.

In the course of the foregoing descriptions we have mentioned the segregation into concretionary lumps and nodules, of siliceous from calcareous matter, and of calcareous from argillaceous; and we have described the radiated and concretionary forms assumed sometimes by magnesian limestone and the re-arranged crystallized beds of gypsum. These, however, are not the only instances of such separation of parts, and assumption of new forms and combinations, by the particles of rock after their deposition, and after their more or less complete consolidation. Any mineral diffused in a state of minute division through a mass of different nature from itself, seems to a have tendency to segregate itself from the mass, and collect together upon certain points or centres. Iron, either in the form of iron pyrites (bisulphide of iron), or ironstone (clayey carbonate of iron), or hæmatite (oxide of iron), frequently forms such concretionary lumps. Iron pyrites, either in cubical crystals, or in balls with an internal radiated structure, is frequent in all argillaceous and calcareous rocks, and in many trap rocks. Ironstone forms regular layers of round nodules, sometimes as much as a foot or 18 inches in diameter, in many argillaceous rocks. These nodules, when broken open, are often found to be traversed by cracks in all directions, more or less filled up with crystalline spars (carbonate of lime, &c.), together with crystals of galena, blende, iron pyrites, and other minerals.

In other clays, carbonate of lime, mingled perhaps with iron, produces similar stones, called septaria or cement

stones in some places. They often take a polish, and the sparry veins produce a variously ornamented appearance.

In these septaria and ironstone balls the external crust is generally smooth and compact, the internal cracks becoming larger and more numerous as they proceed towards the centre. As the cracks are obviously the result of desiccation and consequent contraction, and as the external crust would naturally be the first part to consolidate, it does not at first seem obvious why the cracks should not occur outside rather than in.

Professor Hennessy, however, remarked to us, that in the case of volcanic bombs, which have a similar structure, the fact of the preliminary consolidation of the external crust was the cause of the internal fissuring, since, when that was formed, no farther shrinking or contraction of the whole body could take place; and the internal parts being thus relieved from external pressure, would shrink and contract among themselves, being rather attracted towards the dense external crust than towards the centre. If consolidation commenced at the centre, the whole nodule would have contracted towards the centre, and thus have shrunk into a less size and a denser state, without the occurrence probably of either external or internal cracks.

Hæmatite, whether red or brown, affects a kidney-shaped concretionary form, often hollow, with a minutely radiated structure at right angles to the surface of the mass.

Other minerals, such as galena and blende (the sulphides of lead and zinc), occur in small balls or nests in some rocks, evidently formed as concretions, and not rolled fragments or pebbles.

This separation of one matter from another, and subsequent assumption of a condition more or less different from that possessed by rocks at the time of their original formation, leads us naturally to consider the next great division of our subject, the metamorphic or transformed rocks.

The mere physical force of pressure, as aqueous rocks after their formation become gradually covered by subsequent accumulations, must produce change in them in the way of consolidation and induration. The pressure may of itself be sufficient in some cases to cause the hitherto incoherent particles of sand or clay to cohere and be compacted into a solid stone. It will, however, be greatly assisted, either by the infiltration of water containing mineral matter in solution, or of pure water dissolving and rearranging the soluble materials which it may find in the rocks.

Heat may, in like manner, modify the effects of pressure, either by its mechanical power of expansion producing pressure in every direction, and subjecting rocks to alternate expansions and contractions according to its own variations, or by setting in action chemical forces of decomposition and recomposition, and thus altering the chemical combinations in the materials of rocks.

Heat may also be joined with water, either raising it to various temperatures or actually converting it into steam, and we may thus get changes produced which neither cold water nor dry heat would be able or likely to effect of themselves. It has been stated that it is impossible to maintain the bulb of a thermometer in the boiler of a steamer at very high temperatures, since the glass is dissolved by the chemical action of water heated under pressure. (Sedgwick's *Introduction to Synopsis of Classification*, &c., 3d Fasciculus, p. 29, note.) Now, it may not unfrequently happen that we may have all the forces of pressure, heat, and the dissolving power of water combined in the interior of the earth.

The presence of water in rocks is known by experience, since no stone is ever quarried which will not part with some water on being dried, either naturally in the air or artificially. Bischof says, that he has observed, on breaking blocks of basalt, "wet patches, like rain drops, upon the fractures, and sometimes quite in the centre of the mass, affording positive evidence of the permeability even of so compact a rock as basalt." He says also, that almost all water contains both carbonic acid, and often a slight proportion of silica (silicic acid) in solution, that the silicates in which the silica is in its soluble modification are decomposed by weak acids, and that those also in which it is in its insoluble modifications are unable to resist the long-continued action of acids.

This gives us the explanation of the brown spots and patches found in many rocks containing silicate of lime, such as basalt and greenstone, and also their brown and weathered surfaces. Along the internal margin of the brown part of basalt and greenstone a mineral acid will almost always cause effervescence, as also along the minute cracks and crevices and pores by which the water gains access to the interior. It is plain that the silicate of lime is converted into carbonate in the first place, and this being removed by subsequent solution from more carbonic acid and washed out, the protoxide of iron left behind is converted into peroxide, and the brown colour produced.

Limestone containing much silica or silicate of alumina, and some protoxide of iron diffused through its mass, is, in a similar way, converted into *rotten stone*, while pure limestone is wholly dissolved and washed away.

The decomposition of those rocks which do not contain any lime proceeds in the same way, though it is not so easy to detect it by the occurrence of effervescence with acids along the margin of the decomposed part. Feldspar rocks have their silicates of potash, soda, &c., converted first into carbonates and then into bi-carbonates, which are dissolved and washed away. Their decomposed portions are generally white rather than brown, from the absence of iron, though shades or streaks of red and brown occasionally occur, showing its presence in small quantities.

In the examination of these changes, the study of pseudomorphic crystals of minerals is of great importance. A pseudomorph is one mineral occurring in the crystalline form of another. These are either "alteration pseudomorphs," in which the first mineral has been gradually changed into the other, or "displacement pseudomorphs," in which the first mineral having been gradually removed particle by particle, another has gradually, and particle by particle, taken its place. This action is a very important one; for it is precisely that of "petrifaction," as it is called—that by which organic remains are mineralized, and their external form, and more or less of their internal structure, preserved.

Animals and plants, by means of their fluids, take up and convert into their own substance certain minerals, such as silica, lime, magnesia, soda, potash, phosphorus, carbon, iron, &c. This they do in obedience to the organic forces, those chemico-biological actions, the assemblage of which we call *life*. When life no longer exists, and its forces cease to act, the substances of animals and plants become obedient to inorganic laws, and their mineral portions are acted on just in the same way that other mineral matters are affected. Wood may either, as we have already seen, lose certain *proportions* of its constituents and become more and more *carbonized;* or it may lose the whole of them particle by particle, and as each little molecule is removed, its place may be taken by a little molecule of another substance, as silica, or iron pyrites, and it may thus become entirely *silicified* or *pyritized*.

Bones and shells, and other hard parts of animals, consisting mainly of phosphate and carbonate of lime, may in like manner have the proportions or the state of aggregation of their constituents altered more or less completely, or may have their substance gradually but entirely replaced by another substance more or less different from the former.

Bischof combats the opinion that this pseudomorphous and petrifactive process is ever the result of dry heat or of

Geology.

sublimation, and shows, with what appears conclusive reasoning, with regard to many substances at all events, that whether it occur in the mass of rocks, or in veins and fissures, it must be the result of *water* (temperature uncertain) containing some acid, chiefly carbonic acid, in solution in the first place, and afterwards by means of that acid becoming impregnated with the solutions of other minerals.

Some of Bischof's remarks are so very instructive that we do not hesitate to quote several passages at length. "Stein converted a crystal of gypsum into carbonate of lime by leaving it for several weeks in contact with a solution of carbonate of soda, at a temperature of 122° F." The sulphuric acid of the gypsum uniting with the soda to form sulphate of soda, which was dissolved and carried away by the water, and the lime uniting with the carbonic acid. "All the striæ upon the curved surfaces of the crystal were perfectly retained, as well as the cleavage in the direction of the T-planes. In these artificial pseudomorphic processes, the form of the original substance is retained only under certain conditions, the most essential being slow action; and the same holds good in nature. If these conditions are not fulfilled, the original form is lost."

"In the analysis of a mineral in which changes have already commenced, especially by the addition of new constituents in very minute quantities, it is not unlikely that they may be considered as accidental and deducted. Since, however, alterations seldom take place merely by addition, but more frequently by loss of constituents, it is likewise requisite that the quantities lost should be added to the analytical results.

"There are sufficient grounds for considering andalusite to be a pure silicate of alumina, although previous analyses have pointed out, besides these two essential constituents, potash, lime, magnesia, oxides of iron, and manganese and water. Andalusite is converted into mica, in which change a part of the alumina is removed; potash, magnesia, and peroxide of iron, being introduced into its place. One of these bases is always found in andalusite, sometimes several of them together; and it may therefore be inferred that this mineral, as usually met with, is already in a state of incipient alteration. No other alteration of andalusite is known besides that into mica, except that into steatite. The latter change presupposes not only a partial but a complete disappearance of the alumina, and its replacement by magnesia. These examples will suffice to show the importance of the minute quantities of substances present in minerals, and generally considered as accidental. These substances, which are troublesome to the chemist, because he cannot introduce them into the chemical formula, acquire significance when compared with the constituents of the pseudomorphs, resulting from the alteration of the mineral in question. They then no longer appear as accidental, but indicate the transition of one mineral into others, and lay before us clearly the greater part of the conversion process.

"It is possible that several changes may frequently have taken place before the last product was formed. In the alterations of complex minerals, especially silicates containing several bases, there are, certainly, transitions in most cases, and sometimes a long series. Thus Cordierite is the starting point of a whole series of alterations, finally ending with Mica; while Fahlunite, Chlorophyllite, Bonsdorfite, Esmarkite, Weissite, Praseolite, Gigantolite, and Pinite, are remains of Cordierite in pseudomorphic conditions. Inasmuch as the minerals between Cordierite and Mica are only transition products, they cannot be regarded as individual species."

"As petrifactions are important and in many cases indispensable aids in recognising the sedimentary formations, so likewise pseudomorphs are important, and frequently the only means of tracing the processes of alteration and displacement which have taken place and are still going on in the mineral kingdom.

"Pseudomorphs furnish us with a kind of knowledge which we have no opportunity of deriving from any other source. It will scarcely ever be possible to convert augite, olivine, or hornblende, &c., into serpentine in our laboratories. But when we find serpentine in the forms of these minerals, this fact is a sufficient evidence that such a conversion can take place; and if in any given instance there are geognostic reasons for the opinion that one or other of these minerals, or even several together, have furnished the materials for the formation of serpentine, there is a high degree of probability that such a change has actually taken place.

"If a crystalline mineral can, under certain conditions, be converted into another, whether with or without retention of form, then the same mineral in an amorphous state would certainly suffer the same change when placed in the same circumstances." From this he shows that amorphous masses of serpentine may be formed from amorphous masses of augite, &c., and also that in some instances the original form of a crystalline mineral may be destroyed together with its substance, and the new mineral occur in its own crystalline form. He concludes the subject thus:—

Geology.

"The importance of the pseudomorphic processes, and the error of those who regard them as having but little connection with the changes of rocks, is sufficiently shown by the total disappearance of previously existing substances in veins. I consider that the entire removal of fluor and calc spar from a whole series of veins, and the introduction of an equal quantity of quartz in their place, is a matter of vast importance. To what enormous spaces of time do we come when we reflect upon the periods during which the fluor and calc spar were introduced into these fissures, and then the periods during which they were again removed by water, and quartz substituted in their place! And yet this happened after the formation of the rocks in which these fissures occur. If we imagine similar processes to have taken place in the rocks themselves, and extending over not only both these periods, but the entire space of time since their formation, we shall be compelled to admit that inconceivably stupendous changes have taken place. After such considerations, the conversion of extensive masses of rock by the action of water alone into steatite, talc, serpentine, kaolin, &c., cannot appear in the slightest degree strange." (*Bischof*, chap. ii.)

If we allow so large an amount of metamorphic action to the infiltration of water, it becomes no longer difficult to understand the conversion of limestone into dolomite, subsequently to the deposition of the original carbonate of lime. Such cases as those described by Von Buch, and more recently by Mr Andrew Wyley, in the journal of the Geological Society of Dublin (vol. vi., part 2), in his paper on the Dolomitic Rocks of Kilkenny, where dolomite is found traversing ordinary limestones in dyke-like masses running through a great number of beds in a straight line across the country, becoming explicable on the supposition of springs of water containing much carbonic acid and magnesia rising up through fissures, and the consequent solution of some of the carbonate of lime and its replacement by carbonate of magnesia.

If, again, such great changes as those just alluded to may be expected to result from the simple action of water, we may reasonably conclude still greater to be the consequence of the action of water combined with a high temperature, or of a still more intense heat, which first converts into steam the water contained in rocks, and effects great changes perhaps, or, at all events, prepares the way for great changes by that agent, and then proceeds to act upon the minerals contained in rocks with its own powers. We have already seen that some sandstones and gritstones may have probably been cemented by silica held in solution, either in the water in which they were deposited, or in that which subsequently gained access to them. We know that hot water can contain at least a tenth more silica in solution than cold water. If, therefore, a sandstone became penetrated by hot water, or still more by steam, a portion of the silica of which each grain was composed might be dissolved, and as the water ultimately evaporated, this silica would be redeposited, and act as a siliceous cement to the mass. We should thus have a quartz rock or quartzite produced.

It would appear, however, that dry heat alone is able, under favourable conditions, to produce this effect, since the sandstones that have been used as the bottoms of iron furnaces are, in some cases, altered into a kind of quartz rock. It is true that bases, calculated to act as a flux to the quartz, may have gained access to the sandstone in the latter instance, but then they may, on the other hand, have been present in sufficient quantity for that purpose in many sandstones that have been naturally altered into quartz rock.

While we give full allowance to the importance and magnitude of the metamorphic effects produced by water at whatever temperature, there are yet still greater and more general changes, which we must believe can only have been effected by the action of heat, too great to allow of the presence of water.

When we see whole mountain ranges, and whole districts of country, consisting of rocks that have more or less analogy in structure and constitution to rocks known to be of igneous origin, we cannot help feeling convinced that igneous action must in some way have been concerned in their production.

When we find that these rocks have every gradation, from such as might have been once molten, into rocks which we know to have been mechanically deposited under water, we are compelled to conclude with Lyell that these rocks are altered or metamorphosed by heat from their original aqueous and mechanical formation into a state more or less nearly approaching true igneous rocks.

Our belief in the truth of this metamorphism becomes certainty when we see these rocks always occurring on the flanks of masses of granite, and examine a district (such as Wicklow and Wexford) where both large and small masses of granite appear, and find these metamorphic rocks, not only always accompanying the granite, but occurring *no where else* except in the neighbourhood of granite or granitic rocks, and their extent always porportioned to the size and extent of the particular granite mass they mantle round.

It is by no means intended to assert that the neighbourhood of granite or igneous rock is the only source of heat from which this metamorphosis can arise. Should any mass of rock, capable of alteration, be so deeply buried in the earth as to be brought within the reach of any centre of heat whatever, the same effect would result; and it is quite possible that a far greater intensity and wider range of heat may be thus reached, than could proceed from the mere intrusion of a more or less isolated mass of igneous matter into spaces which were naturally of a lower temperature. But as an intrusive mass of granite must be a source of great heat, and as the metamorphic effects in question are found always to accompany it, we are obliged to look upon heat as the cause of the effect.

This effect of intense heat may doubtless be variously modified by the previous presence or absence of water, and by the various mixtures of mineral matters occurring in the different rocks before alteration.

The very general appearance of mica, either in distinct flakes or crystals, or as a mere glaze upon the surfaces of laminæ,[1] may perhaps be explained by the very various composition of the different varieties of mica, and the consequent number of sources and combinations from which micaceous minerals could be derived. Mr Sorby has shown by the help of the microscope that many ordinary clay-slates are in reality made up of minute mica flakes. Dr W. K. Sullivan also has remarked to us the possibility of several different minerals, or at least many chemical combinations, putting on the micaceous form as a consequence of peculiarity in physical structure rather than of identity in chemical composition.

The metamorphic development of mica, then, offers no difficulties; and we may perhaps suppose that in mica schist, where there are alternate layers of mica and quartz, this development took place in such a way that the basic substances segregated themselves into alternate layers, leaving the silica of the intermediate layers free; these layers being determined by the original lamination or sedimentary layers of the mass, except where that mass was very homogeneous, or greatly affected by "transverse cleavage."

In gneiss, where we have the triple alternation of quartz, feldspar, and mica, a similar action, similarly directed, must be supposed to have occurred under the modifying influence of a different composition in the original rock.

We shall have occasion, under the head of Petrology, to recur to this subject in describing the "cleavage" and "foliation" of the metamorphic rocks. "Cleavage" is, indeed, a purely petrological structure, whatever may have been its origin, since it rarely, and only to a slight extent, produces any lithological change in a rock beyond that of simple induration. A highly indurated *shale* has no lithological difference from a true *clay slate*, it being often impossible, from an inspection of a mere hand specimen, to say whether it be one or the other.

DESCRIPTION OF THE METAMORPHIC ROCKS.

The metamorphic rocks may be divided into two subgroups, those in which the original mineral structure is still recognisable—the particles, however they may have altered their form and state, not having entered into new combinations—and those where such new combinations have been produced.

The former sub-group will accordingly consist of arenaceous, argillaceous, and calcareous rocks, while the members of the latter have a general similarity of structure and composition which enables us to speak of them under one general term, such as the *schistose rocks*.

Metamorphosed Arenaceous Rocks.

60. *Quartz Rock or Quartzite*[1] is a compact, fine-grained, but distinctly granular rock, very hard, frequently brittle, and often so divided by joints as to split in all directions into small angular but more or less cuboidal fragments. Its colours are generally some shade of yellow, passing occasionally into red, and at other times into green. When examined with a lens it may be seen to be made of grains, which appear sometimes as if they had been slightly fused together at their edges or surfaces, and sometimes as if imbedded in a purely siliceous cement. This cementation or semi-fusion of the grains shows at once that it is a sandstone which has been altered and indurated by the action either of heat alone or of heat and water. It has either been *baked* or *steam-boiled*.

Metamorphosed Argillaceous Rocks.

61. *Clay Slate* is a fine-grained fissile rock, differing from shale in being invariably highly indurated, and splitting into plates that are altogether independent of the original lamination or bedding of the rock, and frequently cross it at all angles. This fissile structure or "cleavage" is a superinduced or metamorphic one. The original bedding or lamination of the rock may frequently be traced, even in hand specimens, by means of parallel lines or bands of different colour and texture traversing the slate. These bands are called by Professor Sedgwick the "stripe" of the slate.

Clay slate is generally of a dull blue, gray, green, or black colour, sometimes "striped," sometimes irregularly mottled.

Metamorphosed Calcareous Rocks.

62. *Altered or Crystalline Limestone.*—This was for-

[1] See *postea*, under the head of Petrology, remarks on the production of mica-schist and gneiss on the flanks of the granite of Wicklow, &c.

[1] The student must carefully distinguish between quartz rock or quartzite, as here described, and pure *vein quartz*, which occurs sometimes, as a white compact flint rock, in considerable mass. The "quartz rock," so often spoken of in Australia, is rarely, if ever, true quartz rock, but commonly vein-quartz; not an altered bed of sandstone contemporaneous with the rocks in which it lies, but a deposition in a vein or fissure produced subsequently to the consolidation of the rocks it traverses.

The Continental geologists seem frequently to fall into the same mistake, and confound two things essentially distinct. In a collection of European rocks purchased lately from Krantz of Bonn, among seven specimens of so-called quartzite, at least five were undoubtedly *vein quartz* and not *quartzite*.

merly called *Primitive*, and is even at the present day often called *Primary Limestone*. Since, however, it is known that many crystalline limestones are not primary, that some of the statuary marbles of Italy and Greece, for instance, are even tertiary limestones in a metamorphosed state, it would seem better to disuse the term primary as a mere lithological designation.

It is probable that some limestones were originally formed as crystalline limestones, inasmuch as many parts of a coral reef are even now crystalline internally. Others, however, have certainly been only made to assume the crystalline structure at a period subsequent to their formation. In the well-known experiments of Sir James Hall, it was shown that even chalk could be converted into a hard crystalline marble, by being heated under such a pressure as should prevent the escape of the carbonic acid gas.

Saccharine, or statuary marble, is a white, fine-grained rock resembling loaf-sugar in colour and texture, working freely in any direction, not liable to splinter, slightly translucent, and capable of taking a polish. Concealed flakes of mica or chlorite sometimes exist in it, as may be seen on examining the weathered surfaces of some of the ancient statuary in the British Museum and elsewhere.

Other varieties of altered limestone are variously coloured, and more largely and coarsely crystalline.

63. *Dolomite.*—Some magnesian limestones are clearly altered or metamorphic, forming a true dolomite or highly crystallized aggregate of nearly equal parts of carbonate of lime and carbonate of magnesia. Its metamorphic character, however, can only be certainly ascertained by its geological relations, and not by its lithological structure.

We had long suspected that some serpentines, or verde antique marbles, were nothing but highly altered magnesian limestones. This suspicion has been confirmed by Mr Logan,[1] director of the Geological Survey of Canada, who assures us he has traced in that country serpentines ending gradually in unaltered beds of magnesian limestone.

The Schistose Metamorphic Rocks.

The term "schist" is used here in a restricted sense, as applicable to the fissile structure of "foliated" rocks.

"Foliation" is a term applied by Mr Darwin[2] to those rocks which have had such a subsequent structure given to them as to split into plates of different mineral matter, either with the bedding or across it. "Cleavage" indefinitely splits a rock, either with the beds or across them, without altering its mineral character, and thus produces "slate."

"Lamination" will then be the remaining term applicable to "shale," and signifying the splitting of a rock into the original layers of deposition.

When, therefore, we wish to be precise, we can speak of the *foliation* of *schist*, the *cleavage* of *slate*, and the *lamination* of *shale*.

64. *Mica schist* consists of alternate layers of mica and quartz, the mica generally consisting of a number of small flakes firmly compacted together, and the quartz more or less nearly resembling *vein* quartz. Many mica schists, however, contain comparatively little quartz, and seem scarcely to differ from clay slate or shale, except in the shining surfaces of their plates or folia.

Many mica schists have a minutely corrugated or crumpled structure, the layers being bent into sharp vandykes of one, two, or more inches in height and width. Others, however, are quite smooth and straight.

The separation into layers, or "foliation" of mica schist, sometimes coincides with the original bedding of the mass, and sometimes is independent of it. In the latter case, it may in some cases have taken the direction of a previously existing "cleavage." (Prof. Ramsay, *Geological Journal*, vol. ix., p. 172.)

Instead of mica, other minerals are sometimes found, such as chlorite or talc, when the rock would be called *chloritic schist, or talcose schist*.

Hornblende schist, again occurs, though we believe, in this case, the whole mass consists of flakes of that mineral without any alternation of quartzose layers. The same remark holds good with respect to the rarer rock called *actinolite schist*. As far, indeed, as our own observation goes, we should doubt the existence of these rocks in any other form than as the result of a partial metamorphosis of some hornblendic "ash," or of some other mechanically-formed rock, derived from the wear and tear of a greenstone or a syenite.

65. *Gneiss* is probably of all others the most completely metamorphosed rock that retains any mark of its original mechanical structure.

Some gneiss can only be distinguished from granite by the regular arrangement of its component crystalline particles in a certain parallelism, so as to give it a slightly schistose structure, or "grain," as it is called by Professor Sedgwick. Other varieties of gneiss, again, can only be separated from mica schist by the occasional occurrence of little plates of feldspar in addition to the layers of mica and quartz. In hand specimens, indeed, it is often very difficult to draw any sharp line of separation between mica schist and gneiss, the more fissile specimens being called mica schist, while the firmer ones would be called gneiss. Even in the field they are often so blended together, and alternate with each other so frequently, that their separation is impossible. There is therefore almost every gradation from dull clay-slate through glossy and so called talcose slate into mica schist and gneiss, and thus into actual granite.

Gneiss might, indeed, in its purest and most typical form, be termed schistose granite, consisting, like granite, of feldspar, mica, and quartz, but having those minerals arranged in layers or plates, rather than in a confused aggregation of crystals. In speaking of it as schistose granite, however, we must never forget that true gneiss was never really a granite, with a peculiar laminated structure, but that it was originally a laminated mechanically-formed rock,—a *sandstone* more or less argillaceous, containing, indeed, the elements of quartz, feldspar, and mica, but not exhibiting any more appearance of those minerals at its first deposition than is exhibited by any of the ordinary unaltered sandstones with which we are familiar. We by no means intend, however, to assert that all sandstones could be converted into gneiss, for it is obvious that purely siliceous sandstones could not, but *purely siliceous* sandstones are much more rare than is often supposed. The great mass of sandstones and of clays do contain the elements of feldspar and mica as well as quartz,—that is to say, they contain alumina, iron, potash, soda, magnesia, &c., as well as silica.

We must also never forget that the extreme term of metamorphism by heat is actual fusion and reduction into the state of an igneous rock, and that it is possible therefore that some igneous rocks, nay, even some granites, may be metamorphosed rocks—aqueous rocks that have been completely melted down again. If we look upon *all* aqueous rocks as in some shape or other *derivative* rocks,—and this is a conclusion from which we cannot escape,—we must regard them as either mediately or immediately derived from igneous rocks. With regard to the mechanically-formed aqueous rocks this is obviously true, because if we trace to

[1] Now Sir William Logan.

[2] The term "foliated," however, as applied to schistose rocks, such as *mica schist*, and distinguished from "cleaved" as applied to *slate*, was first suggested by Professor Sedgwick in his paper on the "Structure of large Mineral Masses." (*Geological Transactions*, vol. iii., pp. 479 and 480.)

their original source the silica and alumina, the quartz, the feldspar, and the mica of which they are composed, we must eventually arrive at some igneous, most probably some granitic rock as their parent.

But even as regards the lime and the soda and magnesia of all the chemically and organically-formed aqueous rocks (setting aside the carbonaceous rocks), we are compelled to suppose that the water first derived those minerals from the decomposition of such igneous rocks as contained them. The carbonates of lime and magnesia, and the sulphates of lime, must have acquired their bases primarily from the decomposition of the silicates of lime and magnesia, which are to be found in the igneous rocks; carbon itself being the only element which does not seem primarily derivable from igneous rocks. Speaking generally, then, it need not surprise us to find materials that had once been fused reduced again to that condition. It is true, that in our purest sandstones and clays the matters that once acted as a flux to the silica and alumina may have been washed out and removed more or less completely from their former combinations; but these pure deposits of silica or silicate of alumina are, as just now said, comparatively rare and in small quantity, and if the rocks around them and inclosing them were once to be remelted, they would soon become mixed up and mingled with the rest, and reduced to the same condition.

There can therefore be nothing either unphilosophical or improbable in regarding, with Sir C. Lyell, the whole crust of our globe as consisting of materials passing through an endless cycle of mutations—existing at one time as igneous rocks; then gradually decomposed, broken up, separated out, sorted, and deposited as aqueous rocks, whether chemical, mechanical, or organic; at a subsequent period metamorphosed; and ultimately reabsorbed into igneous rocks.

In this view, the most highly metamorphosed rocks would be those most nearly hovering upon the brink of reabsorption;[1] and gneiss accordingly on the point of passing into granite, and in some cases almost undistinguishable from it.

One thing is quite certain, that many rocks which are now undistinguishable from true igneous rocks, may have been formed by a comparatively slight metamorphism of "ashes," or other mechanical accumulations of materials derived directly from igneous rock, and subsequently brought within the influence of heat. It is probable that many amygdaloids may be altered tuffs or ashes, and possible perhaps that some clinkstones, whether volcanic or trappean, may have a like origin. Some felstones, again, may be but baked and slightly altered feldspathic ash.

Some real and originally-formed igneous rocks may in like manner undergo metamorphoses, more or less complex. Some felstone or greenstone porphyries, for instance, may have acquired their porphyritic structure by long-continued and comparatively gentle heat, acting on previously compact trap rocks. The same comparatively slight action of heat may have caused many once compact or porphyritic igneous rocks to have become completely crystalline, and possibly may in some cases have generated new combinations, and produced mineral forms that did not exist in the original rock. Trappean rocks may thus have become granitic. These possibilities should be borne in mind when we are endeavouring to explain phenomena that otherwise are often difficult to understand.

It will, perhaps, be useful if we give here the foregoing classification of rocks in a tabular form:—

[1] Such speculations as those in the text may be useless enough as far as any practical result to be derived from them, and may by many persons be thought uncalled for. The old ideas, however, of the original independent origin of mica schist and gneiss still linger in some men's minds, and are even, as we are informed, coming more and more into favour with some continental geologists.

IGNEOUS ROCKS.

VOLCANIC.

Essentially Feldspathic.		*Feldspar and Augite.*
Trachyte.	Trachydolerites, or intermediate varieties unnamed.	Dolerite.
Trachytic Porphyry.		Anamesite.
Pearlstone.		Basalt.
Andesite.		Nepheline Dolerite.
Clinkstone.		Leucite Rock.
Obsidian.		Amygdaloid.
Pumice.		Peperino.
Tuff.		

TRAPPEAN.

Silicso-feldspathic.		*Feldspar and Hornblende, &c.*
Felstone.	Intermediate varieties unnamed.	Greenstone or Diorite.
Pitchstone.		Melaphyre.
Clinkstone.		Diabase.
Feldspar Porphyry.		Dabbro.
Feldspathic Ash.		Hypersthenite.
		Aphanite.
		Serpentine.
		&c., &c.

GRANITIC OR SUPER-SILICATED ROCKS.

Quartso-feldspathic.	*Quarto-feldspathic with Hornblende or Mica, &c.*
Pegmatite.	Syenite.
Elvanite.	Protogine.
Eurite.	Granite.

AQUEOUS ROCKS.

MECHANICALLY-FORMED.

Arenaceous	Gravel or Rubble. Conglomerate or Pudding-stone and Breccia. Sand. Sandstone and Gritstone, and their varieties.
Argillaceous	Clay and Mud. Clunch. Loam. Marl. Shale or Slaty Clay.

CHEMICALLY-FORMED.

Calcareous	Stalactite and Stalagmite, Travertine, &c. Some Dolomites.
Siliceous	Sinter.
Gypseous	Gypsum.
Saline	Rock Salt.

ORGANICALLY-DERIVED.

Calcareous, mostly from animals	Limestone and its varieties, compact, crystalline, chalky, oolitic, pisolitic, some magnesian, &c.
Siliceous, probably from animals	Flint and Chert.
Carbonaceous, mostly from plants.	Peat. Lignite. Coal. Anthracite. Graphite.

AERIAL OR ÆOLIAN ROCKS.

Blown Sand on coasts.
Sandhills of deserts.
Calcareous Sands compacted by rain, &c.
Debris at foot of cliffs.
Volcanic Ashes, &c., falling on land.
Soil.

METAMORPHIC ROCKS.

THOSE IN WHICH THE ORIGINAL STRUCTURE IS STILL APPARENT.

Arenaceous	Quartzite or Quartz rock.
Argillaceous	Clay Slate.
Calcareous	Primary, Crystalline, or Saccharine Limestone, or Statuary Marble. Serpentinous Limestone, Verde Antique, &c. Some Dolomites.

THOSE IN WHICH THE ORIGINAL STRUCTURE IS MORE OR LESS COMPLETELY OBSCURED OR OBLITERATED.

Schistose Rocks	Mica Schist. Chlorite do. Talc do. Hornblende do., &c. Gneiss.

Sect. II.—PETROLOGY.

By that division of Geognosy here called Petrology, we may understand the study of rock masses; that is to say, the examination of those characters, structures, and accidents of rocks which can only be studied on the large scale, and only be observed in "the field." This study will comprise the modes of stratification, of separation by divisional planes, those of fracture and disturbance, and those of denudation, as well as the composition of groups or "formations," and the relations of igneous to aqueous rocks.

Chap. V.—PETROLOGY OF THE AQUEOUS ROCKS.

I.—LAMINATION AND STRATIFICATION.

The lamination and stratification of the aqueous rocks is the very foundation of geology,—that on which all the more important deductions of the science are based. It is therefore necessary to describe these structures in some detail.

We have already mentioned the very fine laminæ (plates or layers) of which some beds of shale are made up. Each of these little layers of earthy matter is obviously the result of a separate act of deposition. The whole bed of shale being formed by the gradual settlement of fine sediment, film after film, upon the bottom of some tranquil or very slowly moving water, we may suppose this sediment to have been carried into the water by successive tides bringing matter from some neighbouring shore, by frequent or periodical floods of some river, by the gradual action of some current, or any other agent by which we could imagine fresh materials to have been transported at different intervals into the water. Or we may perhaps suppose that the supply being continuous, and the water more or less turbid throughout, the act of settlement took place at intervals by little successive fits and starts. Whatever may have been the exact nature of the action, it was clearly a gradual, and not a sudden one; and some time must be allowed for the deposition of a bed even *one* foot thick, when we find it, as we often do, made up of distinct laminæ, fifty or a hundred of which do not exceed an inch in thickness.

Still, although some time was required, and although the acts of deposition were distinct, yet they were not so widely separated in time as to allow of any great consolidation of one layer before the next was deposited upon it.

The whole set of laminæ were made to cohere together, so as ultimately to form *one* bed, which may be quarried and lifted in *single* blocks.

Now the planes of stratification differ in this respect from the planes of lamination, that they mark a total want of coherence between two contiguous layers of rock. It would be impossible to get a block consisting of a part of two beds; there would obviously be *two* blocks.

It follows from these facts, that as the coherence of the laminæ of a bed is the result of the comparative shortness of the intervals between their deposition, so the want of coherence between one bed and another is the result of the length of the interval between the deposition of the beds. Each bed had time to become consolidated, to a greater or less extent, before the next was deposited upon it, so that the latter could not at all coalesce with the former. The planes of stratification, then, mark an interruption in the act of deposition, a pause during which nothing was deposited; the duration of that pause being very considerably longer than that of the intervals between the successive laminæ.

Laminæ or layers, then, are the parts of which a bed is made up. Strata or beds are the distinct sheets or wide tabular masses of aqueous rock which are completely and naturally separated from each other. The planes of lamination often refer only to the direction in which the laminæ are arranged, whether the laminæ are separable or not. The planes of stratification are actual planes of separation between one bed and another.

If we are at a loss to estimate the length of the interval between the deposition of the successive laminæ of a bed, still less have we in general the means of calculating the time which elapsed between the formation of one bed and another. When two or more beds are of precisely similar character, as two beds of the same kind of shale or sandstone, we should naturally be led to suppose that the interval between bed and bed was not indefinitely greater than that between lamina and lamina. If we assigned hours to the one, we might assign days to the other; if days to the one, weeks to the other; and so on. Still we should have no certain grounds to go on, and the interval between bed and bed might be years or centuries for anything we could, in the majority of instances, show to the contrary. When, moreover, the two beds were of totally different characters, as, for instance, where a bed of sandstone or limestone rested on a bed of shale, or *vice versa*, we should generally be right in allowing a larger interval between their deposition than where the beds were similar. Some time must be required for a change to take place in the conditions of the neighbourhood. In the case of a bed of sandstone, destitute of all argillaceous matter, resting on a bed of shales, we should be obliged to suppose some alteration in the strength or direction of the currents, so that all the finer matter was swept away, and only the coarser or heavier deposited. In the case of a shale resting on a sandstone we should suppose that the current had diminished in velocity compared with that formerly acting. In either case the current might come from a new quarter where only one kind of material was to be got.

The same current of water, charged with a mixture of gravel, sand, and mud, and having strength enough to carry it all on together, will, as its strength lessens, sort and separate the materials from each other, depositing them in the order of their coarseness, the pebbles first, chiefly by themselves, next the sand by itself, and lastly, the mud by itself.[1] Three different kinds of rock, then, may be deposited at the same time by the same current; but in order that either sand or gravel may be thrown down at a subsequent period on the top of the mud, a fresh current either of greater velocity or from a nearer source will be required, while an interval will be necessary for the mud to consolidate so far as either not to be removed by the new current, or not to allow the fresh pebbles or sand to sink into it.

In the case of a limestone occurring either on shale or sandstone we are still more forcibly compelled to the supposition of a great change of conditions. If the limestone be a pure carbonate of lime without much admixture of mechanical detritus, it is obvious either that all currents had ceased in the water which had previously deposited the sandstone or the shale, or else that they were no longer able to get any earthy matter and transport it to that place. If, indeed, as seems necessary in the case of all marine limestones, we assign an organic origin to this rock, we are compelled to allow a period prior to its production sufficient for the animals from which it is derived to grow and to secrete their solid materials from the adjacent water.

It is possible, indeed, in some cases, by the aid of the remains of animals and plants found fossil in the rocks, to arrive at something like a rough approximation to the time which has elapsed between the formation of successive beds. There are cases, for instance, in which we find

[1] Just as was previously shown for mud of different degrees of coarseness in Mr Babbage's observations.

on the surface of a bed of limestone the roots or attachments of a particular class of marine animals, called encrinites, which when alive were fixed to the rock by a solid calcareous base. These attachments belong to animals of all ages, and are in great numbers; and in a bed of clay or shale which rests immediately on the limestone, there are found a multitude of the remains of the upper portions of these animals, likewise of all sizes and ages. Now it is plain that in this case, after the limestone was formed and consolidated, there was an interval during which the sea was quite clear and free from sediment, and therefore well adapted for the growth of these animals; that they, after a time, settled accordingly on the hard limestone at the bottom of the sea, and grew and flourished there for a sufficient period to allow of successive generations arriving at maturity undisturbed, before the time when a quantity of mud, having been carried into the water, was deposited upon them, and killed them, and at the same time buried their remains. Here, then, we have an interval of many years, if not of centuries, between the formation of two beds of clay and limestone which rest directly one upon the other. (Buckland's *Bridgewater Treatise*, vol. i., p. 429.)

Many instances similar to this occur to the geologist when pursuing his investigations, although not often admitting of such clear illustration and description. (See Lyell's *Elements* for other examples.)

On the other hand, we have instances of fossil trees passing through several beds of sandstone, in such a way as to show that the whole number of beds were accumulated after the tree had sunk, and before it had time to rot entirely away. These trees evidently became waterlogged, and sunk to the bottom, where they rested in an inclined position, anchored by their roots, while successive deposits of sand were accumulated round them. But a tree thus wholly buried in water will last many years before it is entirely decomposed, so that it might very well have become enclosed in several beds of sandstone, especially when we recollect that it forms an obstacle to the currents flowing by it, and checks their force, and thus causes the deposition of sand around it more rapidly than would otherwise take place. Still, whatever number of years we assign to the accumulation of the whole mass of sandstone, we cannot in this case suppose any great interval to have elapsed between the deposition of one bed and that which rests upon it.

It is possible in some cases, even without the aid of organic remains, to discover that the interval between two adjacent beds was a comparatively long one. For instance, we not unfrequently find that two beds, which in one place are contiguous, do in another place let in one, two, or more separate beds between them, as in fig. 4. It is

Fig. 4.

obvious that if we observed the beds *a*, *e* at the spot marked A, we should only suppose an ordinary interval to have elapsed between the times of their deposition; while on tracing the beds to B, we are compelled to enlarge that space of time sufficiently to allow for the formation of the beds *b*, *c*, and *d*, and the *intervals between them.* It appears, then, that while we are able to assign a sort of rough limit to the time required for the deposition of one bed, composed of a number of laminæ, we are rarely able to assign any approximate limit to the time required for the formation of a number of beds. Not only have we to multiply the first period by the number of the beds, but to allow for an equal number of intercalated intervals, of altogether uncertain duration, to represent the pauses that occurred between the formation of each two contiguous beds.

In some cases, if not in most, these intercalated intervals would be probably much *greater* than the periods of deposition, because we cannot very well imagine any set of circumstances that can keep up a continuous or rapid deposition of earthy matter, whether chemical or mechanical, for a very long and indefinite period of time, in any one particular locality. All we know, or can conceive, of the accumulation of earthy matters in the seas or lakes of the present day points to a discontinuous and interrupted action, a bed of sand being formed here, a patch of mud deposited there, a bank of pebbles accumulated in one place, a bed of oysters or other shells growing in another, so that the bottom of the sea becomes gradually covered by several unconnected and partial patches of deposition of different kinds, lying side by side. All our experience shows that for any great thickness or vertical succession of beds like these to be formed, in other words,—for the depth of water to be materially diminished (except in narrow bays and inlets),—a great length of time is required.

The soundings in shallow seas, such as those round the British islands, do not alter very rapidly, though they *do* alter; and the bottom at one period is found to be very various, "mud," "sand," "sand and shells," "small stones," and similar terms, being scattered over the charts. These "bottoms" remain constant for a sufficient number of years to be used as a guide in navigation. In other words, great intervals commonly occur between the deposition of very different deposits at any particular spot on the bottom of the sea.

Moreover, if we take the whole earth generally, and limit ourselves to the consideration of any given instant of time, we must look upon the deposition of mineral matter as the exception, not the rule. Of many hundred thousand square miles of sea, only one perhaps is receiving, at any given instant, the accession of any mineral matter on to its bed. The next successive depositions may either be in adjacent or in widely separated localities; and a vast number of these partial and detached acts of formation will be required before the whole of any particular area will be covered with one or more beds of rock. In reasoning on the methods of production that have been concerned in the formation of our great series of stratified rocks, we are compelled to suppose a similar gradual, partial, and interrupted action to have taken place.

When we rise from the consideration of single beds to that of groups of beds, we find instances, on a still larger scale, of intervals having taken place in the deposition of rocks which at first appear perfectly continuous. Mr Prestwich, in his paper on the "Correlation of the Eocene Tertiaries of England, France, and Belgium" (*Journal of the Geological Society*, August 1855), shows that on examining the rocks called tertiary above the chalk in France, they appear to have a regular continuous sequence of beds of sand and clay, &c., in which there is no sign of any interval having happened, while in reality a group of the English tertiaries, known as the London clay, having a thickness of 400 feet near London, was deposited in an interval between the formation of two of the French beds.[1]

[1] Mr Prestwich's words are:—"It would nevertheless seem that there is a very important interval between the 'Lignites of the Soissonnais' and the 'Lits Coquilliers;' and that at so short a distance as from Kent to the Department of the Oise, there is introduced, wedge-shaped, between these two deposits, the large mass of the London clay, with its multitude of original organic remains. Yet there is not only no evidence either of the great lapse of time,

Geology.

We cannot conceive the London clay to have required less than some thousands of years for its formation, and it may more probably have been many tens of thousands, during which interval no corresponding deposition was taking place over parts of the north of France, though deposition did take place both before and after this period, equally in the seas which covered what is now France and what is now England.

Such instances compel us to raise our estimate of the time required for the formation of a great series of stratified rocks to a perfectly illimitable extent.

These considerations, although they may appear somewhat speculative, are important, as leading us to a true interpretation of many of the appearances which the geologist meets with in his course of observation; and the student will do well if he accustom himself to look upon single beds of shale, &c., as the *possible* representative of a century or two, and upon small groups of beds as the product of thousands, or perhaps even millions of years.

II.—EXTENT AND TERMINATION OF BEDS.

In fig. 4 it is shown that, of a set of five beds at B, only two continue so far as A, the other three having thinned out and come to an end before reaching that part. This leads us to another conclusion respecting beds of stratified rock, namely, that although sometimes very widely spread, they are not of indefinite extent, but must end somewhere. This ending is generally a gradual one, the bed becoming thinner and thinner, till at last it disappears. Sometimes, however, though rarely, the termination is much more abrupt. Whether we reason from our own experience, or from the nature of the case, we should never be led to believe that the deposition of sediment in water, whether it be a chemical or a mechanical one, could, except in very rare instances, be coextensive with the whole water. With respect to the sea, we cannot conceive any natural causes which could produce such an universal and simultaneous deposition, and should never expect to find a marine bed, the area of which at all approached in extent that of the water in which it was formed. The wonder perhaps is, that single beds sometimes extend over such very wide areas as we really find them to occupy.

The extent of single beds is most certainly ascertained in coal mining, in which the horizontal (or lateral) extension of beds is followed. Particular beds of coal, or of shale, or other rock having remarkable and recognisable characters, are sometimes known to spread throughout a whole district. For instance, in South Staffordshire a bed of smooth black shale, a little below the thick or ten-yard coal, is known as the "table batt." It has a thickness of from two to four feet, and extends over all the greater portion of the South Staffordshire coal field—places where it is known being ten or twelve miles apart from each other in straight lines and in different directions. Its original extension was probably much greater, since the beds now disappear in one direction by "cropping out," and are buried in others at too great a depth to be followed. Known beds of coal, with a particular designation, such as "Heathen coal," extend over still wider areas, and similar facts occur abundantly in most coal fields.

When from a single thin bed we come to the examination of a group of a few beds, the instances of mineral identity over very wide areas become still more frequent. This is especially observable when the group of beds is of a character quite different from the larger mass of rocks in which they lie; provided that difference points to a state of greater tranquillity or quietness of action, as would a bed of clay occurring in a group of sandstone beds, or a bed of limestone or coal occurring in others having a purely mechanical origin.

or of the important physical changes which such a formation indicates, but there is even no cause for suspicion of such a fact in the apparently complete and continuous series of the 'Sables Inferieurs' of the north of France."

On the other hand, some beds, even of a considerable thickness, have a remarkably small extension, being mere cakes, thick in the middle, and thinning out rapidly in every direction. This happens sometimes with all kinds of aqueous rocks; but is the more usual characteristic of the coarser mechanically-formed rocks, being more common in sandstones than in clays and shales, and more frequent in conglomerates than in sandstones.

Beds of sandstone in the coal districts are sometimes found to thicken or thin out very rapidly. This is easily observable where sandstone beds are known to the colliers by specific names, and where the coal pits are near together. The miners are occasionally thrown out in their calculations as to the depth at which particular coals will be found by these irregularities, which are sometimes so great and rapid, as to be called "faults" by men not accustomed to precision in the terms they use. Such an instance occurs near Wednesbury in South Staffordshire, where a bed of sandstone, known by the name of the "New Mine-rock," thickens out from 9 feet to 78 feet in the course of a few yards' horizontal distance. In other parts of the district this sandstone varies from 15 to 60 feet, and in some places is entirely wanting.

In examining sandstones and conglomerates, the conglomerates or old gravel beds are often found to be very partial and irregular, forming steep-sided banks and mounds enveloped in sand.

In these cases, although it was obviously a work of time for the pebbles to have been worn and ground down from their original large and angular condition to their present small rounded form, and although we may very well suppose them to have been washed about from place to place, and thus to have eventually travelled far from their original site, yet their final deposition in the place where we now find them was probably a rather rapid and sudden action.

Conglomerates, then, may be quoted as examples either of the *length* of time required for their formation, or of its *shortness*, according as we look to the *preparation* of their materials or the actual *deposition* of them. This remark holds good, too, with respect to all other coarse mechanically-formed rocks.

III.—IRREGULAR AND OBLIQUE LAMINATION AND STRATIFICATION.

In shales the laminæ are remarkably thin and regular,

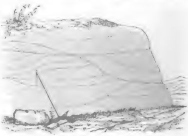

Fig. 5.

all parallel to each other, and parallel also to the planes of

stratification. In many fined-grained, and in some coarse-grained sandstanes, this regularity and parallelism likewise prevails. In other sandstones, however, great irregularity is observable in the laminæ of which the beds are made up, the layers of different-coloured or different-sized grains being oblique to the planes of stratification, and various sets of layers lying sometimes at various angles and inclining in different directions in the same bed, as in fig. 5.

This structure is a proof of frequent change of direction, and probably of strength, in the currents which brought the sand into the water. If we suppose a current of water running over a surface which ends in a slope, as at *a*, in fig. 6, it is clear that any sand which is being drifted along

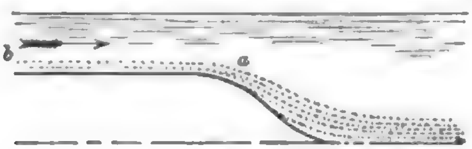

Fig. 6.

the bottom from *b*, will, on reaching *a*, roll down into the comparatively still water of the deeper part, and remain there probably undisturbed. Layer after layer of sand may thus be deposited in an inclined position according to the slope of the bank.[1] On the other hand, if any obstacle arrests the sand which is being drifted along the bottom of any water, some of it will be piled up into a heap, and a bank will be then formed having laminæ more or less inclined. If the current shifts its direction, another bank may be formed with its laminæ inclined at a different angle or in a different direction. Moreover, after one bank has been formed, a subsequent change in the velocity or the direction of the moving water may cut off and remove a portion of it, or excavate a channel through it, and this hollow or fresh surface may be again filled up or covered over by layers having a different form from the first. In this way water subject to changes of current, especially shallow water full of eddies, will throw down or heap up materials in a very confused and irregular manner.

It is a modification of this action probably which has produced what are called "rolls," "swells, or "horses' backs," in the coal measures, and probably in other rocks where they remain less noticed.

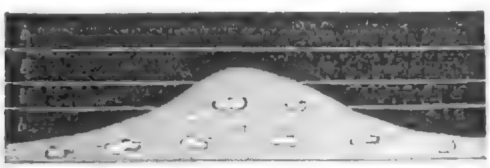

Fig. 7.

In this fig. *a* is black clunch containing balls of ironstone; *bb* beds of coal.

A long ridge, and sometimes one or two parallel ridges, of clay or shale are occasionally found rising from the floor through one or more beds of coal, "cutting them out," for a certain distance, to use the miners' terms. The crest of such a ridge is sometimes 8 feet above the floor of the coal, with a very gentle inclination on either side, the beds of coal ending smoothly and gradually against it. (See *Records of School of Mines*, vol. i., p. 2.) Its formation was obviously anterior to that of the coals which it "cuts out;" those coals and the "swell" itself being regularly covered either by a higher bed of coal, or by the "roof" of the seam, without any interruption or disturbance. The swells are sometimes 200 or 300 yards long, and 10 or 12 yards wide at the base. (See fig. 7.)

IV.—CURRENT MARK OR RIPPLE.

Another effect of current is to produce a "ripple" or "current mark" on the surface of a bed of sandstone or sandy shale. This rippled surface is exactly the same as that which is seen on the sands of the sea-shore when left dry by the tide, and which may occasionally be seen at the bottom of any clear water where a current is moving over a sandy surface. It may be observed also sometimes on sand-hills on dry land, being produced by the drifting action of the wind. Either wind or water, as they roll before them the little grains of sand, tend to pile them into small ridges, which are perpetually advancing one on the other, in consequence of the little grains of sand being successively pushed up the windward or weather side of the ridge, and then rolling over and resting on the lee or sheltered side.

It is produced on the sea-beach, not in consequence of the ripple of the wave impressing its own form on the sand below, which would be an impossibility, but because the moving current of water, as the tide advances or recedes, produces on the surface of the sand below the same form as the moving current of air produces on the surface of the water above. A rippled surface therefore to a rock is no proof of its having been necessarily formed in shallow water, though rippled surfaces are perhaps more frequently formed there, but simply a proof of a current in the water sufficient to move the sand at its bottom gently along, at whatever depth that bottom may be from the surface of the water.

Sandstones of all ages, from the oldest known rocks to the most modern, have occasionally rippled surfaces. Magnificent examples are sometimes shown in the cliffs of the S.W. of Ireland, where highly inclined beds exhibit such markings over spaces frequently of 160 feet in each direction. The size of the ripple, or the distance from crest to crest of the ridges, varies from half an inch to 8 or 10 inches, with a proportionate variation in depth between them.

Mr Sorby has lately shown that inferences may be drawn from the examination of these "current-marks" as to the strength and direction of the currents that caused them, and that we may thus reason back to some conclusions as to the physical geography of particular districts in former geological periods. One important conclusion certainly may be derived from these, as from other structures in rocks, namely, that the strength, velocity, and mode of action of moving water in the old geological periods was precisely of the same kind and intensity as those with which we are familiar at the present day.

In places where the current was troubled and confused, a modification of these rippled surfaces is sometimes produced, the bed being irregularly mammillated on its surface, which is pretty equally, although irregularly, divided into smaller hollows and protuberances of a few inches diameter. This surface structure may be seen in process of production now, on shores where spaces of sand are inclosed by rocks, so that as the tide falls it is made to run in different directions among the rock channels; but it would probably be caused at any depth at which a current could be similarly troubled and confused. It is not unfrequently seen among gritstones, even those of the very oldest rocks. It might be called "dimpled current mark."

V.—CONTEMPORANEOUS EROSION AND FILLING UP.

Instances are not unfrequent in which it appears that a bed, not only of sand, but of clay, coal, or other soft rock, after being formed, has had channels or hollows cut into it

[1] A very pretty little machine has been invented by Mr Sorby for producing this oblique lamination. Sand poured into a small trough is carried forwards by means of a screw, and falling down into a narrow space between a board and a sheet of glass, arranges itself in inclined layers, according to the rapidity with which the screw is worked and the angle at which the instrument is held.

Geology.

by currents of water, and these hollows have been filled up by a part of the bed next deposited.

In fig. 8, taken from a road-cutting in the new red sand-

Fig. 8.

stone at Shipley Common, near Wolverhampton, 1 is a bed of red and white marl or clay; 2 is a chocolate-brown sandstone with irregular beds and patches of marl; 3 is a bed of red marl like 1, but which seems at one time to have been thicker than it now is, and to have had some part of its upper surface carried off before the deposition of 4, which is a brown sandstone, that in like manner seems to have had its upper surface eroded and the hollows filled up by the deposition of 5, which is a mottled red-brown and white calcareous sandstone, or cornstone.

In the tertiary beds near Paris, which are believed to have been deposited in a shallow bay or gulf, receiving rivers, and therefore traversed by currents, this structure is frequent. Two remarkable examples are observable in the large excavation near the terminus of the Rouen railway. In a cliff about 40 feet high, in the fresh-water limestone formation, called the Calcaire St Ouen, two trough-like hollows may be seen about 50 yards apart; the beds previously formed having been excavated for a depth of 20 feet and a width of 15, and the hollows thus formed being filled up by irregular meniscus-shaped[1] expansions of the upper beds. (See fig. 9.)

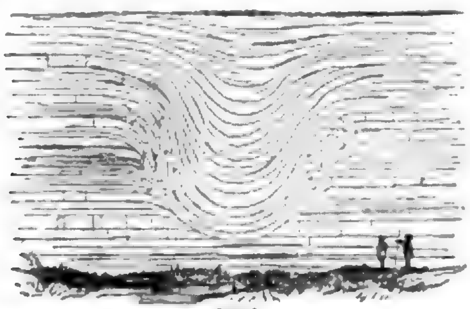

Fig. 9.
Hollow of erosion in tertiary rocks near Paris, filled up by thickening of the subsequently formed beds.

We are not aware how far the French geologists make a distinction in time between the beds thus eroded and those which fill up the hollows.

Similar trough-like hollows are met with in coal mining, traversing beds of coal, the coal being eaten away, and the hollows filled up by the matter which composes its roof, such as clay, shale, or sandstone. Mr Buddle has described very fully one met with in the forest of Dean, where the miners gave the name of "the horse" to the stuff which thus seemed to come down and press out the coal. This trough was found to branch when traced—as in coal-mining it was necessarily traced—over a considerable area, and to assume all the appearance of a little stream with small tributaries falling into it; the channels of the stream being afterwards filled up by the subsequently deposited materials that were spread over the whole coal.

Another modification of this erosive action is represented in fig. 10, taken from a sketch made in a quarry in the neighbourhood of Hobart Town, Tasmania, where a bed of soft brown unctuous clay, about a foot thick, *b*, lying

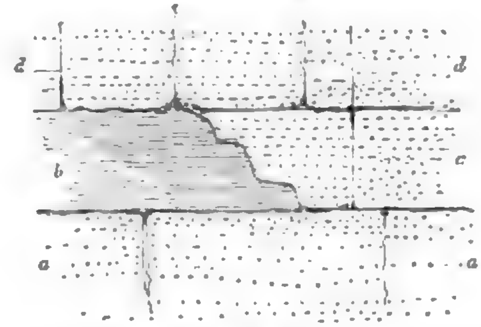

Fig. 10.
Eroded termination of bed of clay, with sandstone formed against it (Hobart Town, Tasmania).

between two beds of hard white sandstone, *a* and *d*, suddenly ended, and its place was occupied by sandstone, *c*, similar in character to the beds above and below it. We must in this case suppose that after the formation of the bed of sandstone *aa*, a bed of clay *b* was deposited over a certain portion of the area, and that then a current of water, bringing in sand, wore back the little bed of clay, eating into it so as to form a small cliff or step, and depositing the sand *c* afterwards against it, as represented in the diagram. The two beds, thus exactly on the same level, but *not exactly contemporaneous*, were finally covered by the bed of sandstone *dd*, which spread equally over both of them.

We see in this case proof, that although the bed *c* is exactly on the same level as the bed *b*, both reposing on, and both covered by, the same beds, yet they are still not exactly of the same age, but that *c* was formed subsequently to *b*, inasmuch as *b* was not only formed, but partially destroyed previously to the formation of *c*. Such facts give us farther proof of the length of the intervals which may elapse between the formation of two beds such as *a* and *d*, and also caution us not in all cases to infer strict synchronism from the fact of beds occupying the same geological horizon.

VI.—CONTEMPORANEITY OF BEDS ON SAME HORIZON.

If a group of beds, whether large or small, have the arrangement shown in fig. 11, the order of the formation of

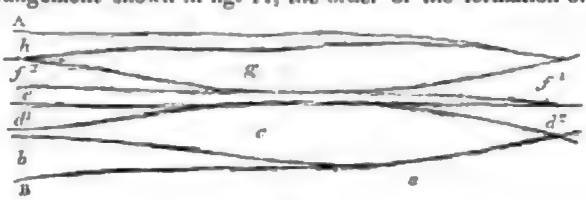

Fig. 11.

the beds is clear enough as regards *a*, *b*, and *c*; but d^1 and d^2 may either have been deposited contemporaneously, or one before the other; *e* is clearly subsequent to them both; but f^1 and f^2, again, are uncertain in relative age, while there is no doubt about that of *g* and *h*. If we wished to estimate the whole time consumed in the formation of such a set of beds, it would be obviously wrong merely to take their mean thickness, as shown at A.B, for the measure of that time. The whole thickness of *a* had been deposited before *b* had been begun, and both were complete before *c* was formed. If, therefore, we assume thickness, or quantity of material deposited, as the measure of time occupied in deposition, it is clear that we should add together the maxima of *a*, *b*, *c*, and not take their mean. Similarly of the whole set, we ought to search out for the maximum

[1] A meniscus is a lens concave on both surfaces.

thickness of each bed, and add those thicknesses together; and in doing this, we should feel some doubt as to whether we ought not to reckon d^1 and d^2, and similarly f^1 and f^2, as two separate and consecutive beds, instead of supposing them to have been formed at the same time. If in the set of beds under examination we found many beds thus ending without overlapping, we should clearly be right in making allowance for the probably successive deposition of some of those which appeared to be contemporaneous.

We have already seen that this irregularity of deposition is most frequently met with in rocks that we supposed to be most hastily accumulated, while those which spread very regularly over extensive areas appeared to be most tranquilly and quietly, and therefore most slowly, deposited. We see now, however, that this very irregularity carries with it, in the long run, its own compensation, and that,—what with partial erosion and removal of some beds, and intervals of greater or less length between the formation of others, together with want of synchronism between beds that seem at first sight to possess it,—although any one bed, or small set of beds, may have been deposited in a comparatively hasty manner, yet the whole amount of time to be allowed for the accumulation of a great series of coarse beds would, if properly estimated, probably not be less than for an equal mass of more gradually and tranquilly formed rocks.

VII.—INTERSTRATIFICATION, ASSOCIATION, AND ALTERNATION OF BEDS.

In studying the formation of aqueous rocks, we should soon perceive that no general rule can be laid down as to their association with one another.

Limestones, sandstones, and clays occur either separately or interstratified one with the other in every imaginable variety of disposition.

We have sometimes a series of beds, many hundreds of feet in aggregate thickness, of pure limestone, with scarcely a single seam of mechanically-deposited matter, even so much as an inch thick. Instances of this are shown in the chalk of the south-east of England, and the carboniferous limestone of Derbyshire, and of large portions of Ireland.

Series of beds of sandstone, almost entirely devoid of calcareous or argillaceous matter, and having a total thickness of many hundred feet, likewise frequently occur. Old gravel beds, now compacted into conglomerate, are often associated with these; and the sandstones exhibit every variety of texture, from lines of small pebbles to the finest possible grains. In such masses of sandstone it is rare to find any foreign bodies, and mineral concretions or chemical deposits hardly ever occur in them.

Groups of beds of almost pure clay also occur, with a thickness of several hundred feet, with hardly a single bed of sandstone or limestone to be found in them.

While cases of this accumulation of one particular kind of matter, of great thickness, and therefore through long periods of time, are by no means rare, it is perhaps more usual to find different beds of rock alternating one with the other, sometimes so interstratified that there is never a greater accumulation than twenty or thirty feet of any one sort without others interposed between them.

Beds of limestone are frequently separated by beds of clay or shale, which is most commonly black or brown. These shales are themselves sometimes calcareous, and there seems occasionally to have been such an equal mingling of the two kinds of matter, that it is hard to say whether it would be most proper to call the rock a shale or a limestone. Such are some of the beds known as calp shale or calp limestone in the middle districts of Ireland.

Beds of sandstone, again, often alternate with such shales; so that we get a series of beds consisting of alternations of all these kinds. Beds of limestone sometimes alternate with sandstones, some of which may likewise be calcareous; but it is more rare to find pure limestone and pure sandstone interstratified with each other, than to have argillaceous beds alternating with either or with both. Speaking generally, indeed, we find, in examining the vertical succession of beds of rock, an approach to the same kind of passage or gradation that we sometimes perceive in their lateral extension. Beds of very fine and very coarse materials rarely rest directly one upon the other. Conglomerates are generally covered and underlaid by sandstones, and not by clays or shales. Coarse sandstone, in the same way, has usually a bed of finer material, either above or below, before shale or clay occurs.

The transition from the conditions favourable to the deposition of one kind of rock to those conducive to another has generally been gradual rather than abrupt. The tranquil water of the open sea, which seems to be the general producer of limestone, becomes first invaded by gentle currents, bringing in finely suspended mud, before it is traversed by those of sufficient strength to carry out the coarser material of sand. When a single bed varies in grain, we generally find the coarser part at the bottom, as we should expect; for when a quantity of variously sized detritus is delivered into any water, the larger and rounder grains or fragments will be the first to sink. Not unfrequently, however, alternations of finer and coarser grained laminæ occur in one bed, proving that the bed was formed by a succession of actions, and by as many different deliveries of matter into the water as there are sets of alternations.

We will give here two instances of alternation of beds, taken from actual observation and measurement. The first is a section supplied by Mr G. V. Dunnoyer, and represents the top beds of the upper limestone (carboniferous), where they are observed to pass into the lower coal measures, in county Carlow, from a quarry close to Old Loughlin.[1] (Fig. 12.)

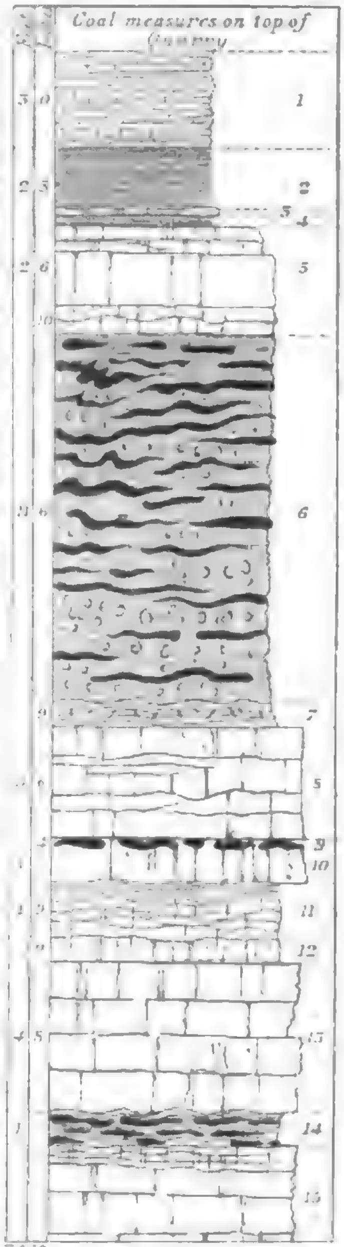

Fig. 12.

[1] In this section the rule as to numbering is not observed, as the numbers refer to the woodcut.

No.		Feet.	Inches.
1.	Hard earthy black splintery shale	3	0
2.	Earthy rotten black shale	2	6
3.	Hard black shale	0	2
4.	Brown earthy layer	0	5
5.	Crystalline gray crinoidal limestone	3	4
6.	Soft brown earthy shale, containing abundance of fossils, and very numerous layers of black chert	11	6
7.	Hard gray shale, encrinite stems, and shells	0	9
8.	Gray compact limestone	3	6
9.	Chert layer, black	0	[illegible]
10.	Gray compact limestone	1	0
11.	Thin irregularly bedded shaly limestone, with gray shale on top	1	9
12.	Compact limestone	0	9
13.	Light gray compact limestone	4	8
14.	Black chert layers in hard black shale	1	0
15.	Gray compact limestone, forming floor of quarry.		

The following is another example of the alternation of beds, derived from the Bristol coal-fields (*Mem. Geol. Survey*, vol. i., p. 210).[1]

No.		Feet.	Inches.
23.	Argillaceous shale	185	0
22.	Sandstone	4	0
21.	Coal	1	6
20.	Underclay	2	0
19.	Argillaceous shale	64	0
18.	Coal and shale	4	0
17.	Coal	1	0
16.	Underclay	4	0
15.	Argillaceous shale	4	0
14.	Sandstone	2	0
13.	Argillaceous shale	23	0
12.	Coal	9	0
11.	Underclay	3	6
10.	Coal	0	6
9.	Underclay	2	0
8.	Argillaceous shale	7	0
7.	Sandstone	1	0
6.	Argillaceous shale	2	0
5.	Sandstone	6	0
4.	Argillaceous shale	4	0
3.	Coal	2	4
2.	Underclay	2	0
1.	Sandstone	3	0

The whole section, of which this is a portion, enumerates 294 similar alternations, having a total thickness of 5084 feet, below which is a series of beds, 1200 feet thick, principally composed of hard sandstone.

It is to be specially noted, as regards the occurrence of coal, that it almost invariably rests on a fine argillaceous bed, often what is called "fireclay." This fact is familiar even to the miners, so that it has received the name of "underclay" in the South Welsh district, and in others is called "coal *seat*." The general order of superposition (or of time of formation, for these are convertible terms), is 1. Sandstone; 2. Clay; 3. Coal; 4. Clay. If we disregard the minor alternations, we should see this rule carried out in almost all sections of coal measures, the clay above the coal (the roof) being generally thinner and stronger (more shaly) than that immediately below. In some few instances the coal seat is arenaceous, and still more frequently a sandstone or "rock" roof may be found.

VIII.—LATERAL VARIATION OF BEDS.

We should in many cases find that, of the beds which we had noted at one locality, many, or most, or all gradually thinned out and died away as we followed their lateral extension, and that their places were supplied by others which as gradually came in. Now, these new beds might either be of similar character to those which had died away, or altogether different.

We might, for instance, in one locality, have a series of limestones of 1000 feet in thickness, resting one upon the other, without the intervention of any other beds. As we traced this group across a country, we should perhaps find that little "partings" of shale began to make their appearance between some of the beds of limestone, and that as we proceeded these shales became thicker and more numerous, while the limestones became thinner in proportion. Some of the limestones would perhaps then altogether disappear, and the series be split up into two or more *groups* of limestone, with one or two intermediate *sets* of shale-beds.

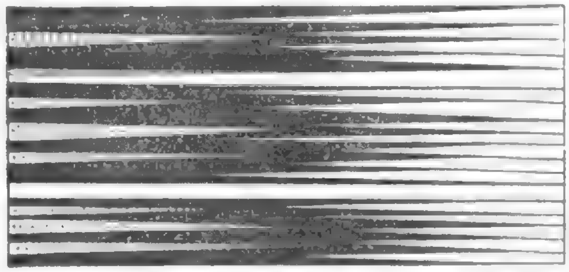

Fig. 13.

In this diagram the white bands are meant for limestones, the black for shales, and the dotted for sandstones.

Still farther on, the limestones might be more and more subdivided by beds of shale, and the shales themselves split up by beds of sandstone, until at length we should find our series consist almost entirely of sandstones and shales, with only one or two very subordinate beds of limestone, at one or two levels, to represent the purely calcareous group with which we commenced. The diagram (fig. 13) gives a rough representation of this lateral change, but requires to be drawn out to twenty or thirty times its length before it could be taken as a proximate delineation of the facts as they occur in nature.

In the same way, groups that consist principally of sandstone and conglomerate in one district, may in another be composed chiefly of limestone and shale or clay, with or without any beds of sandstone.

The scale upon which these lateral changes of character are carried out is altogether indefinite. We see it sometimes take place with respect to a small group of beds within the limits of a single quarry; in other cases, a distance of a few hundred yards or a few miles is requisite before the alteration is apparent. Some groups of beds, indeed, preserve their mineral characters but little altered over whole countries or across whole continents. Still, judging from what we know, we must always hold ourselves prepared for change even in the rocks that seem most constant in their characters; and as a matter of fact, we know of no one group of aqueous rocks that preserve the same mineral characters in all parts of the earth.

Combining thus actual observation with probable speculations, we should be quite ready to understand that the same set of beds may, within the space even of the British Islands, put on very variable characters. Of this we may now advantageously examine some instances. Let us compare the two following sections, which are descriptive of the beds which intervene between the two great continuous groups of argillaceous rock, called respectively the Oxford clay, and the Lias. These intervening beds are called generally the Lower or Bath oolite, because the oolitic limestones contained in them near Bath and elsewhere are the most striking and valuable portions of them. The section near Bath is taken from Conybeare and Phillips, that for Yorkshire from Professor Phillips's *Geology of Yorkshire*:—

[1] In all tabular lists of beds or formations in this article, the series will be arranged on the page in their order of superposition, but they will be numbered in order of age, beginning with the oldest or first formed.

Geology.

NEAR BATH AND IN GLOUCESTERSHIRE.

Oxford clay.

No.	Beds	Feet	Feet
5.—	Cornbrash	16	16
4.	Clay	11	91
	Calcareo-siliceous sand	10	
	Forest marble	18	
	Sand	2	
	Clay	50	
3.—	Great oolite	130	130
2.	Blue Clay	14	122
	Fuller's earth	8	
	Bastard Fuller's earth with a band of shelly sandstone	100	
1.	Inferior oolite	30	80
	Calcareous sand	50	
	Total		469

Lias.

YORKSHIRE.

Oxford clay.

No.	Beds	Feet
5.—	Cornbrash	10
4.	Sandstone, shale, ironstone, and coal	200
3.	Impure, often oolitic, limestone	30
2.	Sandstone, shale, ironstone, and coal	500
1.	Sub-calcareous, ferruginous sandstone	60
	Total	800

Lias.

We see that, while in the south of England these beds are largely characterized by the presence of oolitic limestones, those in the north are almost destitute of them, but contain instead great beds of sandstone and shale, together with thin beds of coal, which are equally wanting in the south. If we examined the fossils they contained, we should find an equal change, as the beds in the north are full of carbonized plants and vegetables, which are almost altogether absent in the south, where the fossils consist of the remains of mollusca and other marine animals that are rare or wanting in the north. It seems as if in proceeding from the south to the north, we were approaching the shore of the old sea, and therefore get a greater quantity of mechanically-formed rocks, together with the products of the land, in the shape of plants that had been drifted from it, while the marine products proportionably decreased.

Had the Yorkshire rocks been those which were first examined and described, the term "oolitic" would never have been applied to them, although they may now be called "oolitic," as having been formed at the same time with those which had previously received the name of "oolitic" rocks in Gloucestershire, and other parts of the world.

Similar results would be arrived at if we traced over a large area another group of rocks, which are called carboniferous, from their containing in some places beds of coal. These rest upon certain beds of red sandstone, called old red sandstone; and if we compare them as they occur in the south of England and South Wales, in central and northern England, and in Scotland, we shall find that, while essentially made up of the same kind of materials throughout, these materials are differently arranged in different places.

We have in South Wales and the border counties—

	Feet.
4. Coal measures, alternations of sandstones, clays, and shales, with occasional beds of coal	7,000 to 12,000
3. Millstone grit, chiefly white quartzose sandstone	200 ... 900
2. Limestones with thin shaly partings, called carboniferous, or mountain limestone	400 ... 1,800
1. Lower limestone shale, alternations of shales, with thin limestones	160 ... 500
Old red sandstone.	

(*Memoirs of Geological Survey*, vol. I.)

In Derbyshire and some adjacent counties, and in North Wales, this series becomes:—

	Feet.
4. Coal measures, as before	3000 to 6000
3. Millstone grit, as before, about	800
2. Upper limestone shale, dark shale with occasional beds of limestone	500
1. Carboniferous limestone, as before	800 ... 1000
Old red sandstone.	

The chief difference between these two sections is the occurrence of a group of beds of black shale *above* the carboniferous limestone in the north, while there is little or none *underneath* it, the reverse being the case in the south.

In tracing these beds, however, from Derbyshire through Yorkshire and Durham to Northumberland, we find a gradual change coming in, so that while No. 4, the coal measures, retain their character of a multiform alternation of beds, No. 3, the millstone grit, becomes split up by shales with beds of coal, thus blending with the coal measures, while No. 2 acquires many beds of limestone and some of sandstone, and eventually also of coal, and even No. 1, the great limestone series itself, becomes interstratified with shales, sandstones, and coals; so that instead of the unbroken succession of beds of limestone which we have in Derbyshire, we get such sections as the following in Durham and Northumberland for the composition of No. 1.

	Feet.
g. Main limestone	70
f. Various alternations of shales, &c	80
e. Underset limestone	24
d. Various, including one coal-seam, one or more limestones, several shales, one or two principal grit rocks, flagstones, &c.	150 to 350
c. Scaur limestone	15 ... 40
b. Various alternations, including a bed of coal, and one or more beds of limestone	125 ... 225
a. Tyne bottom limestone	25 ... 50
	489 to 839

(*Aldstone Moor, as given by Mr Forster.*)

In Scotland we have nothing above the old red sandstone but one great series of alternations throughout, containing beds of coal from the top of the series to the bottom, so that the great carboniferous formation is no longer separable into distinct groups as in the south. All that can be said of the Scotch carboniferous series is, that it is *all* coal measures, beds of limestone being more frequent in the lower than in the upper part of the formation, where they are commonly altogether wanting.

General Conclusions.—As general conclusions from what we have hitherto said, we may state the following:—

1st. For the production of mechanically-formed aqueous rocks the existence of *dry land* is absolutely necessary, since such rocks are the result, almost entirely, of the wear and tear of other previously existing rocks *at* or *above the level of the sea.*

2d. For the production of calcareous rocks animal life was necessary; for that of carbonaceous rocks vegetable life was necessary. The animal life may have been entirely aquatic, the vegetable life may have been either aquatic or terrestrial.

IX.—JOINTS.

We should not long have studied the laminated and stratified structure of rocks, and paid attention to their separation into beds by planes of division which were obviously the result of distinctness and succession in the acts of deposition, without being struck by the occurrence of other planes of division, which cut the first at various angles, and assist them in dividing the rocks into regular or irregular blocks.

We should, indeed, very soon perceive that *all* rocks, stratified or unstratified, igneous, aqueous, and metamor-

phic, were traversed by numerous planes of division of this kind. They may be seen in any quarry, or in any natural or artificial excavation in any solid rock, traversing the rock in various directions, and separating it into blocks of correspondingly various shapes and sizes.

These divisional planes are called "*joints*."

Without natural joints the quarrying of stratified rocks would be very difficult, and that of unstratified rocks almost impossible. If beds of sandstone or limestone were undivided by natural joints, each block would have to be cut or split by artificial means on every side from the rest of the bed; but in rocks, such as granite or greenstone, which have no beds, the blocks would not only have to be cut away on each side, but *underneath* also. It would obviously be a most impracticable task to *dig out* a large block of granite from the midst of a solid mass untraversed by any natural planes of division of any kind.

For the production of natural blocks of rock there must clearly be *at least* two sets of joints in stratified, and three sets in unstratified rocks, each set more or less nearly at right angles to each other. (See figs. 14 and 15.)

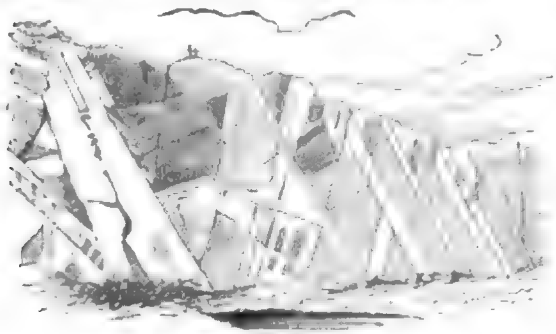

Fig. 14.

Joints in granite. (Large quarries in Killiney Hill, near Dublin.—G. V. D.)

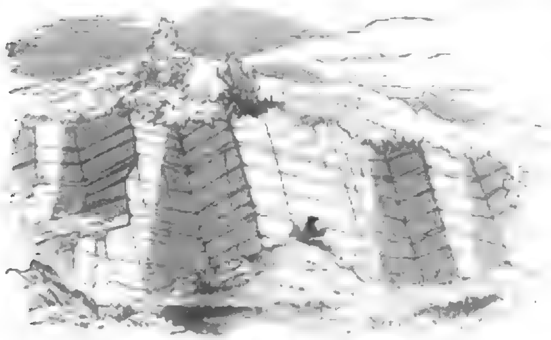

Fig. 15.

Joints in limestone. The planes of stratification are shown by the parallel lines dipping from the spectator and towards the left. The other lines are the ends of joint planes, which also form the smooth surfaces of the rock nearly at right angles to each other, as shown by the projecting corners. (Quarry near Mallow, Co. Cork.—G. V. D.)

Professor Phillips tried many years ago, in his *Geology of Yorkshire*, whether the directions of the principal joints were not related in some way to the magnetic meridian, and arrived at results showing a tendency in the two principal sets of the joints of the Yorkshire rocks to arrange themselves according to certain magnetic bearings. This, however, seems to be only another way of stating that there are two principal sets of joints in the district, those of each set being parallel to each other.

Professor Sedgwick refers the directions of joints chiefly to the lines of upheaval and disturbance in rocks, calling those which run along or parallel to the "strike" of the beds, "strike joints," and those parallel to the "dip," "dip joints."[1] All other joints he calls "diagonal" joints.

[1] For the explanation of the words "strike" and "dip," see *postea*, chap. vi., § 2.

These are useful terms, whether the two things be or be not related in the way of cause and effect.

It is certain that some joints have been produced in all rocks anteriorly to, and independently of, the action of the forces of upheaval which have elevated them; but it is very likely that the direction of the lines of upheaval may have been governed or modified by that of the principal joints, and that other joints may have been the result of the action of these disturbing forces.

In some localities, very widely extended planes of division may be seen traversing a great series of beds in perfectly parallel lines, running at wide intervals down whole mountain sides, so as to be visible at a distance of several miles, but without producing any dislocation or shifting of the beds.[1] Such unlimited joints were very propably produced, not from any internal shrinking on the mere consolidation of the beds, but from a simultaneous yielding of the whole mass to a great expansive or stretching force. When we come, however, to examine the joints of igneous rocks, more especially those of the highly crystalline kinds, such as granite, we see an amount of irregularity and want of symmetry in their arrangement which would make it difficult to attribute their origin to any widely spread polar force or any mechanical power acting in one or two given directions.[2] It is true that over small areas, as, for instance, in single quarries, the regularity of the arrangement of the joints in granite is often very remarkable. One set of planes will be seen to run at such equal distances, and so strictly parallel, that if they be horizontal, or nearly so, they produce the appearance of stratification in the rock, and the workmen frequently speak of the *beds* of rock between such planes (fig. 14). In very large quarries, however, or in long cliffs, this appearance of regularity is found to be very inconsistent and deceptive. One set of joints will most resemble stratification at one spot, and another set at another, each set being gradually obscured by the occurrence of other sets of joints cutting them irregularly and promiscuously.

The shape and the width of joints of stratified rocks vary much according to the nature of the rock. They are generally close, regular, and symmetrical, in proportion to the fineness of the grain and the compactness of the rock, being most irregular and uneven in coarse sandstones and conglomerates. The power of the force which produces them is, however, well shown in hard and well consolidated conglomerates, since the hardest pebbles of pure white quartz are often cut as clean through by the joints as the compacted sand in which they lie. In sandstones, joints are frequently open; in shales, they are closer, but more smooth and regular, being frequently perfect planes. In limestones, there are both close and open joints; but the open joints have frequently been widened by the action of water percolating through them, and dissolving a portion of the rock. Great fissures are sometimes formed in this way; and this has doubtless been the origin of many of the caverns which occur so abundantly in limestone rocks. In highly argillaceous limestones, the joints are often beautifully smooth, regular, and close.

In some cases, it would seem as if each bed had its system of joints formed before the other was deposited upon it, inasmuch as the joints formed in one do not penetrate the other. In other cases, a set of joints is seen to be common to a whole set of beds, and to have been produced ap-

[1] The peninsula that runs out from Glengariff to Berehaven, along the north side of Bantry Bay, is especially remarkable for these vast joints.

[2] We are aware that some great parallel joints may in some localities be traced coursing through granite and other adjacent rocks; but we should class such joints among those subsequent ones just spoken off, and not among the original structural and congenital joints of granite and other rocks.

parently in the whole simultaneously. It is not uncommon for joints, in passing from one bed to another, to shift a little, or slightly change their angle. In such cases it may be doubtful whether a joint previously formed in the one bed may not have given rise to the formation, or at least have modified the position, of the other, in the bed above. There does not seem either to be any reason why all the joints traversing any bed or any set of beds should necessarily be of one age, but the contrary, inasmuch as we may imagine the process of solidification to take place at intervals, being at first incomplete, and afterwards becoming more perfect. Subsequent contraction would not have been so likely perhaps to widen the old joints as to produce new ones, since the shrinkage could hardly exert such a force as to overcome the effects of friction, and cause any large masses of rock to move and slide one over the other even to the most trifling extent.

Joints then may be caused, first, by the consolidation of each bed separately; secondly, by subsequent acts of consolidation, common to several beds; and thirdly, to widely spread mechanical force, affecting whole formations at once.

In the gypsum quarries of Chaumont, near Montmartre, Paris, two thick beds of granular gypsum occur, which, instead of being divided by two principal sets of joints into quadrangular blocks, are traversed by three equally strong sets crossing each other at equal angles; and the whole mass is accordingly split into triangular and hexagonal blocks, giving the beds a columnar appearance like that so well known in basaltic rocks. (See fig. 16.)

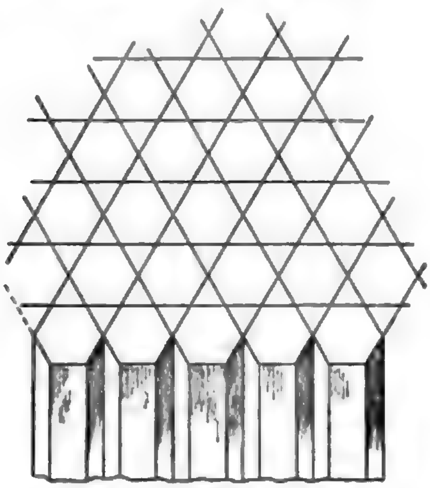

Fig. 16.
Joints in beds of granular gypsum. (Chaumont, near Paris.)

The hexagons and triangles are frequently quite regular and perfect, and the result very curious, and, as far as I am aware, unique in unaltered aqueous rocks. If three sets of equidistant planes cross each other at equal angles, the angle of intersection between any two will of course be 60°. If all three planes meet at the same points, triangular forms only would be produced; but if they be so arranged as that no more than two sets should ever intersect each other at the same point, and that each point of intersection be exactly half way between the other set of planes, as in fig. 16, alternate triangles and hexagons of perfectly regular form will be the result.

These conditions seem to have been exactly fulfilled in the quarries near Paris, and the symmetry of arrangement has not been disturbed or obscured by additional irregular joints, which may possibly mask this, or some other symmetrical arrangement of joints in other places.

We have already said that in massive igneous rocks there must necessarily be at least three sets of planes, all more or less nearly at right angles to each other, for the mass to be separated into blocks, while in stratified rocks there must be at least two sets of joints cutting across the beds. If the planes be equidistant and exactly at right angles, the blocks would be perfect cubes. This exact regularity however, is not to be expected as common, nevertheless the approach to it is frequent, and it would be still more so if it were not for the occurrence of other irregularly disposed diagonal joints. We may, therefore, in practice look upon such blocks as more or less universally cuboidal, and speak of the joints producing them as cuboidal or quadrangular joints. We have just seen that, even in aqueous rocks, other symmetrical arrangements of joints may exist, producing regular forms other than cubes; but this is more especially remarkable in those igneous rocks which occur in comparatively thin sheets, whether as beds or as "dykes," that is, as wall-like sheets traversing other rocks. In these the joints often divide the mass into long prisms.

The sides of these prisms are sometimes regular and equal, producing either hexagonal, pentagonal, or other forms. Sometimes, however, they are unequal and irregular, dividing the rock into uneven and wrinkled prisms like those exhibited by the common substance "starch."

That this prismatic arrangement is the result of contraction on consolidation is shown by the prisms usually being at right angles to the greatest extension of the mass, being vertical in a horizontal bed, horizontal in a vertical dyke, proving that the fissuring commenced at the cooling surfaces, and struck thence directly towards the centre of the mass.

Sometimes it is found that the two sets of prisms thus originating at each surface did not exactly fit when they met in the centre, as is shown in fig. 17. At other times, however, they proceed uninterruptedly from one side to the other, the two sets either having coalesced, or one surface having cooled before the other, and given rise to divisions that were carried right across to the other.

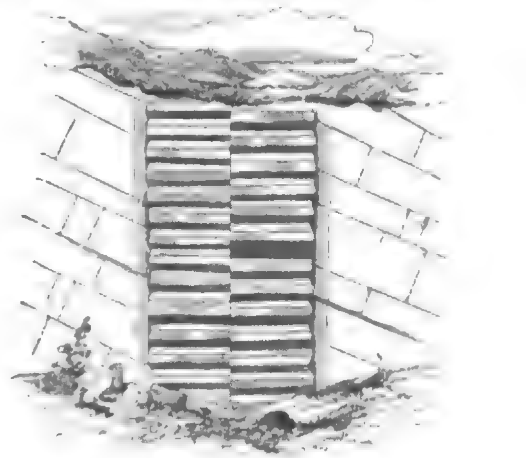

Fig. 17.
Dyke of columnar basalt, the columns not continuous across.

In addition to these prismatic joints, other irregular joints, more or less nearly at right angles to the prisms, also occur; and in very regularly columnar basalt and greenstone the columns are articulated, or separated at regular or irregular intervals into short blocks, by divisions, which are sometimes quite flat, sometimes curved into concave and convex surfaces, forming a kind of approach to a ball and socket joint. The origin of this structure is explained by the celebrated observations of the great Gregory Watt. If a mass of basalt be melted in a furnace, and allowed to cool again, the following results may be observed. If a small part be removed and allowed to cool quickly, a kind of slag-like glass is obtained, not differing in appearance from

obsidian. If it cool in larger mass more slowly, it returns to its original stony state. During this process small globules make their appearance, which, very small at first, increase by the successive formation of external concentric coats, like those of an onion, and the simultaneous obliteration of the previously formed internal coats, so that ultimately a number of solid balls are formed, each enveloped in several concentric coats. As these balls increase in size, their external coats at length touch, and then mutually compress each other. Now, in a layer of equal-sized balls, each ball is touched by exactly six others (see fig. 18), and if these be then squeezed together by an equal force

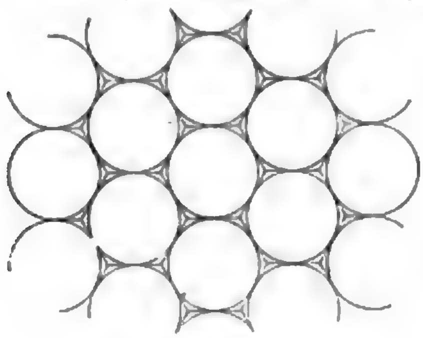

Fig. 18.

acting in every direction, every ball will be squeezed into a regular hexagon. But the same result will follow from an equal expansive force acting from the centre of each ball, or from the tendency to indefinite enlargment in their concentric coats. Each spheroidal mass, therefore, will be converted into a short hexagonal pillar. But if there are many piles of balls one above another, each ball resting directly and centrically on the one below it, we should have a long column of these hexagonal joints, and the top and bottom of each joint either flat, concave, or convex, according to variations in the amount and direction of the pressure at the ends of the columns.

There is no apparent reason why, in a cooling mass of basalt, the balls should be so arranged as that their centres should be in straight lines, and that the hexagonal vertebræ should form straight continuous pillars rather than separate discontinuous pavements. This, however, is probably the result of the simultaneous tendency in the mass to split into prisms in consequence of the joint-forming contraction on consolidation, the two tendencies acting together to produce the columns with the short ball and socket articulations.

In the case of curved columns, it is probable that the accidental arrangement of the centres of the balls overpowered the tendency to produce straight prismatic joints. Many other irregularities, resulting from the unequal action of one or the other tendency, may frequently be observed, since there are not only curved, but oblique and radiating columns; not only hexagonal, but pentagonal, triangular, and other irregular shapes; and in some instances, small uncompressed, or nearly uncompressed balls, may be found in the interstices between unequal and irregular columns. The pillars of basalt are usually from 6 to 18 inches in diameter, and vary in length from 5 or 6 to 100 or 150 feet. Columnar greenstone is commonly on a larger scale, the pillars being sometimes 5 or 6 or even 8 feet in diameter, and the columnar form of the rock is often only to be perceived at a distance. Almost all greenstone exhibits the tendency to decompose into rounded spheroidal blocks, on which we have just seen the columnar structure partly to depend. Felstone is sometimes also beautifully columnar; of which an admirable example may be seen in a small pass to the southward of Lough Gitane, near Killarney. (See papers by Messrs Dunoyer and Foot in the *Journal of the Geological Society of Dublin*, in 1856.) Neither is this tendency confined to basalt, greenstone, and felstone, since it is sometimes perceptible even in granite, producing in that rock the logging stones," or "rocking stones," the "cheese wrings," the "tors," as well as the "pots and pans," and "sacrificial basins," and other curious natural forms occurring in that rock, of which many have been attributed to ancient artificial processes.

The study of joints and the other divisional planes of rocks, and the different forms assumed by them in consequence, both when freshly exposed and when modified by "weathering," is as necessary for the landscape painter who wishes to reproduce nature, as is the study of anatomy to the figure painter. Mr Ruskin has handled this subject in his usual masterly style.

Chap. VI.—FORCES OF DISTURBANCE.

1.—ELEVATION OF AQUEOUS ROCKS.

In the preceding chapter we have been principally engaged with the facts relating to the deposition and consolidation of those rocks that have been formed under water. It will be convenient now to examine the problem of the elevation of these rocks into dry land.

It is clear that all rocks which were formed at the bottom of the sea, and which are now dry land, must have gained their present situation either by the sinking of the sea level or by the uplifting of the sea bottom. If, however, the level of the sea be materially lowered in any one part of the globe, it must be equally lowered over its whole surface. But we find aqueous rocks on the summits of some of our highest mountains, and if these had been laid dry solely by the sinking of the sea, it is difficult to understand what can have become of a shell of water ten or twenty thousand feet deep enveloping the whole globe.

Partial floods and inundations are out of the question. Laplace determined that though the sea is often agitated by storms and earthquakes which raise it into great waves, and make it locally and temporarily overstep its limits, yet *the equilibrium of the ocean is stable if its density is less than the mean density of the earth.* Now, experiments on the attraction of the mountains of Schehallion in Scotland, and Mount Cenis in the Alps, as well as those made by Mr Cavendish, and Reich and Baily, with balls of lead, demonstrate that the earth has a mean density at least five times that of water, and hence the stability of the sea and the invariability of its level is beyond a doubt.[1] (Brewster's *Life of Newton*, vol. i., p. 363).

We must therefore look upon the level of the sea all over the surface of the globe as absolutely invariable, unless by very great changes taking place in the form of its bed,—the elevation of some parts, or the depression of others. To effect either relative or absolute change of level, then, in the surface of the sea, it is the *solid* part of the earth's crust that must first move. Even then we shall not effect absolute change of level in the upper surface of the sea, unless the elevation of its bed in one place be materially greater than its depression in another, or *vice versa*. But this we have no reason to suppose probable, and no right to assume as having taken place.

Wherever, then, we find that a change has occurred in the relative levels of land and sea in any portion of the globe, we must believe that the elevation or depression has taken place in the land,—*in the solid rock*, and not in the

[1] More recent observations by the Astronomer Royal on the pendulum at the surface and at the bottom of deep mines, give a mean of 6·809 for the earth's specific gravity, while those made by the Ordnance Survey on the deflection of the plumb line at Edinburgh give it as 5·14.

fluid ocean. The very fluidity, indeed, of the ocean, which might at first lead us to look to its motion and change of place as the cause of the appearance of dry land, renders any permanent *local* or *partial* change in its level impossible, while a local change in the level of solid rock is more easily possible than a general or universal one.

If, therefore, we can prove that elevation has occurred in one place while depression happened in another, or if we can prove that any alteration of level whatever took place that was not common to the whole globe and equal all over it, it must necessarily have been the rock that moved, and not the sea.

We may arrive at this conclusion in another way. We could not continue our observations upon stratified or aqueous rocks very long without perceiving that their beds were not invariably horizontal, but were, on the contrary, generally inclined to the horizon. Now we have already seen that in certain cases beds of stratified rock may be formed on a considerable slope, or may have an original inclination due to the very circumstances of their deposition. These cases, however, are by their very nature limited to small areas. A steep slope cannot be of indefinite extent in every direction, and could not have strictly parallel beds deposited on it over its whole area if it were. Whenever, then, we have very widely spread beds maintaining an equal thickness and strict or approximate parallelism over a large extent of ground, we may feel perfectly sure that those beds when first formed were horizontal. If such beds are now found in an inclined position, we may be equally certain that they have been moved since their formation, and moved more in one direction than in another. They must have been *tilted*, either by being lifted up at one end or depressed at the other. In many cases we find this motion to have been very great; the beds have been tilted and set on edge so as to rest at very great angles, and in some cases to be absolutely vertical. Beds consisting of alternations of clay and sand, with their seams of round pebbles that must clearly have been deposited horizontally, have been tilted up till they are now perpendicular (see fig. 19).

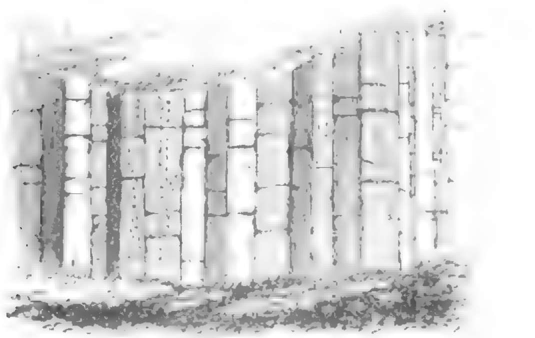

Fig. 19.

Beds containing layers of round pebbles, which must therefore have been deposited horizontally, now in a vertical position.

No one could look at a cliff exhibiting these facts without feeling certain that in this case, at all events, some subterranean and internal forces had acted upon previously horizontal beds, and lifted them into their present position.

If we still hesitated to believe such motion in the solid frame-work of the earth possible, our scepticism must at length give way before the knowledge of the fact that it is still going on even in our own day in various parts of the earth. For a compendious account of movements of elevation and depression in the lands of the present day, either occurring within the times of history or still in progress, we must refer the reader to Sir C. Lyell's *Principles of Geology*, chapters xxix., xxx., and xxxi. He will there find an account of the gradual rise of Sweden and Norway, which is now going on at the rate of about three feet in a century; of the frequent elevation of land along the west coast of South America[1] simultaneously with the occurrence of earthquakes; of the depression of the coast of Greenland, and of both the elevation and depression of the temple of Jupiter Serapis and its neighbourhood in the Bay of Naples, and other similar facts in other parts of the globe.[2]

It must suffice here to say, that these movements seem to be very slow, and to require immense periods of time before any great permanent change is effected. They may either be continuous and insensible in small periods of time, with no earthquake movement, or they may occur simultaneously with earthquakes in little shocks and starts of a few feet or a few inches at a time. It is probable that no earthquake ever occurs without being accompanied by some change of level in some part of the rock shaken by it.

For the cause of these movements we must look to fluctuations of temperature in the heated interior of the earth, —great accessions of heat rising nearer the surface in one part than another, causing expansion of the rocks affected by it in every direction, and thus producing an outward bulging or elevation of these rocks, accompanied by injection of molten matter among them; depression, on the other hand, being due to local refrigeration, and consequent shrinkage and contraction. As to the cause of the fluctuations of temperature, we are perhaps not in a condition to give even a guess.

To such movements as these, operating thus slowly and gradually, we must ascribe the elevation of the whole of the present lands of our globe above the waters of the sea. We say the whole of our present lands, because by far the greater portion of the dry land is covered by or made of rock that has been deposited on the bottom of the sea; and of the remainder, where igneous rocks now prevail at the surface, we have every reason to believe the greater part at least, if not the whole, was once covered by aqueous rock. With the exception, then, of those spots which are composed of matter actually ejected from the mouth of a recent volcano, we either know or must believe that the whole of our present lands have been once beneath the sea, and have been gradually elevated above it.

To such gradually acting forces as those we have mentioned we must ascribe not merely the elevation of all land, but all those effects of unequal elevation, of tension, of disturbance, and of great pressure resulting in fracture and contortion, which I am about to describe. If we know that such is the character of the forces now in action, and if such forces be capable of producing the effects, provided only a sufficient amount of time be allowed them, we have no right to assume that these forces have ever had a different character or a different intensity, unless good reason

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[1] Mr Mallett, in his Report on Earthquakes in the Proceedings of the British Association, points out that these movements are not caused by the earthquake, which is a mere undulation, but accompany it; and that it would probably be more correct to say, that the earthquake was caused by the movement.

[2] More recent movements still were mentioned by Sir C. Lyell, in a lecture to the Royal Institution in 1856, as having occurred in New Zealand simultaneously with the earthquake of January 1855. A *step* of rock, bared of earth, nine feet high, was traceable for ninety miles at the edge of a plain along the foot of a range of hills. An elevation of five feet took place on the north side of Cook's Straits, so as almost to exclude the tide from the river Hutt, and a corresponding depression on the other side of the straits allowed the tide to flow up the river Wairua several miles higher than before.

That these permanent changes of level have not been more often observed is probably in great part owing to the want of a natural standard of level. A change of level diffused over a considerable area could only be detected on the sea-coast, or by accurate measurement referring to some standard of level which had not itself been disturbed. Our only natural standard of level is that of the upper surface of the sea.

can be given why the amount of time could not have been large enough. If, however, it is proved from other sources that the time occupied by geological action is practically illimitable, we are not warranted in diminishing the amount of time and increasing the intensity of force simply to suit our preconceived ideas. This caution is necessary because errors in estimating the nature of the forces in operation not only lead to false theoretical reasoning, but occasionally even to practical mistakes based upon that reasoning.

II.—INCLINATION OF BEDS.

The inclination of beds downwards into the earth is technically called their "dip." It is measured by the angle between the plane of the beds and the plane of the horizon. In fig. 20 the beds dip to the south at an angle increasing from 35° to 50°. When we speak of the opposite of "dip," we use the term "rise." For instance, in fig. 20 the beds *dip* to the south and *rise* to the north. The place where each bed rises out to the surface of the ground is called its "outcrop" or "basset." We say that such and such beds "crop out" to the surface, and we speak of the "basset" edges of the beds. Miners use these and other terms, such as "coming out to the day," "rising up to the grass," when speaking of the "outcrop" of any bed or beds. The line at right angles to the dip, that is, the line of outcrop of a bed along a level surface, is called its "strike," a term in-

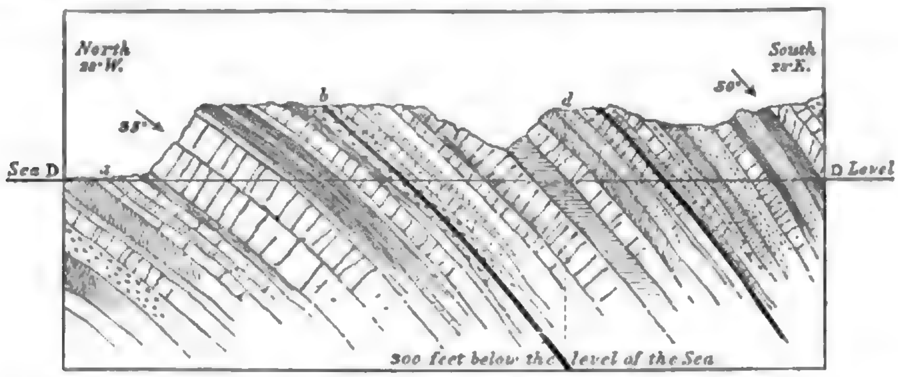


Fig. 20.

troduced from the German by Professor Sedgwick. It is described by its line of compass bearing, either true or magnetic.[1] It may be called the "range" of a bed or beds across a country. Coal miners commonly speak of this as

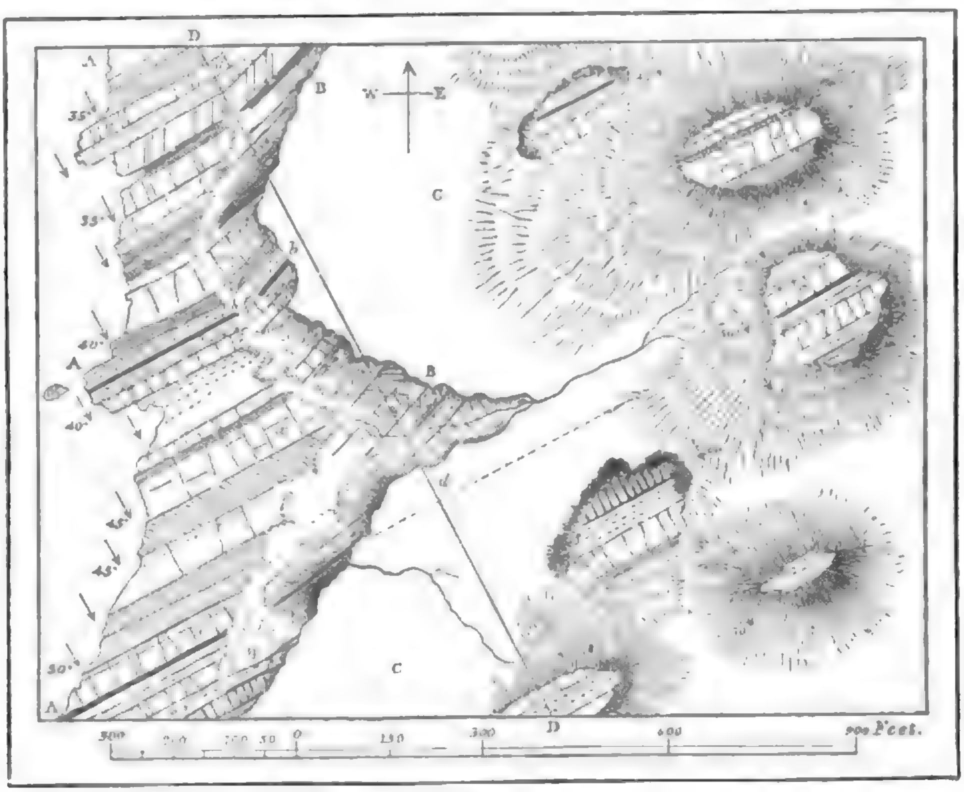


Fig. 21.

the "level bearing" of a bed, seeing that if you draw a line or drive a gallery along a bed exactly at right angles to its line of dip or inclination, it must of necessity be on a true level, or have no inclination either way.

If, then, a bed "dips" due north or due south, its "strike" will be due east and west. If we know the direction of the "dip" of a bed accordingly, we also know

[1] Geologists generally use true compass bearings, a practice that ought to be adopted universally in all land operations.

the exact bearing of its "strike;" but if we only know the strike, we do not necessarily learn either the direction or amount of its "dip," because it may incline to either side of the line of strike, and to any amount from the horizontal plane. In making observations, then, in field geology, it is most important to observe accurately the direction of the dip of all stratified rocks. It is also important to know its amount; but this need not be observed with such minute accuracy, since it is apt to vary continually to the amount of 3° or 4°. In figs. 20 and 21 we have a rough map and section of a piece of country, which will explain these terms. In fig. 21, let A A be a rocky beach exposed at low water; B B a line of cliff about 100 feet in height; and C C the surface of a country above the cliff, with the rock bared of grass and soil, and exposed in several places, either on the summits of eminences or the bottoms of quarries. The arrows point out the direction of the dip, the figures showing its amount. This amount increases from 35° on the north to 50° on the south; and we may assume this increase to be quite gradual, or that the beds are parts of curves and not of perfectly straight planes. Then let D D be a line of section, or supposed cutting, at right angles to the strike of the beds, and let this section (fig. 20) be drawn so as to give the true outline of the ground across which it passes, and representing the beds in the true position they would be seen to occupy were such a cutting or cliff really formed. Being drawn at right angles to the strike, it runs of course along the line of the direction of the dip, and its bearing, as here drawn, is about 28° west of north, and 28° east of south. The latter, then, is the *direction* of the dip. The bearing of the strike marked by the ranges of the beds across the map will consequently be 28° north of east if we look in one direction, 28° south of west if we look in the other. In such a locality as this, if we marked out the boundaries of the beds correctly on our map, we should feel sure of the correctness not only of the map, but of the section, and we should know the position of the beds not only above the level of the sea, but for a considerable distance below it. If, for instance, at the point *d* in the map it was of importance to sink a shaft, so as to come down upon the bed *b*, we should see at once that the depth of *b* under *d* would be, according to the scale, rather more than 425 feet. If we wished to reach the bed *a* in the same way, it would be easy, either by construction or calculation, to ascertain the depth at which it would be found in a perpendicular shaft under *d*.

It would be easy for us also to ascertain the total actual thickness of the whole set of beds shown on the map, either by actual measurement of each bed along the shore, or by constructing a section founded on the observation of their angle of dip and the width of their outcrop. The actual thickness of the beds cut by the sea-level line in the section Fig. 20, for instance, would be a little over 850 feet. That is to say, those beds, if they were horizontal, would be 850 feet from top to bottom; if they were vertical, it would be 850 feet directly across them; while, in their present inclined position, a straight line across their outcrop measures 1200 feet.

If we proceeded to trace those beds into the country *along their strike*, however much the direction of the strike or the *angle* of the *dip* might vary, or however they might be concealed by grass, soil, or superficial covering, we should always have to recollect that there was a thickness of 850 feet of beds to be found or allowed for somewhere; and if in the course of a few miles we came to a quarry or a cutting where the bed *x*, for instance, was shown, and we were able certainly to identify it, we should expect there to find all the other beds above and below it that we had found above and below it where they were clearly exhibited. We should feel sure we were right in this, if in the expected spots, at the requisite distance on either side of it, we found one or more of the beds *a*, *b*, or *c*, shown in other quarries, or cuttings, or cliffs in the neighbourhood.[1] It is in this way, by getting a knowledge of the true sections of a series or group of beds where they are well exhibited, and following them across a country, picking out one of them here, and another of them there, in ditches, brooks, river banks, cliffs, or ravines, wells, mines, road or railway cuttings, and quarries, that geological maps are constructed, showing the boundaries of the several groups of rock, their range or strike across a country, and the area of surface they occupy with their outcrops or "basset edges."

III.—CONTORTIONS.

Where the dip and strike of the rocks are very steady, or where they run in nearly straight lines across a country, and their edges are not too much concealed by superficial covering, this is a task of no great difficulty. In many instances, however, neither the dip nor the strike of a set of beds remain constant over any considerable spaces. The beds are bent and contorted, and twisted about, so that, instead of running in straight lines, the basset edges, or outcrops of any set of beds, follow crooked and curved lines, often doubling back and running altogether out of their former course. Moreover, after dipping down in a certain direction for some distance, such beds are frequently curved up again, and rise to the surface at some other locality, forming basin or trough-shaped hollows; or, again, after cropping out to the surface, the beds underneath them are bent over in a ridge-like form, so that the first beds come in and take the ground again, dipping in an opposite direction.

These bendings and twistings of the beds occur on every possible scale, from mere little local crumplings on the side of a bank, to curves of which the radii are miles, and the nuclei are mountain chains. When on the small scale, they are commonly called "contortions," as in fig. 22.

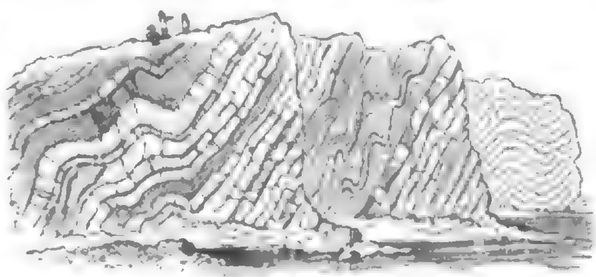


Fig. 22.

There are in some instances wonderfully regular curves visible in beds even of the hardest stone, such as beds of limestone, arches both upwards and downwards, succeeding each other with all the regularity of masonry, as in fig. 23.

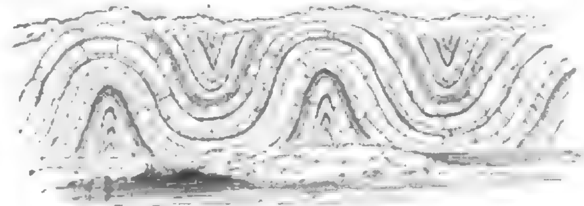


Fig. 23.
Contortions in limestone and shale (borders of Staffordshire and Derbyshire).

In other cases, especially where there are alternations of

[1] In diagram fig. 21, the supposed quarries or exposures of rock in the interior of the country are thickly grouped together; but if the reader will imagine them separated by much wider intervals, and scattered over a far larger space, he will have a truer notion of what usually occurs in nature.

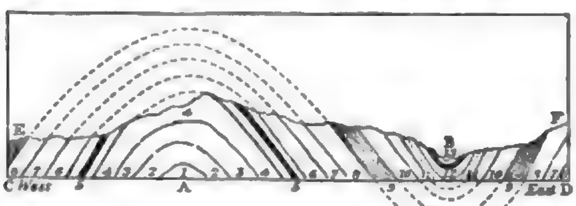
softer and more yielding beds with hard ones, the softer are seen to be puckered and crumpled, as if they had been subjected to lateral pressure and squeezed back, while the harder ones are less broken. This is shown at one part of fig. 22.

Very curious and almost inexplicable contortions may be seen occasionally, but we must recollect, that the conditions under which they were produced, were such as it is not often possible for us to imitate, nor easy even to imagine. When the rocks were thus contorted, they were buried under vast thicknesses, often many thousands of feet, of other rock; the rocks above and below them were also of unequal densities, and offering unequal resistances to force; the forces of disturbance, therefore, even if uniform in their origin, would become complicated in direction, and unequal in intensity, by reason of these inequalities in the structure and position of the rocks, and inequalities in the pressure of the superincumbent masses. We might expect *à priori*, therefore, to meet sometimes with results not capable of any ready or simple explanation.

IV.—ANTICLINAL AND SYNCLINAL CURVES.

When the curves of the rocks are of greater extent, we cease to speak of them as mere "contortions." If the curves have longly-extended axes, that is to say, if the beds are bent up into ridges, or down into troughs, which continue for considerable lengths, in proportion to their widths, we speak of them as "anticlinal" and "synclinal" curves. If, on the contrary, no diameter of the curved area be much longer than another, we call them either dome-shaped elevations, or basin-shaped depressions, as the case may be.

In fig. 24, A is an anticlinal, and B is a synclinal curve, the beds numbered 6, 7, 8, being repeated on each side of both. At A, the lower beds 1, 2, 3, 4, 5 are seen rising out from underneath them in the form of an arch. At B, the upper beds 9 to 13 repose upon them in the form of a trough. It matters not whether we suppose the spaces 1, 2, 3, &c., to represent single beds, and the hill at A a slight elevation, or whether they be taken as groups of beds, and A be supposed to be a mountain chain. The straight line which may be supposed to run directly from the eye of the spectator along the top of the ridge A, or the bottom of the trough B, is called the "axis" of the curve in each case. This axis may be either horizontal or inclined; if horizontal, the section across it will cut the same beds



Section on line C D.

Fig. 24.

wherever it be taken, the variations in its outline only resulting from those in the outline of the ground. If, however, the axis be inclined, different sections will cut different beds, even should the outline of the ground remain the same. This will be best shown if we look at fig. 24, which is a supposed plan of the ground of which fig. 25 is a section, and suppose the axis AA^1 and BB^1 to incline downwards to the north, or from the line of section to the other end of the map, as shown by the arrows, it is obvious that the bed 4, which forms the apex of the ridge in the section, will slope downwards along the inclined axis, and if the ridge of the hill be kept up to the same height, the beds 5, 6, 7, 8, will necessarily arch over it. In the same way, if the synclinal axis BB^1 slope in the same direction, there must either be a corresponding slope and hollow in the surface of the ground, or fresh beds, 14, 15, 16, &c., must come in, resting in the hollow of 13.

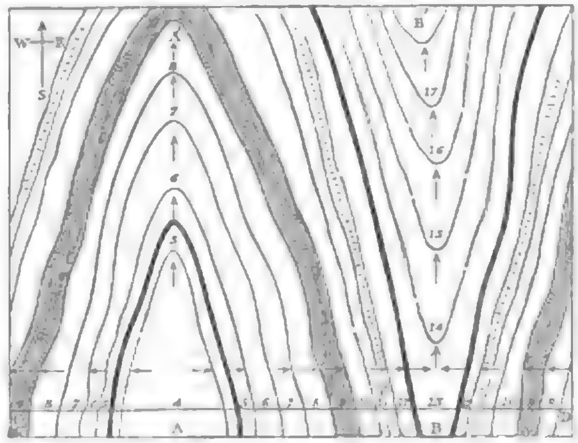


Fig. 25.
Plan of anticlinal and synclinal curves.

In countries traversed by many lines of disturbance, such forms as these are by no means unfrequent. They necessitate great labour in tracing them out, and making an accurate map of them, especially where the ground is itself lofty, broken, and uneven, and the complexity underneath obscured by perplexing irregularities on the surface.

Sometimes the axes of the curves slope both ways from a central point, producing long oval forms like that of an inverted boat, and there is a regular gradation from these to the circular elevations or depressions mentioned before, in which the beds are said to have a *quaquaversal dip* from or to a central point, according to whether it be a dome or a basin that is produced.

These flexures are in some instances carried out so far, both on the large and small scale, as to produce actual inversion (see fig. 26) of the beds, so that the lower surfaces appear to be the upper ones.

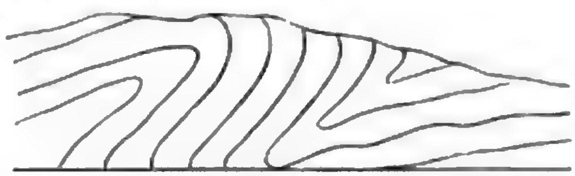


Fig. 26.
Section of beds partially inverted.

This inversion may be seen in some cases in cliffs among highly contorted beds; in other cases it requires a more widely extended observation in order to show that the apparent order of superposition of any set of beds, in any particular locality, is the inverse of that order which is to be observed generally, and where the beds are undisturbed.

Inversion of beds is occasionally to be detected by means of the "ripple," or "current mark," or other structure produced on the surface of beds, when the peculiarities in the forms of these marks are of such a kind as that a "cast" of them shall be plainly distinguishable from the original form. In these cases the "cast" may sometimes be seen on the now upper surface of a bed, dipping under what appears to be the bottom of the superincumbent bed, but which was originally the really upper surface or "mould" on which the materials were deposited that formed the "cast" at the bottom of the succeeding bed.

The inversion of beds is likewise occasionally detected in coal mining, as in Belgium and the south-west of Ireland, where beds of coal are sometimes found with the "coal-

seat" uppermost, and the "coal-roof" undermost. In a disturbed part of the South Staffordshire coal-field also, the same bed of coal was passed through three times in the same vertical shaft, first in its right position, then inverted, and then again right side uppermost. It must accordingly have been bent into the shape of the letter S or Z.

We shall see presently that no mere "fault" can thus bring part of the same bed twice into a vertical shaft.

V.—FAULTS OR DISLOCATIONS.

It may easily be conceived, that the force which was sufficient to raise vast masses of solid rock, of unknown but immense thickness, from the bottom of the sea high into the air, in order to form the dry land, and to bend them into the folds and contortions we have just described, was also sufficient to crack and break them through. We find, accordingly, very frequent instances of cracks and fissures running through great thicknesses of rock. Sometimes these are mere fissures; but quite as frequently there is not only a severance but a displacement of the rocks that have been severed. Beds that were once continuous are now not only broken through, but are left at very different levels on opposite sides of the fissure, many feet, or many hundreds of feet above or below the parts with which they were once continuous. When this is the case, these fractures are called "faults" or "dislocations" by geologists, for which miners in different districts use in addition the terms "slip," "slide," "heave," "dyke," "thing," "throw," "trouble," "check," and other expressions.

The amount of dislocation, measured in a *vertical direction*, produced by a fault, is called its "throw," a fault being said to be an "upthrow" or a "downthrow" or an "upcast" or "downcast," according to the side from which we view it. Its amount is stated in fathoms, yards, or feet, measured perpendicularly from the surface, provided the surface be horizontal, from a given horizontal plane if it be not. If, for instance, a bed of coal, where it is cut by a fault, as at A (fig. 27), be 100 yards from the surface, and

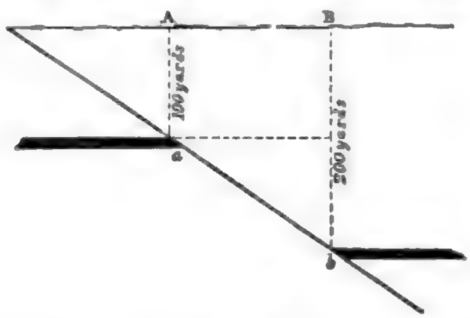


Fig. 27.

the other part of the bed immediately on the other side of the fault, as at B, be 200 yards from the surface, or from the assumed horizontal datum, the throw of the fault is said to be 100 yards, without regard to the distance measured laterally from A to B along the surface,[1] or from *a* to *b* along the fault.

Faults vary in character and in effect,—

1*st*, According to the nature of the rocks which they traverse, whether they be hard or soft, or an alternation of both.

2*dly*, According to the position of the beds which they traverse, whether these be horizontal, inclined, or contorted.

3*dly*, According to the number of lines of fracture, their direction, inclination, and combination.

1. When faults traverse a mass of rather soft and yielding rocks, such as shales and thin sandstones, the fissures themselves are often mere planes of division, just as if the rock had been cut through with a knife. Very frequently, in this case, the two contiguous surfaces of the fault are found to be quite smooth and polished by the enormous friction that has taken place, producing the appearance well known to geologists under the name of "slickenside." In some cases, although the fracture seems quite clean and sharp, yet the beds on each side are found to be traversed by a great number of small, irregular, and discontinuous "slickenside" surfaces, as if a jarring and tremulous grinding motion had been produced in the mass of the beds. Sometimes the beds end abruptly without any distortion (fig. 28); but sometimes they seem to have bent and pulled down along the plane of the fault to a certain extent, as in fig. 29.

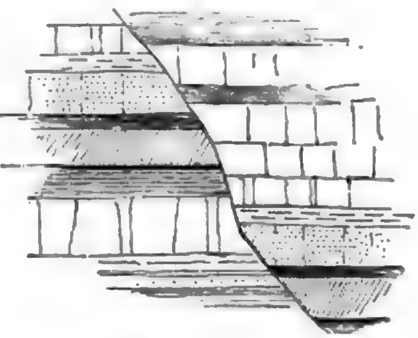


Fig. 28.
Section of beds with fault.

In fig. 29 the beds would be said to "rise towards the upthrow," and "dip towards the downthrow;" and this is naturally the most usual occurrence, though we believe not invariable, as there are said to be instances where the very opposite of this takes place, and the beds seem to "rise" to a downthrow fault.

When faults traverse very hard and unyielding rocks, such as thick hard gritstones, hard limestones, or hard siliceous

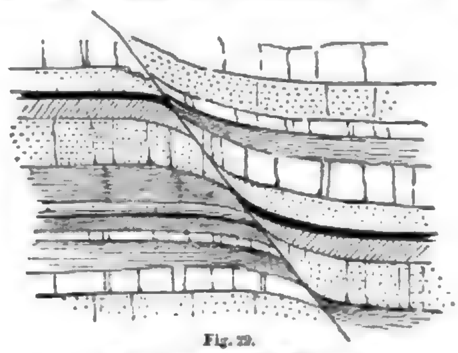


Fig. 29.
Section of hard beds with faults.

slates, and still more, if they penetrate igneous rocks such as granites and felstones, the fissures are apt to be much wider, and often very irregular. If the original fracture shall have taken place not in one plane, but so as to produce two jagged, and broken, or uneven and irregular surfaces, with cavities and protuberances as in fig. 30, and these two surfaces slide one over the other, it is very unlikely that they would ever, unless restored to their original posi-

[1] In taking accounts from miners as to the characters of faults, it is necessary to be on one's guard, and be quite sure that the sense in which they use these terms is properly understood. In some districts they would speak of the distance AB, measured along the surface of the ground, or the horizontal distance between the ends of the beds, as the "width" of the fault, looking only to the extent of "barren ground" as to that particular bed, and paying no attention to the real width of the actual fissure itself, which might be not more than a few inches, or perhaps even not more than one.

Geology.

tion, be made to *fit exactly*, so as to close again upon each other throughout their extent. Protuberance might rest

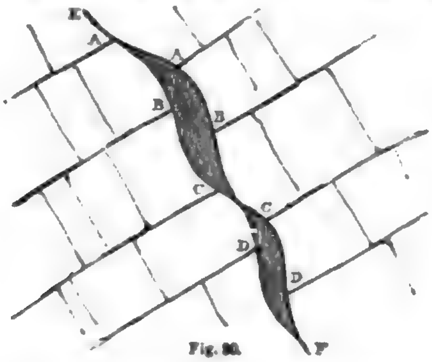


Fig. 30.

Section of hard beds with irregular fault.

against protuberance, or come against a hollow not large enough, or not of the requisite form, to receive it, and thus the two walls of the fissure would be kept partially and irregularly apart, the fissure being closed in some places and open in others. In fig. 30, an uneven fracture having traversed the hard beds A, B, C, D, and dislocation taken place, the result would be the irregular fissure EF.

It is true that the grinding process, as the surfaces moved upon each, would often greatly diminish this irregularity, and in soft rocks probably obliterate it; but in hard rocks it is much more usual to find the irregular openings above described still remaining.

Where alternations of hard and soft beds occur, there may be a combination of the two effects, the fissure being quite closed where soft beds are brought together, or even where soft beds are brought against hard, but more or less open where two hard beds come in contact.

When we speak of open fissures, however, we by no means intend to assert the frequency of fissures now open and empty. They are almost invariably filled with materials either derived from the ruins of the adjacent rocks at the time of the fracture occurring, or accumulated there afterwards.

Some fissures, even in the most soft and yielding rocks, have similarly been kept open, or rather the sides of the fault kept apart by fragments and debris that were dragged into them at the time of their occurrence. Such fragments, often of large size, are found along the lines of faults both vertically and laterally, for it is not unfrequent, in tracing the line of a fault along the surface of the ground, to find lumps and patches, some yards in diameter, of the broken beds caught and resting in the gaps of the fracture.

2. As it is comparatively rare to find beds in a strictly horizontal position over any considerable area, it is necessary to study the effect of faults on inclined beds, and on beds with an inclination varying either in angle, in direction, or in both. If any bed or set of beds "striking" in a given direction, and "dipping" at a given angle, be broken through by a fault, the effect of the vertical "throw" is to produce at the surface the appearance of a lateral "shift."

Let us suppose fig. 31 to be a horizontal plan of the outcrop of a set of beds, of which we may suppose *aa* to be a limestone interstratified with sandstones and shales, and that they all dip steadily to the N. at an angle of 25°, and that these beds are traversed by the fault *bb*, causing a "downthrow" to the E., or an "upthrow" to the W., which is the same thing. It is evident, then, that the outcrop of the beds will be farther S. on the E. side of the fault than they are on the W.

To render this more evident, let fig. 32 be a diagrammatic section along the direction of the line of fault, showing the beds on both sides of it, and let us look only at the limestone *aa*, disregarding the other beds. If we suppose the part *b* dropped vertically down to *c*, and the part *d* in the former continuation of the bed down to *e*, it is clear that a vertical throw of the bed *aa* on one side of the fault will place it in the position *a′a′* on the other side of the fault, the respective outcrops of the two pieces of the same bed being, at the present surface of the ground, at the points *bc*. In other words, the apparently lateral shift of the outcrop of *aa* in the plan (fig. 31), has been produced by the vertical throw of the inclined beds on opposite sides of the fault. It follows, also, that the higher the angle at which the beds dip, the less will be the apparent shift at the surface produced by the same amount of throw. In fig. 33 the angle of inclination is increased to 60°, the vertical throw, or the distance between *b* and *c*, remains the same as in fig. 32; but it is obvious that the apparent lateral shift or distance between *b* and *c* is greatly diminished. This diminution would continue with the increase of the angle of inclination, until the beds were actually vertical, when it is plain that no amount of vertical throw could produce any apparent lateral shifting, for the ends of the beds on the opposite sides of the fault would merely slide up or down along each other. In a set of vertical beds, then, it would be almost impossible to detect a fault, however great may have been the real fissure and dislocation. On the contrary, when the beds lie at a very low angle, a very small dislocation shifts the outcrop of the beds in a very remarkable manner.

It is obvious, from an inspection of figs. 32 and 33, that if we know the inclination of the beds, and the amount of

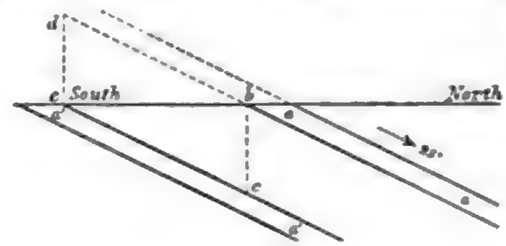


Fig. 32.

Diagrammatic section of Fig. 31.

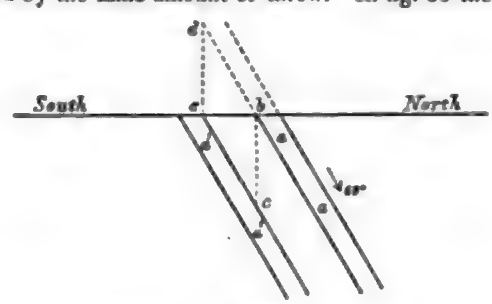


Fig. 33.

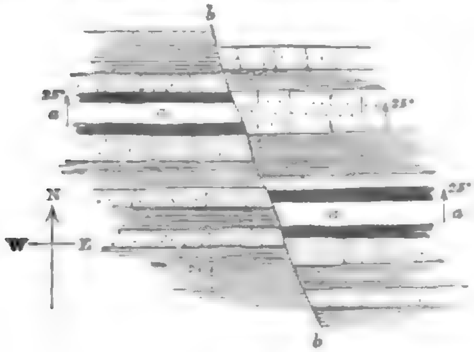


Fig 31.

Fault traversing inclined beds, and producing apparent lateral shift. (Plan.)

the vertical "throw" of the fault, we may easily calculate what will be the apparent shift of their outcrop at the surface; and if, therefore, we find the outcrop of one, it will be easy to discover the outcrop of the other.

On the other hand, if we know the distance between the outcrop of the beds on opposite sides of the fault and their angle of inclination, it will be easy to calculate the amount of the vertical "throw," or to discover the depth (or distance, *bc*) at which the one part of the bed will be found lower than the corresponding point on the other side of the fault.

In practice, allowances have to be made for irregularity in the surface of the ground, and for variations in the angle of inclination of the beds, and also for changes in the amount of "throw" in the fault, but in the above consideration of the simplest case lie the elements of much practical utility in mining and other operations.

That this apparent lateral shift at the surface is really due to vertical elevation or depression, may be shown further by examining its effect on beds thrown into anticlinal and synclinal curves.

Let fig. 34 be a plan in which *aaa* is a bed having a synclinal or basin-shaped depression at SS, and an anticlinal

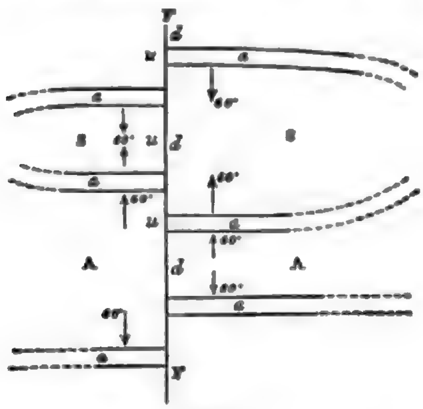


Fig. 34.
Fault across synclinal and anticlinal curves. (Plan.)

form at AA, dipping, as shown by the arrows, at an angle of 60° in each direction, and let it be traversed by the fault FF. It is clear that no lateral shifting will account for the places of the broken ends of *aa* on opposite sides of the fault, since they are shifted in opposite directions; while their present positions are easily and obviously accounted for on the supposition of a vertical elevation on the side of the fault marked *uu*, or depression on that marked *dd*, and a subsequent planing down of the whole to one level surface. If we draw two sections parallel to the fault, and on opposite sides of it, one, as in fig. 35, along *uu*, the upcast

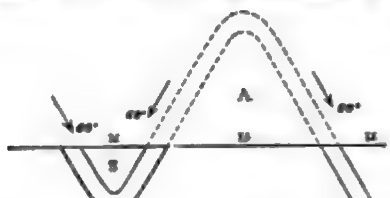


Fig. 35.

side, and the other, as in fig. 36, along *dd*, the downcast side, putting in the beds with a dip of 60°, as directed by the arrows in the plan, we should at once see that, in fig. 35, on the upcast side of the fault, the beds will meet below S, at a point much nearer the surface than they do in fig. 36 on the downcast side; in other words, that the bottom of the synclinal is at a higher level in the first than the last case. In the same way the point A, where the anticlinal lines would meet if produced, is higher above the surface in fig. 35 than in fig. 36, or the whole of the bed *a a* is more nearly out of the ground in fig. 35 than in fig. 36.

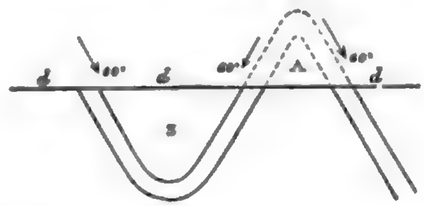


Fig. 36.

It is plain that these appearances are the result of the vertical elevation of the beds on one side of the fault FF in fig. 34, or their vertical depression on the other side of it. The greater the throw on the downcast side the more widely will the outcrops of a synclinal curved bed be separated, and the more nearly will the outcrops of an anticlinal curved bed be brought together, while on the upcast side of the fault the reverse is the case, the outcrops of a synclinal curve will be brought together, and those of an anticlinal will be separated. When either the angle of the dip or direction of the strike of the beds vary along the course of a fault, its effect upon the position and form of their outcrop becomes equally various. This effect may be still farther complicated by a change in the amount of the "throw" of a fault in different parts of its course.

3. We have hitherto supposed the fault to run directly across the beds, or nearly so, but some faults may either, in whole or in part of their course, run obliquely to the strike of the beds, instead of directly across it, and instances may occur of dislocations even running along the strike, so as to entirely conceal some of the beds, as in fig. 37, which

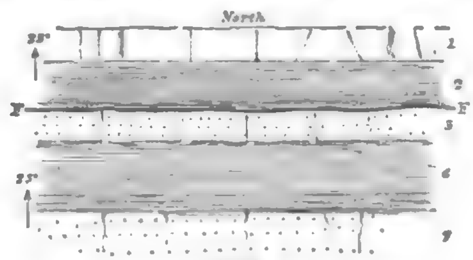


Fig. 37.
Fault along strike. (Plan.)

is a plan, where the fault FF, running directly along the strike of the beds, conceals part of No. 2, the whole of 3 and 4, and part of No. 5, as may be seen by the section, fig. 38.

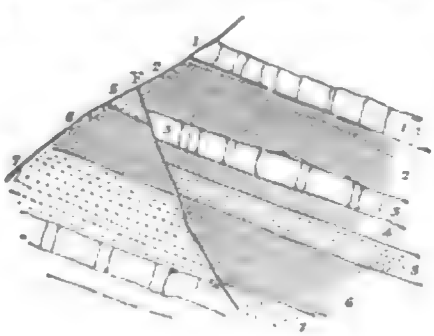


Fig. 38.
Section of Fig. 37.

If the magnitude or throw of the fault diminishes in one direction, we should have some of these beds coming out in that direction, as in fig. 39, producing a slight variation in the strike of the beds.

Many other modifications may arise according to the variations in the direction of the faults, with respect to the strike of the beds, or in the amount of their "throw."

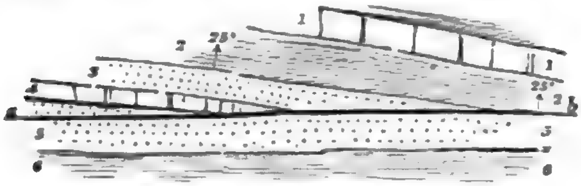


Fig. 39.
Fault along strike, with variation in throw. (Plan.)

4. The number and association of faults also requires consideration in order to properly understand their effects.

If we suppose a single line of fault only to exist, it involves the assumption that the beds have been bent or bulged either upwards or downwards on one side of the fault, or upwards on one side and downwards on the other.

If in fig. 40 we suppose the line *ab* to be a crack or fissure traversing a set of beds, or if we suppose it to be a crack in a plank of wood, or any other flexible substance, ending each way without meeting with any other crack or

Fig. 40.

fissure, it is obvious that although the parts will be *severed* along it, they will not be shifted vertically unless some force be applied to push or bend upwards or downwards, as in fig. 41, the part on one side of the fissure, while the other part is held fast, or pushed in the opposite direction.

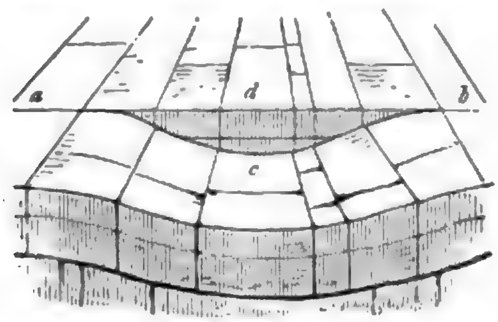


Fig. 41.
Single line fault, produced by bending of beds on one side of fissure.

In fig. 41 some beds are supposed to be cracked by the fissure *ab*, and the part *c* to have been bent down, but we might just as easily have supposed the part *d* bent up, or both operations to have taken place simultaneously. Without some such *bending*, no dislocation could have occurred.

Such "single line faults" have been produced, as is proved in coal-mining. They generally have one, but sometimes more points of maximum "throw" near the centre, and gradually diminishing each way till they die out. Not unfrequently they split towards one or both extremities, as is shown in the plan, fig. 42, in which the main fault *ab* is seen to be split into three at one end and two at the other. The figures represent the amount of the downthrow at each point in feet, yards, or fathoms, as the case may be.

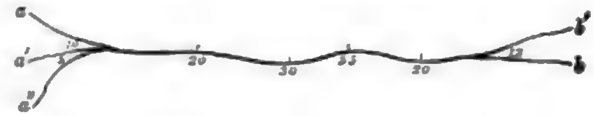


Fig. 42.
Plan of fault splitting at the ends.

It is possible that this bending of the beds along the line of fault may occur more than once, so that they may be thrown into undulations, and thus more than one maximum throw may be produced. This undulation, too, may also become so great that the downthrow may change sides, as is attempted to be shown in fig. 43. This actually occurs

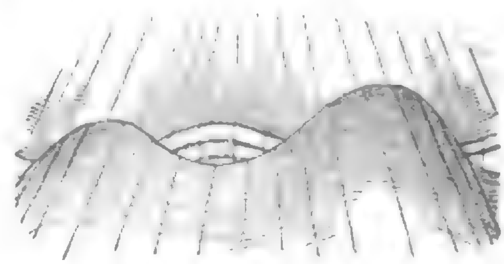


Fig. 43.
Single-lined fault, with alterations of throw produced by undulations of beds along it.

in nature sometimes, the fault appearing to die away when the beds come together, and then to set on again with a dislocation in the opposite direction. The fig. 43, however, is to be taken as a mere diagram to help the explanation, and not as an actual representation of nature, where the undulations are rarely if ever so rapid. Single lines of fracture are probably in general much more extensive than the actual dislocated spaces, since such bendings and bulgings as are here shown to be necessary to cause dislocation, would be more likely to occur near the central portions of a fracture than near its extremities.

When there is more than one line of fracture, the fact of dislocation becomes more easy to understand, since there is no difficulty in conceiving that the angle, or corner of ground included between the intersection of two faults, has been dropped down below, or squeezed up above the corresponding beds on the outside of them. In the plan fig. 44, let *ab* and *cb* be two faults meeting in the point *b*, the included part *d* may be either depressed below, or raised above *abc*. Even in this case, however, the beds on one side or other of the faults must be bent up or down in the direction of *ed*, because, as the two faults end or die out at *a* and *c*, the whole of the beds must be on the same level there, and one part or other must change that level in proceeding in the direction *ed*.

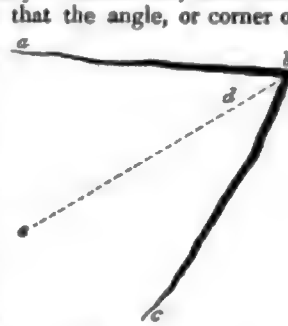


Fig. 44.
Dislocation by two fissures.

There is a modification of this case shown in fig. 45, where we have one long continuous fault AB, with one or more lateral branches, *cd*, *ef*, *ik*, &c., proceeding out of it, or leading into it, as we may choose to consider them, and either on one or both sides of it. In this case, while the whole mass of ground is thrown down on one side of AB, with respect to the other, the particular portions between *cd*, *ef*, or the corners between any one of them and the main fault may have additional minor dislocations of their own.

A long powerful fault is often composed in the whole, or part of its course, of a number of parallel fissures very close

Fig. 45.
Great fault with lateral branches. (Plan.)

together, along a narrow band of country, breaking the rocks into a corresponding number of steps, as in fig. 46, which either "throw" all in the same direction, or having some

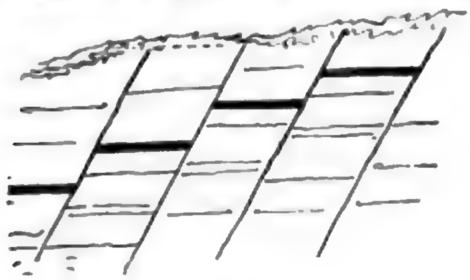


Fig. 46.
Step faults.

steps in opposite directions, produce a balance of "throw" in one direction, so that it is treated as one wide fault.

In order to have any mass of beds entirely cut off on all sides from those that surround them, and wholly depressed below, or raised above them on every side, it is obviously necessary that we should have at least three straight faults, or one or two curvilinear faults surrounding the fractured piece of ground. Such dice-like masses of ground let in bodily among a strange set of beds do occur in nature, though they are very rarely met with.[1]

Faults and fissures are sometimes vertical, as at A, fig. 47, but more commonly inclined at various angles, even so low in some instances as 20°, as at B, fig. 47.

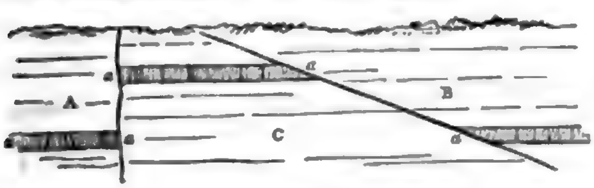


Fig. 47.
Varied inclination of faults.

In speaking of the inclination of a fault, it is better not to use the term "dip," as if it were a bed, but to adopt that of "hade" or "underlie." In inclined faults,—and it almost always happens that faults are inclined,—there is one nearly invariable rule, which is, *that the fault "hades" or "underlies" in the direction of the downthrow.*

As a corollary of this rule also, another equally important one may be stated, namely, that however inclined may be the fault, *no part of any bed will ever be brought vertically under another part of it,* and therefore superior beds can never be brought *by any* fault under those originally below them.

Small exceptions to these rules may sometimes occur in rare instances; when they do, the fault that produces them is called a *reversed fault.*

In fig. 47, for instance, the fault between B and C hades under the downcast piece of the bed *aa*; and it is obviously impossible for a vertical fault, or one inclining in the proper direction, to bring any part of the bed *aa* vertically beneath another part, and consequently no part of the beds above *aa* can ever be brought underneath it.

We have never met with any exception to this rule, except on a very small scale, and where it might easily happen that the exception was more apparent than real, the apparent inclination of the fault being merely a local bend or indentation in a vertical or nearly vertical fault.

The reason of this rule is sufficiently easy to understand when we come to look at faults on the large scale. Suppose that in diagram fig. 48 we have a portion of the earth's

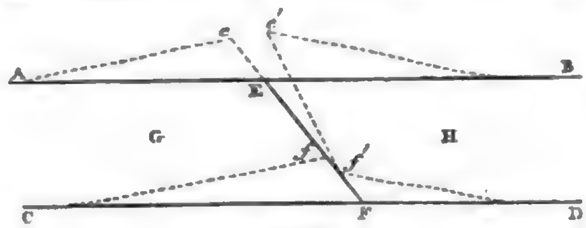


Fig. 48.

crust, of which AB is the surface, and CD a plane acted on by some wide-spread force of expansion tending to bulge upwards the part ABCD. If, then, a fracture take place along the line EF, it is obvious that the expanding force will, on the side of AC, have the widest base CF to act upon, while it will have a proportionately less mass to move in the part AECF, which grows gradually smaller towards the surface, than on the other side of the fault, where, with the smaller base FD, the mass FDBE continually grows larger towards the surface. The mass G will consequently be much more easily raised into the position A*e*C*f*, than the mass H into the position D*f'*B*e'*, the elevation of which could hardly take place without leaving a great open gap along the line of fault between FE and *f'e'*, and, moreover, without leaving the projecting piece *e'* overhanging without any support.

This is yet more clearly perceptible if we suppose two such fissures, as in fig. 49, inclining towards each other,

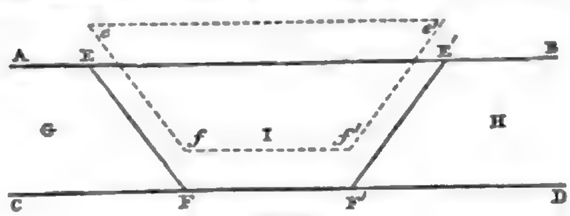


Fig. 49.

since, if we suppose the included piece I to be elevated into the position indicated by the dotted lines, it becomes utterly unsupported unless we suppose huge dykes or ejections of igneous rock to issue out along each fault. But this would remove the case from the class of fractures we are at present considering.

In another case which we might imagine, that of two parallel faults inclining in the same direction, as in fig. 50;

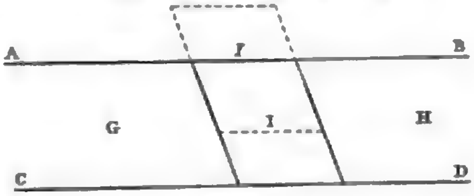


Fig. 50.

the included piece I might be elevated without leaving an open fissure, but still the part *I* would overhang in an unsupported condition, and the enormous friction along two

[1] In the neighbourhood of Bunmahon, in county Waterford, detached masses of old red sandstones are let in among the Silurian rocks, so as to be entirely inclosed by them on every side.

sides of the piece I, would have to be overcome. We are not aware, indeed, of any case similar to this having been even supposed by any one.

Professor H. D. Rogers, in his paper on the "Laws of Structure of the more disturbed Zones of the Earth's Crust," (*Trans. Royal Soc. Edin.*, vol. xxi., p. 3), in describing faults along the axes of anticlinal curves, where inversion has taken place on one side of the anticlinal, speaks of the uninverted part of the anticlinal having been thrust up the inclined plane of the fault, over some of the inverted beds, as in fig. 51.

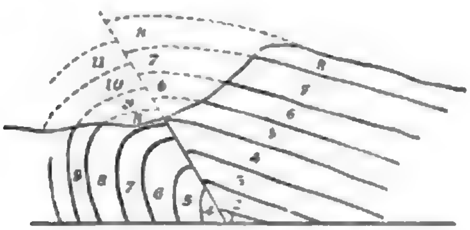


Fig. 51.
Inversion, with reversed fault.

Professor Rogers does not allude to the fact of this form producing a *reversed* fault, nor is it quite clear in his paper whether the structure thus described has been absolutely observed in sections, or is merely introduced hypothetically as an explanation of certain puzzling phenomena. If actually observed, a detailed description of the locality would be very interesting, neither are we prepared to combat the hypothesis, if it be one, since it is just in such greatly disturbed districts that "reversed" faults are likely to occur.

Another published example of a reversed fault on a large scale is given in the Rev. Professor Haughton's paper on the "Mining District of Kenmare" (*Journal Geological Society, Dublin*, vol. vi., p. 2). In this case also, no notice is taken of the fault, as drawn, being a reversed one; and though it is in a highly disturbed district, and running parallel to the axis of a synclinal curve, yet as its plane does not coincide with that axis, but cuts across it obliquely, and buries some of the upper rock under the lower in a very peculiar manner, it appears to us a far less probable form of fault than that described by Professor Rogers.

Faults ordinarily extend indefinitely downwards. We cannot comprehend the possibility of fracture and displacement having taken place in any uncontorted set of beds without all those below having been equally disturbed, unless we come to a part where another fracture occurs, producing an equal amount of displacement in an opposite direction. This junction between two opposite faults produces what is often called a "trough," the faults being called a "pair of trough faults." The opposite faults of a trough may be either unequal in "throw," as *ac* and *bc*, in the trough A, or equal, as *de*, *fe*, in trough B. In the former case, the displacement affects the whole mass of the sur-

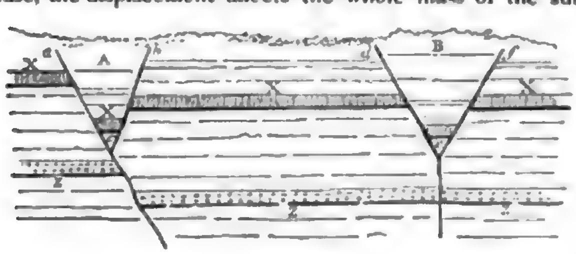


Fig. 52.
Trough faults.

rounding rock, as may be seen by tracing the bed X through the dislocations; in the latter case, it only affects the mass B, which is included between the faults. In the latter case we may see that the bed X on the outside of the trough B is on the same level on both sides.

The mode of explanation of these trough faults that seems to us the most probable, if not the only one, is the following:

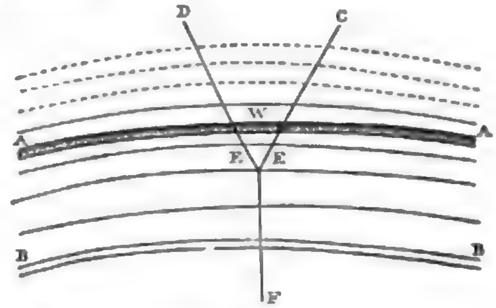


Fig. 53.

Suppose the beds AA, BB, &c., to have been formerly in a state of tension, arising from the bulging tendency of an internal force, and one fissure, FE, to have been formed below, which on its course to the surface splits into two, ED and EC, as in fig. 53. If the elevatory force were then continued, the wedge-like piece of rock W between these two fissures, being unsupported, as the rocks on each side separated, would settle down into the gap, as in fig. 54. If the elevatory action were greater near the fissure than farther from it, the single fissure below would have a tendency to gape upwards, and swallow down the wedge, so that eventually this might settle down, and become fixed at a point much below its previous relative position. Considerable friction and destruction of the rocks, so as to cut off the corner *gh* (fig. 54) on either side, would probably take place along the sides of the fissures, and thus widen the gap, and allow the wedge-shaped piece W to settle down still farther.

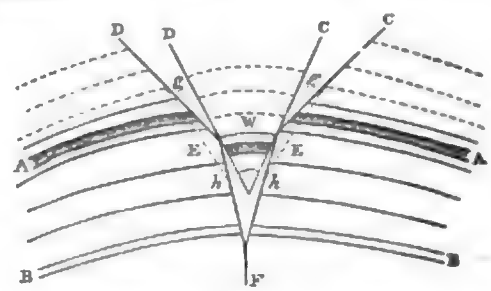


Fig. 54.

When the forces of elevation were withdrawn, the rocks would doubtless have a tendency to settle down again, but these newly included wedge-shaped, and other masses, would no longer fit into the old spaces, so that great compression and great *lateral* pressure might then take place.

The reader must recollect that the figs. 53 and 54 are mere diagrams to assist his comprehension, and not actual representations, in which there would necessarily be introduced a much greater amount of irregularity and complexity. This may be seen by an inspection of fig. 55, which represents the commencement of a trough fault, on the small scale, in the middle of the thick coal of South Staffordshire. This was carefully drawn to scale by a competent observer, Mr Johnson of Dudley, and will show that fractures similar to those just spoken of actually occur in nature, and what are the circumstances attending them. (See *Records of the Geological Survey*, vol. i., part 2, p. 313.) In this fig. the coal CC has apparently once been more completely arched, and on the cessation of the elevatory action, has tended to settle down again. The insertion of the wedge-shaped piece of the upper beds A has prevented its gaining the original horizontal position; but the

pressure of the superincumbent mass has caused it to crack in various places, and the part of the coal next the wedge BB was completely crushed, and its grain or lamination and internal structure destroyed by the compression under which it suffered, being reduced to a state as if made of "a paste of coal-dust and very small coal."

Examples of "trough faults" are by no means uncommon in disturbed coal-measure districts, and are doubtless equally common elsewhere, where they cannot be detected. Their study is instructive, as giving us often more accurate ideas than we should otherwise possess as to the nature of faults.

We have already seen, in tracing faults superficially along what may be called their lateral extension, that it is impossible to conceive displacement to occur except in consequence of a second fault meeting the first, or in consequence of a bulging of the beds along a part of the line of the fault.

Similar reasoning will apply to the vertical extension of a fault.

Fig. 55.

Mr W. Hopkins has shown us that fractures in the crust of the globe have taken place in obedience to certain mechanical or physical laws. If a tract of country of indefinite length and breadth, composed of a set of nearly homogeneous beds, supposed to be originally horizontal, and nearly equally tenacious all over, be acted on by an expansive force from below, such as an elastic gas or a molten fluid would exert, those beds will be strained so as to tend towards bulging upwards, until a number of parallel fissures are formed, commencing at points below the surface, and running up to it. They may be crossed either then or subsequently by another set of parallel fissures at right angles to the first set. These are the normal results which may, in actual fact, be complicated by many irregularities arising from conditions different from those which were assumed.

It seems to follow from these results, that for displacement to have taken place among the fractured masses, two or more faults should meet below, so as entirely to sever the masses from each other, and allow of unequal motions being communicated to them, or that faults should gradually end downwards on the surfaces of highly-curved, undulated, and contorted beds.

The intrusion of igneous rock will in some instances increase the dislocations; but the student must be on his guard against attributing to local intrusion of igneous rock effects of elevation, or contortion, or fracture, which are due probably to very widely-extended accessions of heat expanding large masses of rock of all kinds simultaneously over great countries, and the subsequent contractions when that heat is diminished or taken away. Small local intrusions of igneous rock act principally as stays and wedges to prevent the dislocated beds settling back into their former places, but can rarely be looked on as the actual causes of disturbance. When we come, indeed, to consider large intrusions of great granitic masses into the rocks above them, we see a fertile source of dislocation, first, by the expansion of the superior rocks from the mere protusion of the bulk of the molten mass, and afterwards from contraction in consequence of the cooling of that mass which contraction, as we have already seen (chap. ii., §. 3.) might amount to even one-fourth of its bulk.

Where any large mass of matter, too, has been ejected over the surface of the ground, the withdrawal of its bulk will have tended to leave a void space in the interior, which, if it were not filled up with other igneous matter, would be followed by subsequent sinkings and dislocations of the rocks over it.

VI.—MINERAL VEINS, THE RESULT OF CAVITIES FORMED BY DISLOCATIONS.

In studying faults, our object was principally to describe their effect in dislocating the beds which they traverse; the form, the width, and the extent of the fissures themselves was only noted as affecting the beds; and the contents of the fissures, when any spaces or cavities existed between their walls, was scarcely spoken of at all.

It was shown, however, that when faults traversed hard rock, they must necessarily, unless the fissure be a perfect plane, be more or less open in places, some portions of their walls being kept apart by the protuberances of other parts. It was said also, that fragments of the fractured rocks were often found in the fissures, and these fragments must necessarily contribute to keep the sides of the dislocated portions apart from each other.

Now, in some districts, these more or less open faults and fissures have become the repositories of minerals that have been subsequently introduced into them.

These minerals are usually in a crystalline form, and consist commonly of quartz, calc, heavy, fluor, and other *spars*, together with the *ores* of one or more metals, such as lead, copper, tin, iron, zinc, antimony, mercury, silver, gold, and platina.

Fissures containing minerals in this form are called "mineral veins," or "lodes."

Spars and ores, however, are not confined to fissures such as we have been describing. They are found occasionally in all kinds of cracks and cavities, whatever may have been the cause of the hollows, and even in little nests, lining detached holes, often no larger than the fist, and entirely surrounded by solid rock. They are found also in long pipe-like hollows in limestone, which are due apparently to the corroding action of acidulous waters; in the interstices between beds and joints similarly or otherwise enlarged, as well as in cracks, resulting from desiccation in the middle of nodules. Those in pipe-like and irregular cavities are called "pipe veins," as distinguished from "lodes," which are also called "rake veins." Wherever, indeed, permanent hollows and interstices of any kind, size, shape, or origin, exist in hard rocks, and where they are kept open for great periods of time, there appears to be a possibility, and, in particular districts, a probability, of crystallized minerals, spars, and ores, being formed in them.

That they occur most frequently and in most abundance in such fissures as we have described under the head of faults and dislocations, is due, probably, to the great range and extent of those fissures, and to the fact of their necessarily having many hollows and cavities throughout that extent wherever they traverse hard and solid rocks.

There is also another reason why the quantities of crystallized minerals should be greater in such fissures than elsewhere, and that is, that any subsequent disturbances in the mass of the rocks will tend to produce subsequent motions along the lines of the old fissures, and thus form

additional cavities, which may be filled up by fresh accessions of spars and ores. (See *Geological Report on Cornwall, &c.*, by Sir H. T. De la Beche, p. 344, &c.)

We have already said that faults, and therefore mineral veins, are sometimes perpendicular, but more often inclined. This inclination, however, is generally a high one—more often above than below an angle of 45°. Now, any subsequent fractures and dislocations which may traverse the original faults or veins, will shift or displace their course at the surface of the ground, just as if they were similarly inclined beds. What has been said, therefore, at p. 172 as to the apparent lateral shifting of inclined beds being due to vertical elevation or depression, will also be true with regard to the intersection and shifting of veins. If, in figs. 31, 32, and 33, *aa* be a vein instead of a bed, the explanation of the positions at the surface of the various parts of it will equally hold good.

In studying the intersection of fissures or veins, however, it may happen that the apparent shifting at the surface may not be due to any dislocation of one vein by the other at all. They may both have been produced simultaneously, one or the other not having been continued exactly in the same straight line. It may happen, too, that instead of *bb'* having cut through and shifted *aa* (fig. 56), *bb'* may have been the first formed, and that when *aa* was subsequently produced, it ran along *bb'* for a certain space before it was continued into the "country" on the other side of it.

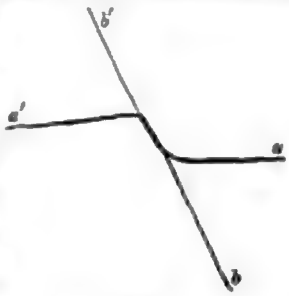


Fig. 56.

Great care, therefore, is necessary in examining the intersections of mineral veins before deciding on the relative age or on the exact nature of the dislocations that have caused or affected them. Having said so much here as to the connection of mineral veins with faults and dislocations, we shall defer their further consideration to a future place.

VII.—CLEAVAGE: ANOTHER RESULT OF THE PHYSICAL FORCES BROUGHT TO BEAR ON ROCKS SUBSEQUENT TO THEIR CONSOLIDATION.

We have now described three kinds of divisional planes traversing rock—those, namely, which we might call *congenital*, or planes of lamination and stratification; those which are necessarily *resultant* on consolidation or joint planes; and those which we may term *accidental*, such as fissures, faults, and veins. There is yet another kind to be described, which we may call *superinduced* planes of division; and these are planes of "cleavage" and "foliation."

By "cleavage," or "transverse" or "slaty cleavage," as it is sometimes called, we understand a tendency in rocks to split into very thin plates, having a certain given direction over wide areas independently of any original lamination or stratification of the rocks. It is a structure which is most especially remarkable in clay slate, but is sometimes apparent in sandstones and limestones. Where it exists it is always most perfect in the finest grained rocks, splitting them into an indefinite number of thin leaves or plates, perfectly smooth and parallel to each other. The coarser the rock, the fainter, the wider apart, and the more rough and irregular do the cleavage planes become.

This cleavage may either coincide with the original lamination of the rock, or cut across it at any angle. When it cuts across the bedding of the rock, the original lamination, or tendency to split along the planes of deposition, is generally obliterated, the laminæ being sealed up, or, as it were, welded together. This cementation of the original plates of lamination is not quite invariably the case. I have met

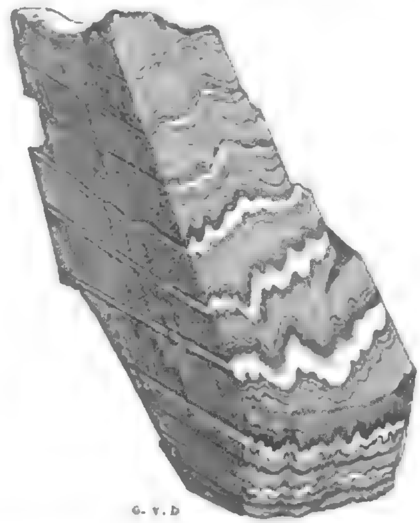


Fig. 57.

Sketch of a block of variegated slate from Devil's Glen, county Wicklow. The crumpled horizontal bands are the beds, the fine perpendicular striæ in front are the cleavage planes; the fine lines on the darkened side merely represent shadow, and must not be taken for planes of division in the rock, like those in the front, which do not pass through the white bands.

with at least one instance where the rock, an indurated shale, split as readily along the original lamination as along the cleavage planes, and was thus minced into long, needle-shaped spiculæ of slate. (*Report of Geological Survey of Newfoundland*, p. 75.)

Transverse cleavage in sandstone usually divides the rock into coarse slabs only, the upper and under surfaces of the sandstone often breaking into dog-toothed indentations. In traversing conglomerates, the cleavage planes leave the pebbles standing out in relief, and do not cut through them as joint planes do. (*Professor Sedgwick.*)

Cleaved limestone generally has the original bedding greatly obliterated and obscured; the slabs are thick and uneven, and their surfaces often coated by argillaceous films, sometimes giving to the cleavage the exact appearance of bedding. Among trap rocks, some very fine-grained felstones are occasionally effected by cleavage, and fine-grained feldspathic and hornblendic ashes are often so affected.

The direction of cleavage planes is generally constant over considerable areas, retaining the same compass bearing through whole mountain chains, or across large countries, without paying any regard to the contortions and convolutions of the rocks. One of the best examples of this steady direction in the strike of the cleavage planes is the south of Ireland, over the whole of which, from Dublin to the Mizen Head and the Dingle Promontory, the direction of the cleavage never varies 10° from E. 25° N., whatever rocks it traverses, and however different these rocks may be in lithological character and geological age.

This steady direction generally coincides with that of the main lines or axes of elevation and disturbance which traverse the district, and consequently with the "strike" of the beds.

The inclination of the cleavage planes varies from perpendicularity to within a few degrees of horizontality, but has no apparent reference to the dip or inclination of the beds.

In passing through beds of different texture, the cleavage planes often vary their angle a little, having a tendency to strike more perpendicularly across the coarser than the finer grained beds. When the inclination of the cleavage planes

and that of the original planes of lamination become nearly coincident in any locality, they sometimes appear to coincide entirely, as if the cleavage went a little out of its way, as it were, to coincide with the bedding.

The finest and largest roofing-slates seem to be those of a bluish gray or pale green colour. Where they become either very red or quite black, they are more brittle, and more readily decompose, owing probably to the presence of peroxide of iron in the one, and carbonaceous matter in the other. Bands of colour, such as faint red, green, white, or gray, may sometimes be observed on the sides of slates, often coinciding with slight changes of grain or texture. These, which are called the "stripe" of the slate by Professor Sedgwick, mark its original stratification. The bands in the block, about 18 inches in height, which is figured in fig. 57, show this stripe very well. The white bands are pale greenish, or grayish fine-grained grit—the intermediate parts being purple slate of various tints and degrees of colour. They are the original laminæ of deposition of the rock. Irregular blotches, however, of different colours, occasionally occur; and sometimes even pretty regular broad bands of colour are to be seen, which do not coincide with the bedding, but go sometimes directly across it, as proved by beds of sandstone interstratified with the slate. Care must be taken, therefore, in field observations, not to rely too implicitly on mere bands of colour in slate colours.

Professor Sedgwick was the first to systematically observe and describe the phenomena of slaty cleavage. His observations will be found in the *Transactions of the Geological Society*, vol. iii., on *The Structure of large Mineral Masses*, and also in his *Introduction to a Synopsis of the British Palæozoic Rocks*, 3d Fasciculus, p. 33. In the latter, he gives the following as the results at which he had arrived:—

"1*st*. That the strike of the cleavage planes, when they were well developed, and passed through well-defined mountain ridges, was nearly coincident with the strike of the beds.

"2*d*. That the dip of these planes (whether in quantity or direction) was not regulated by the dip of the beds, inasmuch as the cleavage planes would often remain unchanged, while they passed through beds that changed their prevailing dip, or were contorted.

"3*d*. That where the features of the country or the strike of the beds were ill-defined, the state of the cleavage became also ill-defined, so as sometimes to be inclined to the strike of the beds at a considerable angle.

"4*th*. Lastly, that in all cases where the cleavage planes were well developed among the finer slate rocks, they had produced a new arrangement of the minutest particles of the beds through which they pass.

One of the most striking effects of cleavage is the distortion it produces on fossils or other small bodies embedded in the rocks, lengthening and pulling them, as it were, in the direction of the cleavage, and contracting them in the opposite direction. Relying on these facts, which were first distinctly noticed by Professor John Phillips, Mr Sharpe attributed the production of cleavage to the action of great forces of compression squeezing the particles of rock in one direction and lengthening them in the opposite. (*Quarterly Journal Geological Society*, vol. iii., p. 87.) Mr Sharp believed that the fossils were lengthened in the direction of the dip of the cleavage, but Professor Haughton believes this to be impossible, and that the lengthening must always be in the direction of the strike of the cleavage. Mr Darwin also, from his observations in South America, formed similar ideas as to the origin of cleavage, and speaks of cleavage planes as being probably parts of great curves, of such large radius as that any portions of them that can be seen at one view appear to be straight. More recently, Mr Sorby, resting on the fact of beds of sandstone which occur in slate being contorted, and their dimensions being contracted at the sides, and expanded at the tops and bottoms of the curves, the axes of which curves coincide in direction with the cleavage planes, while the beds of slate above the sandstone are little or at all bent, shows that the particles of the slates must have been compressed at right angles to the cleavage planes, and lengthened along them, so as to allow of their being squeezed into the same contracted space as the sandstones, without much bending of the surfaces of the beds. (See *New Philosophical Journal*, 1853, vol. lv., p. 137; or *Lyell's Manuel*, 5th edition, p. 611.)

By microscopical examination, Mr Sorby found that the minute particles of clay-slate were either lengthened in the direction of the cleavage planes, or that those minute particles, which were of unequal dimensions, were so re-arranged as that their longer dimensions coincided with the planes of the cleavage.

Professor Sedgwick at one time thought that he could perceive a tendency to a symmetrical arrangement of the inclination of the planes of cleavage with respect to the axes of lines of elevation, the dip of the cleavage being inwards on each side of the mountain ranges. He afterwards, however, saw reason to abandon this conclusion. Mr Darwin speaks of the fan-like arrangements of the cleavage planes which have been described by Von Buch, Studor, and others; and Mr Sharpe says that this apparent fan-like arrangement is due to parts of two contiguous curves meeting where their adjacent sides become perpendicular. But we must refer the reader to his papers on this subject, in the third and fifth volumes of the *Journal of the Geological Society* before quoted, and in the *Philosophical Transactions* for 1852. A second cleavage plane cutting across the first at right angles, and also across the bedding, is described by Mr Sharpe in his second paper on cleavage in the *Geological Journal*, vol. v., p. 3, and was also long before observed and mentioned by Professors Sedgwick, Phillips, and others. Mr Sharpe attributes this likewise to compression.

The subject has recently been investigated by Professor Tyndal, who, in a paper in the *Philosophical Magazine*, vol. xii., distinctly refers the origin of cleavage to the same force of compression, acting at right angles to the cleavage planes, that Mr Sorby and Mr Sharpe had referred it. Professor Haughton, in a paper in the same volume, has deduced mathematically a value for the compression of the rocks, from examining the amount of distortion suffered by fossils in some particular instances in consequence of this compression.

There seems, indeed, now little doubt that mechanial compression is the true cause of cleavage; but the whole subject requires still more accurate and detailed observations than have yet been made on it. We have seen reason to suspect—in some districts of North Wales, for instance—that subsequent movements and dislocations have affected large

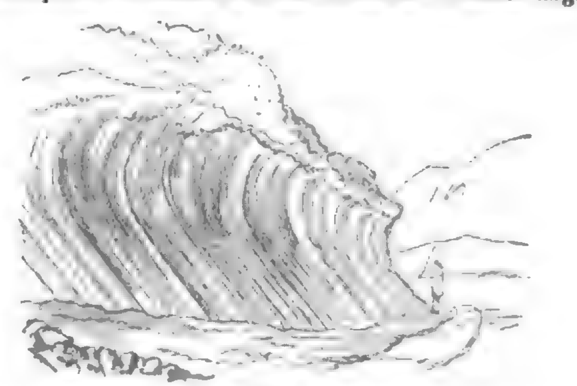


Fig. 58.
Surface-bending of cleavage planes.

cleaved districts in such a way as may have altered both the

Geology.

dip and strike of the cleavage from their original position. Only direct observation, then, will now lead us astray, unless it be corrected by a more accurate knowledge than we yet possess of the amount and direction of these dislocations, and of their relative age compared with that of the cleavage. The dip of the cleavage, especially, is very easily mistaken, unless it be observed in very clear and deep excavations. Superficial causes have frequently affected, and sometimes completely reversed it, to very considerable depths, as may be seen in fig. 58.

When these superficial bendings of slate occur on deeply inclined ground, they may perhaps be referred to the action of gravitation on substances loosened by weathering, or the "weight of the hill," as it has been called. In other cases their origin is more obscure, and we have seen one instance in North Wales, where, on the horizontal surface of an isolated boss of rock, the slates were so sharply and abruptly bent back and laid nearly flat, and partly consolidated in that position, as to give the idea of its being due to some sudden and great force, such as the grounding of an iceberg.[1]

Thoroughly to work out the subject of the "cleavage" of any district would require months of continuous and laborious observation in a country the geological structure of which had in other respects been thoroughly and accurately surveyed; and, with the exception, perhaps, of North Wales, no country has yet been surveyed with anything like an approach to such accuracy.

VIII.—FOLIATION.

The *foliation* of the *schists* appears to be equally a superinduced structure with the *cleavage* of *slates*. It is, however, quite clear that even if the cleavage of slates have a mechanical origin, the foliation of schist cannot be due to such a cause alone. Mechanical pressure may be readily supposed to communicate a certain mechanical texture, but cannot by itself cause a difference in chemical composition. Now, "foliation" is defined by Mr Darwin, to whom we owe the recent technical use of the term, first introduced by Professor Sedgwick, to mean "a separation into layers of different chemical composition;" while "cleavage" means only a "tendency to split" in a mass of the same composition.

Nevertheless, the folia of schist are in some districts arranged in certain given directions by compass over very wide areas. Mr Darwin says that the gneiss and mica schist of South America, for instance, have their layers or folia always arranged in a certain given direction, even for hundreds of miles. For 300 miles, at least, in the Chonos and Chiloe islands, it does not vary a point of the compass from N. 19° W. and S. 19° E. Over the eastern parts of Banda Oriental the foliation strikes N.N.E. and S.S.W., and over the western parts W. by N. and E. by S. In Venezuela, according to Humboldt, it is uniformly N.E. and S.W. (Darwin, *Volcanic Islands*, p. 163.)

According to Mr Sharpe (*Transactions Geological Society*), the foliation of the gneiss and mica schist strikes across Scotland in directions varying from N. 50° E. in the south of the Highlands to N. 25° E. in the north. The dip of the folia of schist resembles that of the dip of cleavage planes, in being much more uncertain in direction and quantity than that of the strike.

Some geologists have held that gneiss, mica schist, &c., were originally formed nearly as they are now, being the direct result of the erosion of granitic rocks, of which the quartz, feldspar, and mica were arranged in regular layers as we now find them, the only change having been a mere consolidation or induration. The perfect parallelism of these layers, however, over such wide areas as those before mentioned, would of itself be against this supposition, and in favour of the rearrangement of the particles of the rocks, in obedience to some wide and general force.

As to the nature of this force, Mr Darwin and Mr Sharpe, as well as Professor Sedgwick, agree in looking on foliation as the extreme term of cleavage,—"that foliation and cleavage are parts of the same process; in cleavage, there being only an incipient separation of the constituent minerals; in foliation, a much more complete separation and crystallization." If, however, this be true, we do not see how this process can be the merely mechanical one to which we have just seen reason to assign the production of cleavage.

Mr Darwin even appears to look upon many of the great divisions of foliated rocks, which are ordinarily termed beds or strata, as merely farther results of the process, different mineral substances having been segregated from each other on the large scale.

In large greatly altered districts, however, the very amount of the alteration has so completely changed the character and texture of the rocks, that it is more difficult to detect that it is a change than in other districts, where the alteration having taken place on a smaller scale, and to a less extent, its nature may be more readily grasped.

In the S.E. of Ireland, one great mass of granite has been erupted through the clay-slates of the district, forming a continuous range of granite hills from Dublin Bay to the neighbourhood of New Ross, a distance of 70 miles. Between this range and the coast, other smaller intrusive bosses of granite make their appearance at the surface through the clay-slate rocks. The clay-slates are dark-gray, blue, or black, but sometimes pale-green, or greenish-gray, with occasionally red or purple bands. They are generally of a dull earthy texture, and without lustre. Small bands of gray siliceous grit frequently occur in them.

Wherever the granite comes to the surface, a belt of slates surrounding it is converted into mica schist, with, in some few places, beds of perfect gneiss. Crystals of garnet, schorl, andalusite, staurotide, &c., make their appearance in these altered slates in greater and greater abundance as they approach the granite. The width of the metamorphosed belt is generally proportioned to the size of the granite mass which it surrounds. Round the smaller granite bosses it is sometimes not more than 50 yards wide; round the main granite mass it sometimes reaches to two miles. It matters not through what part of the slate rocks the granite rises, or which beds strike toward the granite; they are all found to be affected in the same way as they approach it.

In going towards the main granite ridge, it is found sometimes at a distance of 2 miles from the outcrop of the granite (which is, however, much nearer probably in a vertical direction), and that the slates have acquired a "glaze," as it were, or micaceous lustre, with a soapy feel. This lustre is apparent throughout the mass when the slates are broken, and even when they are ground down into sand or powder. This micaceous resemblance increases as we approach the granite, till at last distinct plates and folia of mica are to be seen, and the whole assumes the ordinary character of mica schist, occasionally passing into a kind of gneiss.

Together with the micaceous lustre on the surface of the slates, the rocks often assume the puckered and corrugated structure of mica schist. We at one time thought that this corrugated structure might be a metamorphic one, like the foliation; but on examining localities where the small bands of siliceous grit were interstratified with the slates, we found these grit bands to be equally corrugated and puckered. The structure, then, must be ascribed simply to a mechanical force compressing the rock laterally.

[1] Without intending to impeach the accuracy of any recorded observations, we yet cannot feel sure that many even of our own registered observations on cleavage in different localities may not be affected by errors of the kinds alluded to above.

In the majority of instances, too, the folia of the mica schist, whether straight or puckered, were parallel to the grit bands, and therefore to the original lamination and stratification of the rock. In these instances, the micaceous folia were largest and best developed. In other cases, the foliation ran across the bedding, coinciding apparently with the cleavage, as remarked by Professor Ramsay in a similar case in North Wales. In these instances we generally found the micaceous folia short and discontinuous, being apparently interrupted by the changes of texture or composition in the original lamination of the rock. We could, however, easily conceive that where the rock was quite homogeneous, the folia of mica schist might be almost as extensive as the planes of clay-slate.

Some of the beds of gneiss in this district are obviously beds of sandstone, originally interstratified with the shales, the rocks having all the appearance of interstratified beds of shale and sandstone at a distance, and until they are broken open and found to be perfect mica schist and gneiss. Other gneiss beds are massive and thick-bedded, and containing large crystals of feldspar (apparently orthoclase) becoming quite porphyritic and completely mineralized, but still having a foliation parallel to what is apparently the original stratification of the mass, which in one conspicuous instance (near Graiguenamanagh), is nearly horizontal.

We do not think that the person most sceptical as to the fact of the metamorphic origin of mica schist and gneiss could examine the rocks bordering the southern end of the granite range in Carlow, Kilkenny, and Wexford, without becoming a complete convert to the theory. For ourselves, we can no longer feel the slightest hesitation in accepting the metamorphic origin of all those which have been described under that head in Lithology.

IX.—DENUDATION: A CONSEQUENCE OF THE ELEVATION OF ROCK.

In a previous section we have spoken of the erosive action of moving water upon aqueous rocks while in course of formation; and in treating of the formation of mechanically-formed aqueous rocks, we have tacitly assumed the fact of great disintegration and erosion of previously existing rock, in order to afford the materials of which these mechanically-formed rocks were composed. We have now also considered the general effects of disturbing forces in elevating aqueous rocks from the bottom of the sea into dry land, so far as regards the new positions into which these rocks have been thrown, and the divisional planes and dislocations which have been produced in them. It yet remains to study some other of the less immediate results of these elevating forces.

In examining the outcrop of a set of beds along the surface of the ground, either in "the field" or by aid of geological maps and sections, we must be often struck with the fact that the present terminations of the beds are not their former or original terminations. Beds rise successively to the surface, and end there abruptly, that were once obviously continued beyond or above the present surface of the ground. In fig. 20 the beds on the beach and those in the cliff are the same. It is clear that they have been cut down on the beach to their present level, and that before they were so cut down they rose upwards to the same height as those in the cliff. In the same way, those in the cliff itself, and which stretch from it into the land, formerly extended upwards to a greater height than they now do. Now in many instances we can tell how far they formerly extended upwards. In figs. 24 and 25, the anticlinal and synclinal curves into which the beds are thrown enable us to estimate the amount of this cutting down or denudation for the beds there drawn. In fig. 24 we see that beds 2, 3, 4, bend continuously over No. 1; and we should naturally conclude that beds 5, 6, 7, 8, &c., once equally extended continuously over the anticlinal A. If we doubted the fact, we should be convinced of it when we traced them in the map (fig. 25), and found them gradually meeting and continuous over the anticlinal farther towards the north.

Similarly in the synclinal curve B, though we might suppose by the section that No. 13 was the highest bed, we should find that towards the north it was overlaid by beds 14, 15, &c.; and we should be compelled to conclude that the latter had once been continuous over the whole. The dotted lines in fig. 24 would, if completely carried out, and bed 13 were represented as arching continuously over A, give us the measure of the amount of solid rock removed by denudation from above the present surface of the ground EF, so far as the beds there drawn are concerned.

It makes no material difference in this reasoning whether we suppose the spaces 1, 2, 3, &c., to represent single small beds of a foot or two in thickness, or groups of such beds, and suppose the whole series, 1 to 15, to represent a vertical thickness of many hundreds or many thousands of feet.

Neither would it make any difference in our reasoning, so far as the amount of denudation is concerned, if we were to modify our conclusions by supposing, in all those cases in which great thicknesses are concerned, that the whole mass of beds were never continuous over the anticlinal curves *after* the total amount of elevation had been reached. We may suppose that soon after the elevation commenced, and simultaneously with the first arching of the beds, the denuding forces began to act, that they took advantage of the very first cracks that were formed to commence the erosive process, and that long before the bed No. 1 attained its present position on the axis of the curve, more or less of the higher beds 7, 8, or 12, 13, &c., had been removed, and a surface given to the rocks more or less approximating to the surface they at present possess.

Another very clear case in which we can estimate the amount of denudation is that of an "outlier," as it is called. It often happens that a number of beds, rising at a slight angle from beneath the surface, end in a steep slope or "escarpment," as at A in fig. 59. In front of this escarpment there often rises an isolated hill as B. In descending the escarpment, we pass over the edges of the beds 11, 10, 9, 8, &c., in regular succession, and find 4 coming out from beneath them, and stretching continuously across the intermediate flat or valley, and forming the base of the hill B; and on ascending the side of B, we find the very same beds 5, 6, 7, 8, resting on each other in the same order as we saw them in the escarpment A, and at the same angle of inclination, so that the conclusion becomes irresistible that they were once continuous across the intervening space C. This space, then, is due to the erosive action which has removed the upper beds, and denuded or laid bare the lower bed No. 4, across the valley C, and for an indefinite distance on the other side of the hill B. We should feel quite certain that not only the beds 1, 2, 3, 4, but also 5, 6, 7, &c., had stretched across this space formerly, and had also extended beyond the hill B for some indefinite distance in the direction of D. This latter conclusion we should in many cases find confirmed by the occurrence, at a distance perhaps of many miles beyond B, in the direction of D, a locality where the beds dipping in an opposite direction from that

Fig. 59.
Escarpment and outlying hill.

in fig. 59, these very same beds (1 to 8 of fig. 59) are brought in again in the very same order and with exactly the same character as before (fig. 60). In some cases, such a little isolated basin forms the only remaining patch of

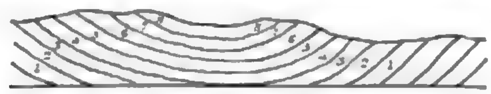


Fig. 60.
Outlying basin.

the beds left in this new district, by having been dipped down below the level of the surface formed by the denuding agent, and remaining as a monument of their former extension over the wide intervening space between this new locality and that of the escarpment and outlier before mentioned.[1]

Geological maps of large countries often enable us to prove by such reasoning as this the former extension of a great mass of beds over very wide areas, and consequently the very large amount of denudation that has taken place. In many instances we can show the geological date of this denudation; that is, we can prove it to have taken place before the time when such and such beds were deposited, the age of which is known, and which we find lying across the edges of the denuded beds. This leads us to the next subject of unconformability. We must, however, always guard ourselves against attributing to the last period of denudation that occurred, with respect to any set of beds, effects, a large part of which perhaps took place at previous periods. Almost all lands have risen from the bed of the sea, not once only, but many times, having passed through many periods of alternate elevation and depression, suffering denudation at each passage through the upper surface of the sea, and during each period of existence as dry land. It appears probable, from the observations of Mr Darwin and others, as also from the very nature of the case, that a period of slow and gradual elevation is the one most favourable to the action of the destruction of pre-existing rock, or to denudation, while a period of depression is that most favourable to the deposition and formation of new rocks on the surface of the old. Many districts, however, might be depressed without being covered by the deposition of new rock, or by so thin a skirt of it, that it might be easily stripped off during a subsequent elevation; and in every new period of elevation the erosive forces would most probably act again upon their old lines, deepening former hollows, and thus intensifying the previous features of the old lands on their re-emergence from the sea.

X.—UNCONFORMABILITY: THE RESULT USUALLY OF ELEVATION, DENUDATION, AND SUBSEQUENT DEPRESSION.

When one set of beds have been elevated and denuded, and another set of beds are deposited on this denuded sur-

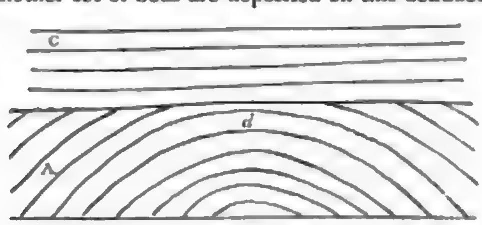


Fig. 61.
Unconformable beds.

face, the two sets are said to be *unconformable* to each other. In fig. 61 the arched and denuded set of beds A are covered by the unconformable set of beds C. Whenever two sets of beds lie at different angles of inclination, they are *apparently or obviously unconformable*. In fig. 61 this discordance of inclination is seen strikingly at either end of the figure, but if we confined our attention to the central part *d*, we should not perceive any unconformability.

Beds, then, may repose apparently at the same angles over considerable spaces, and yet be unconformable in reality. In fig. 62, again, two sets of beds, A and C, are

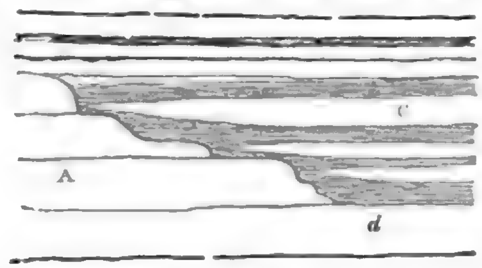


Fig. 62.
Unconformability in horizontal beds, in consequence of denudation of lower group.

shown, which are both horizontal, A ending in a broken cliff, with C abutting directly against it in that part, although it rests in apparent conformity on A at the point *d*.

The essential point in unconformability is, that the upper group of beds shall rest upon different parts of the lower group at different places, and this could not happen without previous elevation and consequent denudation having affected the lower group. It proves, then, the lapse of a considerable interval between the deposition of the two sets of beds.

Now, although this interval may have been occupied by the process of destruction going on in one locality, there is no reason why production may not have been taking place at the same time in another locality. Whenever, then, we find two sets of beds unconformable to each other, we must suppose that there is a set of beds wanting there which may elsewhere be found, and that where they are found there will be probably no unconformability. If fig. 63 re-

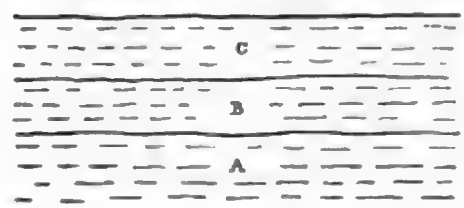


Fig. 63.
Three conformable sets of beds, A, B, C.

present the state of things at one locality, where the three sets of beds ABC were deposited in regular continuous succession, figs. 62 or 61 may represent the other localities, where the interval here occupied by the deposition of B was there employed by the forces of elevation and denudation in the destruction of a previously existing part of A. It is even quite possible that the materials which were used in the locality represented in fig. 63 in the composition of B, were partly derived from this destruction and breaking up of a portion of A in one of the other localities, and that we may accordingly find in B pebbles or angular fragments of A.

XI.—OVERLAP: THE RESULT OF DEPRESSION, WITH OR WITHOUT PREVIOUS DENUDATION.

There is a minor degree of unconformability to which the term overlap is applied. This consists in a greater ex-

[1] For some striking details on the subject of denudation, see Professor Ramsay's paper on the Denudation of South Wales, &c., in *Memoirs of the Geological Survey of Great Britain*, vol. i.

tension of the superior set of beds than that possessed by those on which they rest, so that they overlap and conceal their edges. In fig. 64 the beds 1, 2, 3 are successively overlapped by those above them. This may in some instances have been the result of a more partial deposition in the lower beds, from the defect of material or other cause, but in other cases it has been the result of the gradual depression of the old land, and the consequent extension of the area of water in which alone deposition can take place.

Fig. 64.
Overlap.

While unconformability, therefore, proves an elevation and denudation, and an absence of continuous deposition, overlap may take place in a perfectly continuous series, merely proving the fact of a depression of the area contemporaneously with that deposition.

Chap. VII.—PETROLOGY OF THE IGNEOUS ROCKS.

We will now consider the general forms and modes of occurrence of the principal kinds of igneous rock, and their relations to the aqueous rocks. We have previously spoken, under the head of Lithology, of the different kinds of igneous rock, and shown that these differences partly depended on the difference of their chemical composition, and partly on the texture resulting from the physical circumstances—as pressure and rate of cooling—under which their consolidation took place. The granitic rocks, or those which are most completely crystalline and most thoroughly saturated, as it were, with silica, cooled slowly and under great pressure, that is to say, at some considerable depth in the interior of the crust of the globe.

The volcanic rocks, on the other hand, were consolidated at the surface, while the intermediate and variable class which we have called trappean may have been solidified under various and intermediate conditions.

I.—FUNDAMENTAL GRANITE.

As a matter of fact, it has been found that in all parts of the globe, wherever the base of the aqueous rocks has been brought up to the surface and exposed to view, that base rests upon granitic rocks. By the "base of the aqueous rocks" is meant the lowest aqueous or sedimentary rocks known in the particular locality, *whatever may be their age*, whether they be some of the oldest known rocks, or whether they be of a much later date than those, and whether they retain their original characters unaltered, or have been metamorphosed into mica-schist, gneiss, or any similar rock.

It is by no means intended to assert that the converse of this is true, and that wherever granite is found at the surface, there the lowest of all known rocks, or even the lowest rocks of that particular locality, will be found reposing on it. On the contrary, we shall show presently that granite frequently comes *through* great masses of rock, without bringing them up along with it. But at every place where any rock does make its appearance at the surface *from underneath the lowest* of the *stratified* rocks known in that locality, that rock is a granitic one, and wherever any large mass of granite comes to the surface, we have no reason to believe that any other rock but granite would be found underneath it. We do not here speak of any veins, or intrusive dykes or sheets of granite, but of large, widely extended masses. In short, we have every reason to believe that if we pierced vertically downwards into the earth at any part of its surface whatever, we should eventually come either to granite or to yet molten and unconsolidated rock, which on cooling would form granite. Again, in many parts of the world granite is found occupying large areas of the surface; and we have no reason to suppose that any other rock but granite would be found under those surfaces, although, if we sank deep enough, we might perhaps come eventually to red-hot granite, and ultimately to yet molten granite. These facts and these opinions have naturally led many early geologists to the conclusion that the earth was once a molten globe of fiery matter, and that on cooling there was formed about it a primæval crust of granite; and they hence inferred that much of the granite now to be found at or near the surface was actually part of this primeval crust. At one time, indeed, it was held that all granite had this primæval character; but this notion has long been exploded, since *intrusive*, and therefore subsequently consolidated masses of granite, have been found penetrating rocks of almost all ages in different parts of the earth.

Now the hypothesis of the earth having once been a molten globe of fiery matter is one for which more or less good argument may perhaps be brought forward; but it is one with which the geologist has properly little or nothing to do. The geologist may grant the probability or possibility of this molten globe having existed, of its having cooled down till a granitic[1] crust was formed about it, of the temperature having been gradually lowered till the existence of water and air become possible upon it, and yet maintain that no part of this primæval crust is now in existence, and that none of the rocks now open to our observation can date back their formation to this quasi-fabulous and mythical age of the earth, this pre-historic or pre-geological period of its duration.

Whatever may have been the nature of the primæval crust of the globe, that crust had been more or less completely destroyed and remodelled by the erosive action of water, and the remelting action of heat, before the commencement of even the earliest of our geological periods. The very lowest of the unaltered stratified rocks of which the age is known, namely, the Cambrian of North Wales and Ireland, are made up of indurated clays, sands, and gravels, which were derived from the waste of previously existing stratified rocks, exactly like themselves. (*Professor Ramsay.*) The crust of the earth, then, was, before that earliest of our periods, made up of stratified and unstratified aqueous and igneous rocks, as it is now made up of them. Just so much of these earlier rocks are preserved to us as have not been since destroyed by the action either of fire or of water. Over very large areas, very early rocks, having been attacked from above, have been eroded and destroyed by the action of water; and the old base on which they rested has been denuded, and is either now exposed at the surface, or has been re-covered by other rocks subsequently deposited upon it. Over very large areas, very early rocks having been attacked from below, have been so baked, so altered and metamorphosed by the action of heat, and by the many physical and chemical forces which heat has set in motion, as to have been altogether transformed from their original state, and many of both aqueous and igneous origin actually remelted down perhaps, and reabsorbed into the molten masses of the interior, in which they either still remain as molten rock, or from which they

[1] If we were inclined to speculate on such a state of things as the first cooling of the crust of a molten globe, in which the expansive power of heat must hav been acting intensely even at the surface, we might perhaps reasonably doubt the possibility of so dense a rock as granite being formed upon that surface. Porous trachyte, pumice, and obsidian, would occur to us as more probable productions than granite.

Geology.

may have been subsequently reconsolidated as newer igneous rock. Some ancient rocks have been in other areas spared by both these processes; but as these processes are continually going on, and continually shifting their areas of action, it is clear that, in proportion to their antiquity, all rocks must have been more or less affected by them, and that we can reason back to a period in the earth's history, the coeval rocks of which have only one or two undestroyed or unaltered areas still left upon the globe; and going one or two steps still farther back, we arrive at a period of which *none* of the coeval rocks can remain in their original recognisable state.

Dismissing, then, all speculations as to the primæval crust of the globe, and the primitive character of granite, let us come to what we know to be true.

II.—INTERNAL HEAT OF GLOBE.

That the earth has a great internal heat, is rendered almost certain by the following facts:—

1. The specific gravity of the globe is, according to the old observations, about 5·0, or according to the recent experiments of the Astronomer-Royal, Mr Airey, about 6·7. Now, the specific gravity of granite varies from 2·6 to 2·9; that of basalt is about 3·0; that of rock in general is from 2·5 to 3·0. The earth, therefore, is more than twice as heavy as it would be if made of any known rock, such as that rock appears at the surface. The pressure of gravity, however, would render any such rock, as granite, for instance, much more than twice as dense as it is at the surface long before it reached the centre.[1] We should expect, then, that the globe would have a much greater specific gravity than 5 or 6, if it were not for some expansive force in its interior counteracting the pressure resulting from gravitation. We know of no such force except that of heat.

2. As a matter of direct observation, it is found that in all deep mines the temperature of the rock increases as we descend, at the rate of 1° of Fahrenheit for every 50 or 60 feet of descent after the first 100. This is the case in every part of the globe, and in all kinds of rock.

Deep springs also, and wells, such as the deep Artesian well of Grenelle, at Paris, are always found to have a high temperature. At Grenelle, the water brought from a depth of 1798 feet has a constant temperature of 81°·7 of Fahrenheit, while the mean temperature of the air in the cellar of the Paris Observatory is only 53°. Very accurate and careful observations have lately been made by M. Walferdin on the temperature of two borings at Creuzot, within a mile of each other, commencing at a height of 1030 feet above the sea, and going down to a depth, the one of 2678 feet, the other about 1900 feet. The results, after every possible precaution had been taken to ensure correctness, gave a rise of 1° Fahrenheit for every 55 feet, down to a depth of 1800 feet, beyond which the rise of temperature was more rapid, being 1° Fahrenheit for every 44 feet of descent. (*Cosmos*, May 15, 1857.)

Hot springs are usually found to proceed from great faults or fissures which penetrate deeply into the crust of the globe.

3. As another result of direct observation, we may state that all igneous rocks proceed from below upwards, coming out of the interior of the earth; and that, as just observed, whenever we are able to see the actual base of the aqueous rocks in any district, we find them reposing upon cooled igneous rocks, generally granite, and that *cæteris paribus*, the lower the rocks, or the deeper they have formerly been buried, the more marks do they bear of having been subjected to a great heat.

We may look, then, upon the great internal heat of the globe generally as a fact pretty well established; and it appears that if the increase of heat towards the centre goes on at the same rate that it does near the surface, all water would be boiling at a depth of 9000 feet under the British Islands, and that at the comparatively small depth of 20 or 30 miles, the heat would be sufficient to fuse any of the substances we know at the surface.

There are said to be, however, certain general astronomical and physical considerations which make against the supposition of the earth's being a molten fluid mass, with only a slight external crust, and render it probable, that, however intense the temperature, the mass is still solid, either entirely or in part, to a very great depth into the interior.[1]

In this case, it appears that the molten masses which have formed, on cooling, the igneous rocks we are acquainted with, either proceed from detached lakes of fiery liquid, or were rendered fluid by some special and locally acting circumstances.

Speculations, however, on the general state of the interior mass of the globe, although interesting, have, like those on its primæval condition, little theoretical and no practical importance; and as we shall be for ever probably condemned to remain in ignorance concerning it beyond a few general facts such as those before mentioned, they need not occupy more of our attention.

III.—POSITION AND FORM OF GRANITE.

Granite generally makes its appearance at the surface in large masses, occupying considerable areas, and extending for a great but unknown depth into the interior. Veins of granite, often branching and crossing each other, sometimes proceed from these masses, penetrating the adjoining rocks; and dykes, or wall-like sheets, of granite-rock are frequently found in their neighbourhood, running sometimes for several miles in straight lines through other rocks.

Smaller bosses of granite are likewise not unfrequent in such districts, apparently the tops and eminences of larger masses that are still concealed below.

Granite generally forms high mountainous ground, and hills composed of it have commonly a heavy rounded outline and sombre aspect. Sometimes, however, granite is found as the surface rock over considerable spaces of low gently

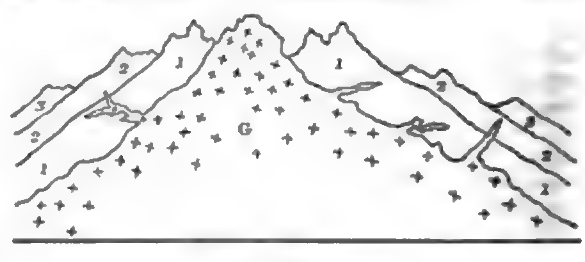


Fig. 65.
Supposed position of granite.

undulating ground, in which case the plain is commonly diversified by small rounded knobs and bosses of rock.

Granite is also found not unfrequently as the rock form-

[1] According to Leslie, water would be as heavy as mercury at a depth of 362 miles, air as heavy as water at 34 miles. At the centre of the globe, steel would be compressed into one-fourth of the dimensions it has at the surface, and most stone into one-eighth, if the law of compression be supposed to be uniform from the surface to the centre.

[1] Mr W. Hopkins gives 800 miles as the minimum thickness of the solid external crust of the globe. Professors Henessy and Haughton, however, and also, I believe, Professor Jellett, dissent from a part of the reasoning on which that conclusion is based, and think that no certain conclusion can as yet be arrived at respecting the thickness of the solid crust of the globe. (See *Papers in Phil. Trans.*, and in *Trans. of R. I. Academy*).

ing the axis of mountain chains, or the nucleus of mountain masses.

When it forms the true axis of a mountain mass, the rocks which rest upon it dip from it in every direction, and the lowest of the stratified rocks are found nearest to the granite, as in fig. 65, where G is a mass of granite forming the axis of a range, and 1, 2, 3, are the stratified rocks dipping from it in each direction, the lowest or oldest, No. 1, being next to the granite, and the highest or newest, No. 3, the furthest from it. This central and fundamental position is the one usually assigned to granite where it appears in a mountain chain. Without attempting to deny that it frequently does hold this position, we are yet rather inclined to doubt whether it has not in many cases been assigned to it as a matter of course, without adequate investigation. We are disposed to suspect that the rocks nearest the granite having been most altered, and the most altered rocks having been assumed to be the oldest or lowest, this position may often have been taken for granted instead of proved. We know, at all events, that in many cases granite, where it occurs as the constituent of a mountain range, and as the geographical axis of such a range, is not the true geological axis, inasmuch as it does not bring up with it the lowest rocks of the country, and has not the central and fundamental position, nor has it exercised the elevatory action assigned to it in fig. 65.

The granitic district in the S.E. of Ireland, extending from Dublin Bay to near New Ross in county Wexford, is one of the largest and most persistent masses of granite in the British islands, being 70 miles long, and from 7 to 17 miles wide. There were in this district at least two great geological formations, each consisting of slates or shales and sandstones, and each several thousand feet thick, at the time of the intrusion of this granite. These two formations are known as the Cambrian, which is the lowest or oldest, and the Lower Silurian, which rests unconformably upon the Cambrian. Now in no instance is any part of the lower or Cambrian formation found reposing on or coming against the granite at the surface, though it does come to the surface in some places within 2 or 3 miles of the granite, as shown in fig. 66.

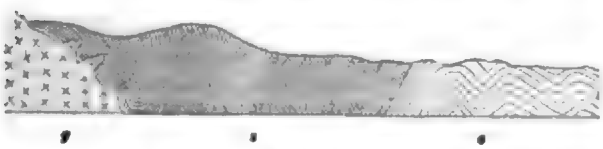


Fig. 66.

Section near Douce Mountain, county Wicklow.

g, Granite. c, Cambrian. s, Silurian.

The Silurian rocks, however, have been broken into, and lifted and altered by the granite, which has sent veins into them, as in fig. 67; and we are compelled to suppose, therefore, that the granite must have *come through* the Cambrian rock below, before it can have penetrated into the Silurian rocks which now rest upon it. Neither, although the main direction of the granite is parallel to the general strike of the rocks and principal lines of disturbance in the district, does the eruption of the granite seem to have had much effect on the general elevation of the country, but simply to have partaken of it, along with the other rocks, and to have had its direction governed by the direction of the forces of disturbance that were acting at the time of its intrusion. The Silurian slates, which are frequently vertical and greatly contorted over all the district, often appear to dip at or towards the granite, at a distance of about 2 or 3 miles from its present surface boundary, and to have been only so far affected by the proper elevatory action of the granite as to be crumpled up or dog-eared against it for a short distance close upon its flanks (see fig. 66).

If we passed from Ireland into Cornwall and Devon, similar conclusions could be drawn from the relations of the granitic masses there with rocks of a still newer date, namely, with those called Carboniferous and Devonian. The granite penetrates and alters rocks of both those periods, and is therefore newer than both. It has not, however, by its irruption brought up the lowest rock, namely, the Devonian, everywhere on its flanks. On the contrary, where it cuts into and alters the Carboniferous rocks, we are compelled to suppose that it has passed though and left behind the Devonian. Neither does the granite of Cornwall and Devon appear to have acted in any sense as a geological axis or centre of elevation, but simply to have partaken with the rocks of the district of whatever disturbances occurred during or since its intrusion; and the granitic veins appear to have been shot into the cracks and crevices of the rocks, which were opened for them by those disturbances, and not to have made any of those cracks and fissures for themselves.

In other parts of the world, as has been said before, granite is found in the same way bursting through, sending veins into, and altering rocks of still newer date, rocks of what are called the Secondary periods, and rocks of what are called the Tertiary periods; and granite must be forming now wherever molten rock of the proper chemical composition is cooling under the requisite physical conditions, that is, deeply seated under the pressure of great masses of other rock.

It is doubtless true that granite is found more frequently associated with the older rocks than with the newer; in other words, with the lower rather than the higher rocks. The reason of this, however, is clear from the very fact of the source of granite being in the interior of the earth. Granite, in order to reach the higher, must pass through whatever lower rocks there may be in the way. Many eruptions of granite may have proceeded a certain distance from the interior, penetrating only the lower rocks; but none can have reached the upper without penetrating the lower. That granite should be most frequently associated with the lowest rocks follows, too, from the very nature of granite. Molten rock that reached or came near to the surface would not, on consolidating, form granite, but some other kind of igneous rock—a felstone trap or a trachytic lava, as the case might be. There is also still another reason why granite is found principally in connection with low rocks that have formerly been deep-seated, and that is, that all granite now found at the surface must be there in consequence of vast denudation having taken place, by which great masses of other rocks have been removed, together perhaps with much of the granite that once existed above the present surface. This denudation of course exposes the lower rock to view, while the parts of the higher rocks that were perhaps equally penetrated by the granite have been swept off and removed (see fig. 67); the other parts

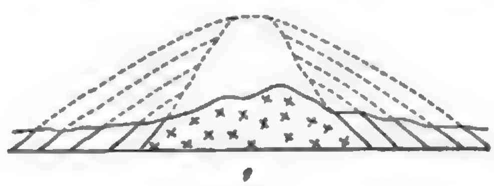


Fig. 67.

The dotted lines represent the former extension of stratified rocks, equally penetrated by g, the granite, but the penetrated parts removed by denudation.

which remain being now at a distance from the granite, and showing no signs of such penetration.

It is therefore where the lowest or oldest rocks come up to the surface that we should expect most frequently to meet with surface granite, as we find to be the case.

Geology.

IV.—AGE OF CONSOLIDATION OF GRANITES, AND OF PRODUCTION OF SURFACES OF LAND.

There is a remarkable class of results which follow from this deep-seated origin of granite, and from the necessity of great denudation having taken place before it can appear at the surface.

In the first place, it proves the fact of this denudation having occurred. Wherever we find granite forming the surface of the ground, however lofty may be the summits of the granite mountains, or however widely spread the extent of the granite plains, we may feel sure that at the time of its consolidation it was covered with a thickness of at least several thousand feet of other rock, and that this thickness has been removed by the gradual action of erosion by moving water.

2dly, We may in many cases ascertain the date of this denudation, namely, that it took place and was completed before such and such a geological period; and thus we get a geological date for the production of the present outline of the surface of the ground.

3dly, We get a date for the formation or consolidation of the granite itself, since we know that this must have occurred previously to the denudation.

In the case, for instance, of the granites of the west of England and the S.E. of Ireland, mentioned before, we are able to prove that the granite of Wicklow, &c., is older than the granite of Cornwall. We saw, indeed, that the Wicklow granite penetrated older rocks than did that of Cornwall; but, so far, there was nothing to tell us when the Wicklow granite penetrated those rocks. It might have been that the granites were produced at the same time, that of Wicklow only reaching so far as the Silurian rocks, while that of Cornwall burst through into the rock above, namely, the Devonian and Carboniferous.

If, however, we follow the Wicklow granite into the adjacent counties of Carlow and Kilkenny, we should find that rocks of nearly the same age as those of Devon and Cornwall, namely, those called Old red sandstone and Carboniferous limestone, reposed directly upon the granite in such a way as to show that not only had the granite been cooled and consolidated, but that it had been denuded and brought to the surface in that locality before the Old red sandstone had commenced to be deposited.

For a space of about 25 miles, the Old red sandstone first, and then the Carboniferous limestone, overlap the Silurian, and come across it on to the granite. They are quite unaltered by the granite. The granite sends no veins into them, and moreover the lower rock, namely, the Old red sandstone, is more or less made up of sand derived from the materials of the granite, as in fig. 68, when the sandstone

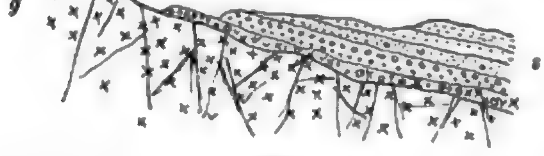


Fig. 68.

Sandstone *s* resting upon granite *g*, and made out of the sand derived from it.

s is partly, or entirely made up of the debris of the granite *g*. It is clear, then, that the *bare* granite formed the bottom of the sea in which those rocks were deposited; in other words, that all the vast mass of Silurian rock which had covered the granite at the time of its consolidation had been removed by denudation before the period in which the lowest of those newer rocks came into existence.

But the granite of Cornwall and Devon penetrates rocks which were deposited at the same time, or nearly so, with the Old red sandstone and Carboniferous limestone of Carlow and Kilkenny, and is therefore newer than those rocks, and consequently much newer than the Wicklow granite. But we may draw this yet further conclusion. The surface upon which the Old red sandstone of Kilkenny reposes is of course older than that rock; but that surface is continuous, with only slight modifications, over all the adjacent granitic and Silurian district of Wexford and Wicklow. The conditions as to denudation and form, &c., of the surface covered by the Old red sandstone and Carboniferous rocks, are obviously, by inspection of the map, nearly the very same conditions as those of the adjoining surface, which is uncovered by those rocks. Moreover, there is reason to believe that those rocks did once extend over much more of that surface than they do now, because detached patches of them are found here and there resting upon it. Therefore it follows that the main outlines, and all the principal features of the surface of the ground which now forms the counties of Wexford and Wicklow, and parts of the adjacent counties, are older than the period of the Old red sandstone. The principal part of the denudation by which that surface was formed took place before the period of the Old red sandstone, and any subsequent action, either atmospheric, when it was dry land, or marine, when it may have been passing through the surface of the sea, has been principally efficacious in removing rocks subsequently deposited upon it, or in modifying features, the outlines of which were graven at that ancient date.[1]

These views on the nature and origin of granite are not exactly those which the student will find expressed in most geological works, though they are implied in the recent writings of many geologists. They are based upon what may now fairly be called the Lyellian philosophy of geology, a philosophy daily becoming more prevalent as its truth becomes more apparent and its applications more extended. The student, however, must expect still to meet with difficulties arising from the use of the old nomenclature, which is apt to still adhere to our tongues after the corresponding ideas have passed away from our thoughts.

V.—GRANITE VEINS.

Granite veins often differ sensibly in lithological character from the parent mass which they proceed from; and sometimes the external margin of the granite differs also from its deeper and more central portions. Veins very frequently become more fine-grained, and they lose commonly the mica and sometimes more or less of the quartz which the mass contains, becoming less crystalline and

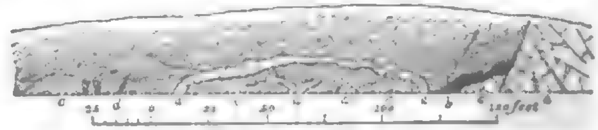


Fig. 69.

Railway cutting at Killiney (Dublin), showing junction of granite and slate with granite veins.

a, Granite.
b, Black slate unaltered.
c, Gray slate converted into mica-schist.

more earthy. Sometimes they take up into their constitution additional materials, derived from the rock which they penetrate and traverse (fig. 69). A striking instance of this latter occurrence is described by Professor Haughton in his paper in the *Journal of the Geological Society*, London, vol. xii., p. 3, where he describes the granite of Carlingford

[1] This conclusion is one admitting of a much wider application than has yet been given to it. The present surface of the ground in most of the areas which are occupied by old rocks are surfaces of very ancient date, recent denudation having had but comparatively slight effect upon them.

mountain as sending veins into, and cutting through some beds of the carboniferous limestone, and having its feldspar changed from an orthoclase, which was the feldspar of the granitic mass, into anorthite, in consequence of the addition of the lime which it had taken up from the limestone. Anorthite is said by the continental geologists never to occur except in recent volcanic rocks, and they appear to look upon its production as a mark of age, and suppose it, therefore, to be an impossible constituent of granite. This case, however, proves that it is a mark not of age, but of place, and of peculiarity of condition, and that a molten mass proceeding from actual granite may, in different parts of its course, contain different minerals, and become changed into different rocks according to the circumstances in which it is placed.

Other veins are to be found in granite itself, different in character from the surrounding rock, such as veins of eurite (see *ante*, p. 79), traversing coarsely crystalline and highly micaceous granite. Such veins may sometimes be due to subsequent intrusion of molten matter into the cracks of the granite; and when they do not consist of granitic rock, but of traps, such as greenstone and basalt, they undoubtedly are so due. In many instances, however, we believe them to be contemporaneous veins, either segregated from the mass while it was quite fluid, or perhaps more frequently, on the first commencement of consolidation, portions of the still molten mass below were injected into the cracks and fissures formed on the first attempt at consolidation of its upper portion. This we believe to be the generally true explanation of veins of eurite or other granitic matter differing from the mass of the granite. Such veins are commonly found to be confined entirely to the granite, and not to penetrate into the surrounding rocks, even when the granite itself does send off many veins into those rocks. In other cases, however, veins of "eurite," or of granite differing in texture from the surrounding granite, are seen to pass from the granite into the adjacent slates. These are of course formed subsequently to the consolidation of the granite which they traverse, but still they may in many instances be not long subsequent to that consolidation, and their consolidation may have been contemporaneous with that of lower portions of the granite.

The elvans or veins of quartziferous porphyry,—that is, a granular crystalline mixture of feldspar and quartz, which are common both in Cornwall and Devon, and near the granite of the S.E. of Ireland, are probably in reality granite veins, or veins proceeding from a granitic mass. Large masses of similar rock, however, occur in Wicklow and Wexford, forming mountainous hills with all the character of granite hills, except that the rock differs somewhat in texture from granite, and contains no mica.[1] These rocks, for which we have suggested the name of elvanite, but which continental geologists might possibly call pegmattie, are probably one of the intermediate varieties between true granite and a purely feldspathic or feldspatho-siliceous trap (felstone). They should, however, still be retained among the granitic rocks. The other granitic rocks described in Part I. resemble granite in their mode of occurrence, being generally massive and underlying. Pegmatite, protogine, and syenite are indeed commonly mere local varieties of granite. Large masses of greenstone-porphyry, or felstone-porphyry, or quartziferous-porphyry (elvanite), also occur in some districts as massive, deap-seated, underlying rocks, with all the petrological character of granite. These rocks, however, are by no means universally found as underlying rocks, since all kinds of porphyry often occur in bed-like masses, either as great intrusive veins or dykes, more or less nearly horizontal, or as contemporaneous traps.

[1] Recent explorations in company with Professor Haughton, induce us to believe that this elvan-like rock is only the external skin, as it were, of true granite below.

VI.—FORM AND POSITION OF TRAP ROCKS.

The Trappean rocks may be especially characterized as being intrusive and overlying rocks when compared with the granitic class; but, inasmuch as they always proceed from below, it is obvious that every "overlying" mass of igneous rock must have a connection with some underlying mass by means of an intrusive pipe, dyke, or vein (see fig. 70). The terms "pipe" and "vein" sufficiently explain themselves. "Dyke" is a North British term for a "wall;" it is sometimes by miners applied to a mere fault, or fissure, but by geologists is always understood to mean a wall-like mass of igneous rock filling up a fissure in other rocks. A dyke may come up through any kind of previously existing rock, whether igneous or aqueous, trap dykes sometimes traversing granite, and overlying masses of trap resting on that or any other kind of rock whatever.

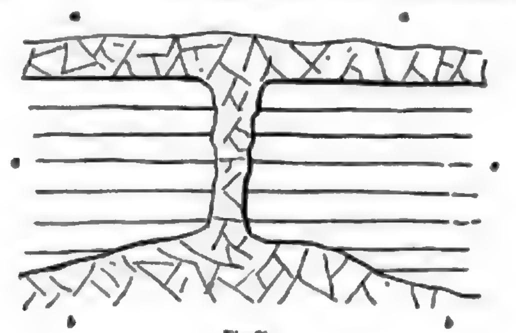


Fig. 70.

Overlying trap proceeding from underlying mass.
a, The overlying igneous rock.
b, The underlying igneous rock.
c, The previously existing rock, whether igneous or aqueous.

They may also reach and flow along all kinds of places,—the surface of the dry land, when they become volcanic rocks, and would be called lava; the bottom of the sea, when they would probably be called lava or trap, according to its depth and the circumstances of time and pressure under which they cooled; and in between the beds of aqueous rocks at different depths, or perhaps between the horizontal or other joints of previously cooled igneous rocks, whether granitic or trappean.

Those portions of trap rocks which have spread out upon the bottom of the sea, and have thus become buried between two consecutive deposits of aqueous matter, are called "contemporaneous traps."

In the old Silurian districts of the British islands great sheets of *felstone* and of *feldspathic ash* are thus interstratified with the aqueous rocks, and have since suffered with them all the accidents of flexure, contortion, and fracture that subsequent disturbing forces have brought upon those districts. Some fine-grained traps and ashes have undoubtedly been even affected by slaty cleavage and made into trappean slate, though as some of them, like the clinkstones of Mont Dor and Velay, may assume a finely laminated or slaty structure on cooling, this character requires to be very carefully observed before it is attributed to the same cause that cleaved the aqueous rocks.

Felstones, both contemporaneous and intrusive, occur also in great variety and in important masses in the Devonian and Carboniferous rocks of the S.W. of Ireland, near Killarney and near Berehaven.

Greenstones occur likewise in contemporaneous beds interstratified with both "ash" and aqueous rocks. The beds of "toadstone"[1] in the limestone of Derbyshire form one

[1] Toadstone is a local name, either given because the rock often

instance of this, and other instances occur abundantly in Ireland and other parts of the British islands.

In other cases both felstones and greenstones have been injected as great sheets, or as dykes, or as veins, into the previously existing rocks.

In the case of intrusive sheets of trap running in between beds of other rock, we may suppose that having been forced up through previously formed fissures to a certain height, the molten rock then met with such an opposition above that it was as easy for the expansive force which was impelling it to lift the beds above as to break through them. The planes of stratification then became those of least resistance; some horizontal cavities or some marked division between the beds was perhaps taken advantage of, and the molten stream, beginning to flow in, was injected with sufficient force to float the mass above upon its surface.

Sheets of greenstone thus injected have been traced by the government surveyors sometimes for miles among the Silurian rocks of North Wales. They have been found also by mining in the South Staffordshire coal-field over an area of above 20 square miles, with a thickness varying from 15 to 60 feet. (*Records of School of Mines*, vol. i., part ii., p. 244.)

VII.—DISTINCTION BETWEEN INTRUSIVE AND CONTEMPORANEOUS TRAP.

It is sometimes not very easy to distinguish between such injected sheets and beds of contemporaneous trap.

If a sheet of trap rock (whether felstone or greenstone), after running for some distance between two certain beds, cut up or down and proceed between other beds, as in fig. 71, it is obviously intrusive and not contemporaneous.

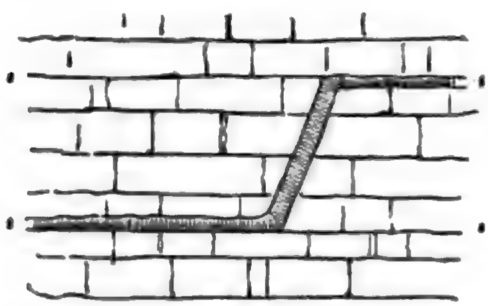


Fig. 71.

s, Stratified Rock.
t, Trap running partly between, partly across the beds.

If the beds above a sheet of trap be as much altered or "baked" by the igneous rock as those below, or if it send any veins up into the beds above it, it is equally plain that it must be an intrusive sheet.

If, however, the bed below the trap be altered, while that above it, composed of equally alterable materials, is quite unaffected, we may conclude that the trap was poured out and flowed over the surface of the lower bed, and that the upper bed was subsequently deposited upon it; in other words, that the trap is contemporaneous and not intrusive as regards the beds in that place.

This conclusion would be confirmed if the upper surface of the trap be rugged and uneven, and if the stratification and lamination of the bed above conformed to these rugosities, as suggested in fig. 72.

In the "toadstone" of Derbyshire globular masses of the upper surface are often almost completely included in the superincumbent limestone, clearly showing that the limestone was deposited at the bottom of the sea on the uneven surface of the cooled trap.

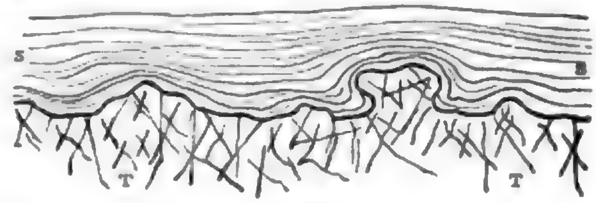


Fig. 72.

S, Stratified rock, the lamination of which conforms to the rugged surface of T, a trap, in such a way as to show that it was deposited upon it.

If, again, the bed above the trap contained any fragments clearly derived from the erosion of the trap, it would prove the trap to be a contemporaneous one. At Carrig-o-gunnel, near Limerick, a great mass of greenstone, sometime amygdaloidal, is overlaid by a still larger mass of brecciated "ash," consisting of fragments of trap and fragments of limestone, and the beds of limestone immediately above this contain rounded pebbles and small flakes of the trap, demonstrating that it was formed by an outburst in the bed of the sea in which the adjacent limestone was being deposited.

When beds of trap (whether purely feldspathic or feldspatho-hornblendic) are clearly interstratified with beds of "ash" or "tufa" of the same character, whether that ash were subaerial or submarine ash,[1] it becomes almost certain that the trap is contemporaneous; for that ash is clearly derived from some contemporaneous trap somewhere, and the chances would be greatly against a sheet of similar trap being subsequently injected into those ashes without producing in them great and obvious alteration, or cutting them with dykes and veins so as to clearly show its intrusive character.

Even should the ash show a considerable amount of alteration from its original state as a mechanical deposit, such, for instance, as the production of crystals of feldspar, it would not be conclusive evidence against its being an "ash," or against the contemporaneous age of the trap beds associated with it, since such alteration might be the result of a subsequent general action which had taken place with regard to the whole mass of the rocks, but had produced a greater effect on the "ash" than on the other rocks, because its nature made it more easily impressible, and more open and liable to change than the solid igneous or the simple and more homogeneous aqueous rocks.

It is partly, perhaps, for this reason, as well as on account of the original alternation and partial blending[2] of the results of aqueous deposition and igneous outflows and dejections, that in some highly and generally altered districts such as North Wales and the lake district in England, the south-east of Ireland, and the Border Highlands of Scotland, it is often difficult to determine the difference between actual trap and "ash" or between ash and other mechanically-formed rocks, such as some varieties of sandstone or slate. In such districts we get great irregular bosses and mountainous masses of trap of various kinds, apparently the centres or foci of eruption; we get huge continuous sheets of

resembles a toad in colour, or more probably derived from the German word "todstein" or "dead stone," because the lead veins "die out" on approaching the toadstone, and were supposed not to reappear beneath it.

[1] The student must regard the term "ash," introduced by Sir H. De la Beche, as merely an English synonym of the Italian word "tuff" or "tufa," when the latter is applied to igneous materials. The advantage of using the term "ash" is the avoidance of the ambiguity arising from "tufa" being sometimes applied to calcareous or other depositions of a soft friable character.

[2] See the "Memoirs" of Professor Sedgwick in *Proceedings of Geological Society*; also his "Letters to Wordsworth" in the *Guide to the Lakes*, and *Introduction to Palæozoic Rocks*, 3d Fasciculus; also Murchison's *Silurian System*, and the Maps and Sections of North Wales and south-east of Ireland, published by the Geological Survey.

felstone and other kinds of trap spreading over great areas interstratified with "ash," sandstone, and slate; we get still more widely-spread sheets of "ash," sometimes hardly distinguishable from trap when near the igneous foci, but becoming thinner and more obviously mechanical, more completely conglomeritic or brecciated, or more calcareous and more regularly bedded, as we proceed from these foci, and we get the whole of these rocks cut through and penetrated in different places by subsequently formed dykes, veins, and intrusive sheets of other traps (greenstones, felstones, syenites, elvanites, &c.), altering the rocks more or less entirely according either to their chemical composition or to the mass of the intrusive trap, and thus completing the complexity and confusion which the geologist has to unravel.

When such a district has been greatly upheaved and disturbed, thrown into many and complicated folds, and broken by many faults running in various directions, heaving and dislocating the rocks now one way and now another, and with ever-varying amounts, sometimes throwing them as much as three or four thousand feet from the level of the corresponding beds on the other side of the fault; when, in addition to this, such a district has been worn and eroded into all kinds of hollows, valleys, and glens, with precipitous cliffs and crags, separated by more or less inaccessible ravines; and when, yet more, the rocks are frequently disguised by partial decomposition, and concealed over wide intervening spaces by soil, by vegetation, or by superficial accumulations of gravel, clay, and sand, it will be readily understood that it is no easy or unlaborious task, though often a healthy and delightful one, to trace out all this complexity, to restore order to all this confusion, to delineate the outlines and positions of the rocks as they now are, and to reason back to their original state, and to the causes which produced them.

VIII.—RELATIONS BETWEEN FELSTONE AND GREENSTONE.

We have occasionally been struck in some of the districts just alluded to with the association of felstone and greenstone, it being rare to find any considerable mountain mass of felstone without irregular patches of crystalline greenstone disseminated about it. The irregular outline of these greenstone patches gave them the appearance of being subsequently intrusive into the felstone, but the frequent association of the two has sometimes led us to speculate on the possibility of the two rocks having been part of the same molten mass, and having settled or segregated apart from each other on the cooling of the whole. There seems no very cogent reason why we should necessarily suppose the whole molten mass to have been completely homogeneous; but granting that it was so, is it not possible that, when a deep-seated mass of trap commences to cool, a separation may take place, and one more fusible portion of it may be segregated from the rest, and thus one or more local centres might be established, into which the greater portion of the more fusible bases (silicates of lime and iron) should be concentrated? These local patches, which, on the ultimate complete refrigeration of the whole, would form greenstone, while the rest of the mass was felstone or elvanite (quartziferous porphyry) as the case may be, *might* retain their fluidity for a time, till, on the consolidation and consequent contraction of the other mass, they were squeezed in various directions into the cracks and fissures that would then be caused, and then cool rapidly in consequence of their greater extent of surface.

IX.—TRAP DYKES AND VEINS.

There do occur, however, quite a sufficient number of independent intrusive masses of greenstone, inclosed entirely in slate or other rock, to render these speculations unnecessary in many instances.

As a good instance of an intrusive vein of igneous rock we give the following (fig 73), taken from *Rec. Sch., Mines*, vol. i., part, 2, p. 242, as having been drawn carefully to scale.

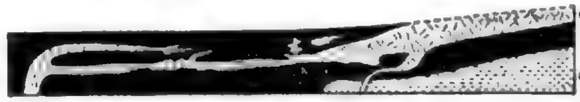


Fig. 73.
a, "White rock" trap. b, Altered coal. c, Sandstone.

The igneous rock here is a white trap springing out of the greenstone ("green rock") of the neighbourhood. Its chemical composition, as determined by Mr Henry, is—

Silica	38·830
Alumina	13·250
Lime	3·925
Magnesia	4·180
Soda	0·971
Potash	0·422
Protoxide of iron	13·830
Peroxide of iron	4·335
Carbonic acid	9·330
Water	11·010
	100·073

showing a great amount of variation from any ordinary greenstone, in the presence of so large a quantiy of carbonic acid. This alteration is probably the result of its having come in contact with a coal, and having been consequently affected by the subsequent percolation of carbonic acid, which has converted the silicates of lime and iron into carbonates. The alteration of the coal, in consequence of the heat of the trap, is equally great, as it has in many places lost its bright lustre, and its regular "face" has parted with much of its bituminous or inflammable character, and more nearly resembles anthracite than bituminous coal, though different from both, being often full of concretions of iron pyrites, or of carbonate of lime, or other minerals. In the language of the colliers, the coal is said to be "blacked," and to be now "brazil," or "brassil," and consequently not worth the trouble of "getting."

A wonderful example of a trap dyke is the one so well known in the north of England as the Cockfield Fell dyke, a nearly vertical wall of trap, 18 or 20 yards thick, which runs in a nearly straight line from north-west to south-east, for a distance of about 70 miles, cutting through all the rocks from the coal measures into the lower oolites, and baking the lias and every other rock it meets with for a distance of some yards from its sides. Its effect on one of the coal beds under Cockfield Fell, is well described by Mr Witham in the *Transactions of the Natural History Society of Newcastle*, vol. ii., p. 343. The coal, I believe, is originally about 6 or 8 feet thick, one of the principal bituminous coals of the district. In approaching the dyke, it begins to be affected at a distance of 50 yards from it; it first loses the calcareous spar which lines the joints and faces of the coal, and begins to look dull, grows tender and short, and also loses its quality for burning. As it comes nearer it assumes the appearance of half-burnt cinder, and approaching still nearer the dyke, it grows less and less in thickness, becoming a pretty hard cinder only 2 feet 6 inches in thickness. Eight yards further it is converted into real cinder, and more immediately in contact with the dyke, it becomes by degrees a black substance, called by the miners "dawk," or "swad," resembling soot caked together, the seam being reduced to 9 inches in thickness. There is also a large portion of pyrites lodged in the roof of that part of the seam which has been reduced to cinder.

X.—FORM OF BASALT.

Basalt is rarely, if ever, found as an underlying rock, and not often as an intrusive sheet. It occurs commonly either as a dyke, or as an overlying mass. One of the most celebrated plateaux of basalt is that in the north-east of Ireland, covering almost the whole county of Antrim with a mass 300 or 400 feet in thickness, and 50 miles long by 30 wide, or about 1200 square miles in area. The basalt occurs in three or four sheets, in many places beautifully columnar and interstratified with beds of ash or "ochre," as it is called, associated with beds of lignite; one of the columnar beds dipping gradually into the sea on the north coast is known as the Giant's Causeway. Many dykes are perceivable in the district, cutting through different kinds of rock, altering the Lias shales into a Lydian stone, and the Chalk into a crystalline marble. The basalt of the west of Scotland is likewise beautifully columnar, as at Fingall's Cave and other places, while that of Arthur's Seat is massive, and often crystalline, showing distinct crystals of olivine, and being highly magnetic from the abundance of magnetic oxide of iron.

The ash associated with the basalt of the Calton Hill is very admirably exhibited on all sides of it.

The greenstone of Salisbury Crags has greatly altered and indurated the gritstone below it (one of the Carboniferous sandstones), which is converted into a kind of quartz rock.[1]

It is probable that all these basalts and greenstones were of submarine formation, but the lower part of many lava streams proceeding from subaerial volcanoes, or at all events from volcanoes which are now subaerial, are as regularly columnar basalt as the Giant's Causeway itself.

XI.—FORMS AND POSITIONS OF VOLCANIC ROCKS.

Lavas differ from traps partly in mineral character, such as the occurrence of augite instead of hornblende, and of labradorite or anorthite instead of orthoclase, &c., but principally in the texture and form of the rocks, rather than their composition.

True lavas have always been poured out either on the dry land or in shallow water, forming regular flows or "coulées" of molten rock. Cooled under these circumstances, the upper surface of a lava stream is generally quite porous and vesicular, from the escape of the gases pent up within. The upper portion of such a bed consists of loose blocks of cinders of all sizes, from rough masses of 2 or 3 feet in diameter, to those of as many inches. It might be likened to a mass of clinkers, slags, and cinders from a huge foundry. The far end of a lava stream has been described as a slowly-moving mass of loose porous blocks, gradually rolling and tumbling over each other with a loud rattling noise, giving evidence of the pressure of a viscid mass of cooling lava within. The upper end of a lava stream, where it issues perfectly fluid from the intense heat of the volcanic orifice, moves much more rapidly.

All rock is a bad conductor of heat, so that, when once a lava stream acquires a cooled crust, the mass within may remain glowing hot for a considerable period of time. We are told of persons walking about on the cooled surface of a lava stream while able to roast eggs or light cigars in the cracks and crevices of the crust. Caverns are sometimes formed in lava streams by the sudden escape of the molten mass below, leaving the cooled crust standing like the roof of a tunnel.

In such a mass it is obvious that, while the upper surface was light, porous, and cindery, the lower portion, cooling much more slowly, and under pressure, might be solid, compact, or crystalline. As a matter of fact, wherever old lava streams have been cut into, either naturally or artificially, and their lower portions laid open to our inspection, we find the vesicular character of the upper surface gradually disappearing below, and the rock passing quickly into a hard, compact stone, often columnar, and frequently quite crystalline.

The hornblendic or augitic lavas more readily assume the columnar form than the feldspathic lavas or trachytes, which, however, on the other hand, are often much more highly crystalline than the augitic dolerites or basalts.

The lower parts of many lava streams are not to be distinguished by any internal characters (and probably not by any differences in chemical composition) from columnar basalt.

Many old basalts, indeed, which are ordinarily considered as trappean rocks, may have had a porous cindery upper surface at the time of their formation, that surface having been subsequently washed away by denudation.

Almost all true lavas are embedded in, and surrounded by, vast piles of ashes, dust, and fragments, ejected from the volcanic orifice from which they themselves proceed, or from some neighbouring orifice. They commonly issue from a cup-like hole, or crater, either on the summit or on the flanks of a great conical pile of such loose ejectaments.

XII.—ELEVATION THEORY OF CRATERS.

Von Buch and other geologists formerly took it for granted that lava would not solidify into thick masses of compact or crystalline stone, if it had been poured out down a slope having an inclination of more than 3° or 4° to the horizon. It has been shown, however, by Sir C. Lyell and others, that this assumption was a gratuitous one.

Upon it was based the "elevation theory" of cones and craters, which supposed it necessary that all lava streams, and the associated beds of ashes, &c., should have been once nearly horizontal, and subsequently elevated into their present inclined position and qua-qua-versal dip, by an upheaving force acting on a central point. This theory is here mentioned chiefly that the student may know what the elevation-crater theory was.

It is not intended to deny the possibility of such an elevation, since a dome-shaped elevation and qua-qua-versal dip is a common occurrence among stratified rocks, and may have been given equally to igneous rocks, as in the case of Mount Jorullo, stated by Humboldt to have swollen up like a bladder to a height of 1600 feet above the surrounding ground. But we wish to guard the student against supposing it the necessary mode of formation of all volcanic cones and all crateriform hollows from which beds of lava incline downwards in all directions. All, or nearly all, volcanic cones have been formed by the frequent ejection into the air of cinders, blocks, and ashes, from one central orifice, round which they have fallen nearly equally in all directions (except perhaps that from which the wind was blowing at the time), together with the occasional outflow of a molten lava stream, which has either broken down one side of the lip of the crater, or has broken through at some lower and weaker point in the flanks of the cone.

On the flanks of a great volcanic mountain minor lateral cones and craters are frequent at the surface, and are probably much more numerous within; many former excrescences having been buried and concealed by subsequent accumulations (whether of lava streams or ashes) ejected from the central region.

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[1] Professor Ramsay informs us that Professor Edward Forbes had conceived the idea, which has lately been completely confirmed by the Geological Survey, that the igneous rocks around Edinburgh belonged to two very different periods, the one part probably Carboniferous, and the other much more recent, probably Tertiary, perhaps contemporaneous with the Miocene (?) basalts of the north of Ireland and the west of England.

XIII.—CONE WITHIN CRATER.

In great volcanic mountains it is not unfrequent to find the ruins of a former grand central cone, from the interior of which a new central cone is commencing to grow. This is the case in the Peak of Teneriffe, where the present cone rises from a corner of the space now called the Pumice Plains, that was once the interior of a much grander cone, the ruined walls of which may still be traced in a line of crags surrounding the plains.

In the volcanic mountain of the Bromo in Java,[1] which lies in the centre of a great volcanic range, from one end of which Mount Semiru rises to a height of 12,000 feet, and from the other Mount Arjuno to 11,000 feet, there is an excellent example of a similar structure. The Bromo is a flat-topped mountain, about 8000 feet high, formed by a narrow circular ridge sloping steeply down on the outside, and having a perpendicular precipice within, only broken and accessible at one or two points, and being generally 1000 feet in height. The circular space within this great wall is 4 or 5 miles in diameter, and a large part of it is a flat expanse of fine sand, called the Laut Pasir, or Sandy Sea. From near the centre of this rises a rough conical mound, 600 or 800 feet high, deeply furrowed on all sides, and having on one side a number of subordinate cones and craters, partly growing out of it, as it were. One of these had been frequently active in 1845, when we visited it, and was then belching out much smoke and steam, with a great rumbling noise proceeding from the depths of the funnel-like crater.

For further details of volcanic mountains, and an account of their distribution, we must refer the reader to Lyell's *Principles of Geology*, Daubeny *on Volcanoes*, Wilkes's *Voyage*, Scrope's *Central France*, Johnstone's *Physical Atlas*, Walterhausen's *Ætna*, &c. See also a very interesting paper by Mr Scrope in the *Geological Journal*, vol. xii., p. 4.

XIV.—DYKES AND VEINS OF LAVA.

Just as among the trap rocks we found dykes and veins frequent, seeming sometimes to be the mere extensions of the mass below into the cracks and crevices of the rocks above or around it, sometimes apparently the feeders of overlying masses, so we should find volcanic cones and the surrounding districts penetrated in every direction by dykes and veins of compact lava, serving often to bind together or to support the otherwise rather incoherent materials; and we should know, although we could not see it, that every lava stream had its central pipe or feeder in the interior of the mass from which it had proceeded. It is probable that, both in the case of traps and lavas, the size of the dykes or feeders often bears but a small proportion to the mass of the overlying rocks that proceeded from them.

It is not absolutely necessary, in the case of a volcanic cone, that the flow of lava and the central pipe or feeder should remain in connection, and cool and consolidate together; for when the lava ceased to be impelled so as to flow over the crater, the portion left in the funnel might sink down, and perhaps ultimately cool and consolidate at a considerable distance below, and might possibly make even a different kind of rock from the ejected mass.

This may sometimes occur also among trap rocks, since it is quite easy to conceive that an overlying mass or an injected bed might be deserted by its feeder on the internal impelling power being withdrawn, and the orifice by which it rose might be closed, so that two kinds of rock may be formed at different places, and possibly of rather different character, though once perhaps actually forming part of the same molten mass.

XV.—ASSOCIATION OF TRACHYTES AND DOLERITES.

In many volcanic regions there appears to be an alternation, or to have been a succession, in the different products; the lavas being at one time trachyte, and at another dolerite. It was formerly supposed that the trachyte was always the lower, or the older of the two, and that flows of trachyte were never found above flows of basalt or dolerite. We are not prepared to say how far this relation of position has been borne out or not by recent researches.

Bunsen, however, in a paper formerly cited (*Sc. Memoirs*), in speaking of the trachytic and augitic lavas of Iceland, refers their origin to two separate volcanic foci, and even speaks of a third separate volcanic focus for the intermediate lavas, though he also speaks favourably in another place of all the volcanic rocks arising from one mass.

The identity or very great similarity of the various volcanic products in all parts of the world seems to point to a common origin for them. The frequent association in all parts of the earth of the two great classes of these products, trachytic or purely feldspathic (or highly siliceous, with little alkali, lime, or iron), and those in which the feldspathic minerals are largely mingled with hornblendic or augitic (containing much alkali, lime, and iron), seems to show that their separation is not so much due to diversity of origin, as to some cause tending to segregate the one from the other, out of a generally diffused mass, in which the constituents of both may be equally mingled.

The association previously mentioned of felstone and greenstone among the traps seems to be reproduced in that of trachyte and dolerite among the lavas. In both instances the occurrence of pure or unmixed feldspathic rocks is less frequent and less universal than that of those in which the feldspar is mingled with the more basic minerals. Trachytes and feldstones seem both to be confined to certain localities, in which, however, they are very abundant, sometimes alone, and sometimes largely mingled with dolerites, basalts, or greenstones. These latter rocks, on the contrary, are not only found in association with the former, almost wherever these igneous rocks appear, but also in many other districts, in large or small quantities, unaccompanied by any other igneous rocks.

If we assume all igneous rocks to proceed either from one central molten mass of equable constitution throughout, or from separately fused portions of perfectly similar constitution, might we not suppose that the difference in the constitution of the various products which we find at the surface depended on the circumstances and conditions in which they had been placed? The portions now open to our examination had probably to pass through different thicknesses and different kinds of other rocks; they would be placed then under different conditions of temperature and pressure, which might perhaps alone cause a separation to take place in their different ingredients; they might also take up in their passage other ingredients of different character from those which they originally possessed, or larger proportions of one or other of their original ingredients. In those places, or at those times, when violent accessions of heat approached most nearly to the surface, trachytes and felstones might be poured out, while at other periods of less intensity no molten rock could reach the surface unless it were composed of more easily fusible minerals. These more readily fusible substances might be conceived either to have separated in liquid strings and veins from the consolidating rocks below, or to have been acquired by the upper portion of the mass from the rocks it met with in its passage towards the surface, the substances thus added having acted as an additional flux to matter which would

[1] See *Voyage of H. M. S. Fly*, vol. ii., p. 68.

otherwise have solidified before it could have been poured out.

Some such hypothesis as this seems less forced than one which obliges us to suppose separate deep-seated foci or reservoirs for every variety of igneous rock, those varieties frequently occurring in the same district, and alternating one with the other over the same space of ground.

If it be well founded, it will enable us to account for the gradual changes in one connected igneous mass, as also for the veins and patches of different character sometimes to be found occurring very abruptly in such masses, independently of the supposition of a subsequent intrusion of one igneous rock through the body of another. This would often relieve us of a difficulty where the veins are confined to the igneous rock and do not penetrate the adjacent aqueous rocks. We might then look upon such veins as veins of segregation, occurring probably at the time of the contraction consequent upon the mass of the rock passing from a molten to a solid state, or from a pasty to a crystalline state (see *ante*, p. 84), while yet some parts of it remained fluid.

XVI.—ORIGIN OF VOLCANIC ACTION.

It still remains an undecided question whether the heat by which rocks are molten in the interior of the earth be due to an original central heat or to mere local causes. Dr Daubeny maintains Davy's hypothesis of the probability of volcanoes arising from the heat generated by the oxidation of large masses of the metallic bases of the earths and alkalies, independently of any central heat. We have, however, already seen that there is a high degree of probability for the existence of a great internal temperature.

Professor Phillips has remarked that the fact of internal heat by no means excludes the hypothesis of the local intensity of volcanic action near the surface being due to the local chemical causes to which Dr Daubeny ascribes them. The linear arrangement, however, of the great volcanic bands of the earth's surface suggests, as Humboldt says, the idea of their being arranged over great cracks in the crust of it, by which the molten matter of the interior escapes to the surface. The existence of these cracks, on the other hand, may be equally efficient, as allowing the access of water to the elementary or simple substances of the interior, and their consequent oxidization and combustion.

Even granting the central heat and fluidity of the earth to be a fact, there still seems to be a difficulty in supposing our lava streams to have any direct connection with this central fluid portion. If they had, they would apparently be kept constantly molten, and constantly at the same height in all volcanoes, unless, indeed, we suppose the attraction of gravitation not to be universally perpendicular to the earth's mean surface.

XVII.—THE CONTENTS OF MINERAL VEINS.

Having described the veins of igneous rock, and the cracks, fissures, and faults which affect all rocks in different places, we are now in a position to re-examine the subject of mineral veins, with a view especially to their contents.

In veins or dykes of igneous rock, we have seen that they are either *veins of segregation* with or without fissures, or *veins of injection*, liquid matter having been forced into fissures, either previously existing or formed at the time of injection. There is commonly in such veins no farther dislocation of the adjacent rocks than will allow of the intrusion of the igneous matter.

We have also seen that in "faults" the fissure will probably be closed in soft and easily compressible rocks, while in hard ones it will often stand open, either wholly or in part, the walls or sides of the fissure being kept asunder by the knobs and protuberences which result from the irregularities of its form.

It is of course quite possible that molten matter may gain access to such a fissure, and fill it up with a dyke or vein of igneous rock. If, however, it be not so filled up, it will be ultimately more or less completely filled with other kinds of mineral matter, and in a different way.

Blocks and fragments of the adjacent rocks may fall into such a fissure, and such blocks are often found in mineral veins. If it have anywhere any open communication with the surface, different matters may be swept into it by floods or springs. Branches of trees, gravel, sand, and clay, and other surface matters, have accordingly been found in mineral veins.

Besides these matters, however, thus introduced by mechanical causes, many minerals have been chemically deposited in fissures, and it is to these chemically-deposited substances that we look as the true contents of a *mineral vein*.

The number of minerals found in such veins is far greater than that of the minerals forming the principal constituents of rocks. Silica or quartz, however, among the earthy minerals, maintains an equally abundant presence in veins as in rocks. In addition to the earthy minerals, however, such as quartz, fluor spar, baryta, calcite, strontia, &c., mineral veins are the principal repositories of the metallic minerals, the ores of copper, lead, tin, zinc, mercury, antimony, silver, gold, platina, &c. &c.

It is to these metallic minerals that the miner of course chiefly looks, and he generally speaks of the earthy minerals as the gangue, matrix, or vein stuff of the "vein" or "lode."

The mineral contents of a vein is sometimes confusedly dispersed through it, the "vein stuff" being either crystalline or amorphous, and the ore occurring either as disseminated crystals or nests, or as "strings" or ribs." Sometimes there appears a regular arrangement of the various substances, the "cheeks" or "walls" of the "lode" being lined with a layer of crystals of one kind of substance, with their points or apices directed inwards, each of these layers being covered by a crystalline layer of another substance impressed by the crystals of the first, and therefore evidently deposited upon it, and after two or three such alternations a rib of ore is found in the centre.

In other instances the vein will be filled with only one kind of substance, sometimes the "vein stuff," sometimes the ore.

Such structures as that in fig. 74 seem necessarily to

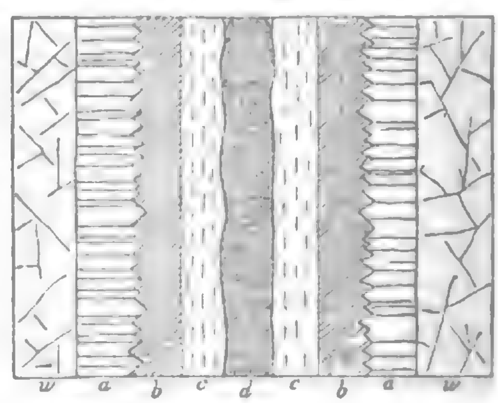

Fig. 74.

a. Coating of one mineral, say quartz.
b. Coating of a second mineral say fluor spar.
c. Coating of first mineral, or of a third, say sulphate of baryta.
d. Rib of ore, as copper or lead.
w, w. Walls of the lode.

involve the idea of successive depositions of the different

 coatings or linings of the vein, the central rib of ore being the last or newest.

Assuming, however, the vein to have been filled with a liquid solution of these minerals, it is not absolutely necessary to suppose them to have been successively introduced, since all the substances may have been in solution together, and circumstances having been favourable at one time to the deposition of one substance and to that of another at another time.

In some veins it appears that after being filled up, subsequent movements have taken place, causing fresh openings, and new deposits of crystals formed in these openings. These subsequent movements have often produced shining striated surfaces, the effect of enormous friction, which are known as "slickensides;" but these are not confined to veins, since they are found in "faults," and in broken or contorted and fractured rocks of all kinds, where a grinding motion has been communicated to different parts of the rock.

Where "lodes" and "cross courses" occur together in a district, their contents are often different, one kind of minerals being found in one and another in the other. Where the date of the "cross course" is newer than that of the "lode," which is often the case, it is easy to understand the difference in their contents. When, however, the two veins are contemporaneous, as sometimes happens, it is not so easy.

Sometimes the cross courses contain no ores themselves, but the parts of the right lodes near the cross courses are found to be more than usually rich. By "right lodes" are meant those mineral veins which run parallel to each other with a certain magnetic bearing over a given district of country, and by "cross courses" those which cross these more or less nearly at right angles. Both in the north and west of England the "right lodes" run nearly east and west, the "cross courses" nearly north and south.

Of the various hypotheses proposed to account for the origin of the contents of mineral veins, none perhaps are altogether satisfactory. Mr Were Fox called attention to the fact of currents of electricity traversing veins; and there appears no difficulty in supposing that if veins are filled with water more or less acidulated and impregnated with mineral solutions, a great natural "electro-plating" process may be set up, by which different minerals may be deposited at different times or in different parts of the walls of the lodes. Where the minerals, however, and especially the metallic ores, are derived from, is another question, whether directly from original repositories below, or indirectly by segregation in minute particles from the adjacent rocks. That the fissure should remain open for a great and indefinite period of time, and that its sides should be hard rock, seem the two essential conditions, though perhaps the latter may only be necessary to ensure the former.

The mineral contents of veins seem to be by no means permanent, even when complete, since crystals of minerals are often found that have not their true form, but the form of some other mineral; the originally deposited crystal having decomposed and been removed, and the newer one deposited in its place. Vast periods of time must have elapsed for such processes to have taken place.

If the mineral contents of veins have not been deposited from aqueous solutions either filling the veins or trickling down their sides, the only other alternative appears to be to suppose them the result of sublimation. This supposition seems to have lately lost the favour with which it was once received, it having been objected to it, that the temperature of the walls of the vein must necessarily be too low for sublimation to take place, or for minerals to continue in a state of vapour in any but the lower and more deeply-seated parts of veins. To this objection, however, it might be replied that the mineral veins, now near the surface, were probably deep-seated, and covered with vast thicknesses of other rock, at the time the minerals were formed in them, and therefore their walls may have had then a very high temperature. Moreover, it may be doubted how far it is impossible for minerals to be brought into them in a state of vapour even now. With respect to lead, at all events, we recollect to have been shown a chimney a mile long, built along the side of a hill, proceeding from some lead works in the county of Northumberland, with chambers in it at intervals, and to have been told that its expense was repaid in a few years by the quantity of lead deposited in these chambers, which would otherwise have been dissipated in the state of vapour into the atmosphere. It was the noxious action of these mineral vapours on the surrounding crops which first necessitated the erection of the chimney.[1]

It appears then, that, provided it be possible for mineral vapours to be generated and gain access to fissures in rocks, it is not impossible for some of them at least to be condensed and deposited on the sides of lodes in the way in which we now find them, even close to the present surface.

This method of formation, however, would not account for the strings of ore that are often found leading from lodes into the minute cracks of the walls, frequently horizontal, and often more or less completely blending with the rock itself; nor would it account for the detached nests and concretionary lumps of ore frequently found, entirely inclosed in rock, both in the neighbourhood of mineral veins and elsewhere.

In the rounded concretionary blocks of ironstone, for instance, found in the clays of the coal measures, crystals of galena and of blende are often found together with those of iron pyrites, carbonate of lime, and others. In the Carboniferous limestone and Old red sandstone rocks of the south of Ireland and elsewhere, small cavities are found, not so large as the fist, filled up with crystalline concretions of galena and of specular iron ore.

Any explanation of the formation of the contents of mineral veins must include that also of the deposit of these detached and isolated nests of minerals, as well as the formation of quartz veins in general, and all other veins, and strings, and nests, and cavities that have been more or less completely filled by any crystallized mineral substances of whatever kind.

If we take the crystalline stalactites and stalagmites forming in caverns as the basis of our reasoning on this subject, and suppose all other cavities to have been either filled or to be in process of filling by crystalline minerals

[1] As this was a recollection of twenty years ago, we wrote to Mr Sopwith, the eminent manager of Mr Beaumont's mines, respecting it, and in answer we were informed by him that formerly "large quantities of lead were carried off in the state of vapour and deposited on the surrounding land, where vegetation was destroyed, and the health of both men and animals seriously affected. This led to various extensions of the horizontal or slightly inclined galleries in use at Mr Beaumont's mines, and the quantity of lead extracted rapidly repaid the cost of construction. The latest addition of this kind was made at Allen Mill, and it completed a length of 8789 yards (nearly five miles) of stone gallery (or chimney) from that mill alone. This gallery is eight feet high and six feet wide, and is in two divisions widely separated, one being in use during such times as the *fume* or deposit (a black oxide of lead) is taken out of the other. There are also upwards of four miles of gallery for the same purpose connected with other mills belonging to Mr Beaumont in the same district and in Durham, and further extensions are contemplated. The value of the lead thus saved from being totally dissipated and dispersed, and obtained from what might be called *chimney scrapings*, considerably exceeds ten thousand pounds sterling annually. It should be observed, however, that the mines of which these chimneys or flues are an appendage, are the largest lead mines in the world, and that the royalties or freehold rights of mining belonging to Mr Beaumont, in the county of Northumberland alone, extend over more than a hundred square miles, in addition to extensive leasehold mines in the county of Durham."

in a similar way, we shall probably not be far from the truth.

We may not be so well acquainted with the exact nature of the process by which other minerals are dissolved in one place and redeposited in another, as we are in the case of carbonate of lime; but we may feel pretty well assured that water is the principal medium through which other agents act in the one case, as carbonic acid does in the other.

The association of different minerals in different veins may possibly some day throw some light on the nature of these processes. Werner, for instance, says that galena or lead glance, copper pyrites, blende, and calamine, frequently occur together; as also cobalt, copper, nickel, and native bismuth; tin, wolfram, tungsten, molybdena, and arsenical pyrites, &c. It appears that magnetic iron (the emery of the gold diggers) generally occurs with gold. Silver also is commonly found in lead ore. Recent experiments of Dr Percy show that minute quantities of gold occur in almost all lead ores, as well as in all copper and iron pyrites.

The relation between the contents of mineral veins and the nature of the rock which they traverse is also important. The lead veins of the north of England traverse limestones, sandstones, and shales, and their contents vary according to the nature of the substances which form the walls of different parts of the "lodes." It is even said that the "lodes" vary in contents in different beds of limestone, but it does not appear that the richness of a lode is constant for any beds of limestone. When one or both walls consist of shale, the lode is always poorest, but this may be the result simply of the greater contraction of the fissure and more unstable condition of its walls when soft than when they are hard.

The supposed relation between mineral veins and the age of the rocks they traverse is probably an accidental one only. Mineral veins may be expected in all highly-indurated and greatly-fractured rocks, whatever may be their geological date. Neither does the connection between mineral veins and the occurrence of igneous rocks appear to be better founded, than on the probability that igneous rocks will be most likely to be found in the same indurated and fractured districts which we have seen to be essential for the production of mineral veins.

PART II.—PALÆONTOLOGY.

(*The treatment of this part of the subject is deferred to a separate article under that head.*)

PART III.—HISTORY OF THE FORMATION OF THE SERIES OF STRATIFIED ROCKS.

CHAPTER I.

PRELIMINARY OBSERVATIONS.

We have hitherto been dealing with general principles, examining structures which are common to all rocks, and referring the production of those structures to their several causes. We have had occasion to remark frequently on the vast lapse of time required for the formation of these rocks, and it remains now to classify and arrange the results of the operations that have been taking place during this vast lapse of time, and to give, as far as possible, a connected history of the events which have been concerned in the production of that external portion or crust of the earth which alone is open to our examination.

The way in which this order is to be discovered will, I think, be sufficiently obvious from what has been said before. In a former chapter we saw, that after having acquired a knowledge of the number and nature of a series of beds, by examining a cliff on a sea-shore, or other "section" where they were well exhibited, any little natural or artificial excavation in the interior of the country which enabled us to identify one of these beds assured us of the presence of all the rest above and below it. By searching out places where such "sections" were to be seen, and then following them by different indications across countries, and joining them on one to another, verifying them now and again by the discovery of other sections where they were again to be seen in more or less detail, and performing the same process for the sets of beds that successively cover them, we eventually survey great tracts of country, and arrive at a knowledge of the order and succession of subterranean groups of rock, to a much greater depth under certain localities than it would be possible to reach to by any process of mining or direct excavation.

The history of the formation of the whole crust of the globe, then, is to be learned by piecing together our knowledge of different parts of it, as they rise to the surface one from under the other, over different tracts of ground.

We might give this history in either of two ways, namely, by investigating or *tracing* it backwards from the present to the past, or by *narrating* it as nearly as possible in the order in which it occurred. We prefer the last method as the shorter and more intelligible, since it is hoped that the previous parts of this article will have sufficiently prepared the student to understand it.

As, however, to narrate this history in full, even so far as it is already known, would require a library rather than a book, what will be here given must be taken as a mere abstract,—a chronological table rather than a history,—by means of which the student will be able to refer to its proper period any more detailed account, which he may either read or observe for himself, of its different portions.

Even this abstract is a very imperfect, broken, and fragmentary one. Comparatively few parts of the earth's surface have as yet had their structure even sketched out; still fewer have been accurately surveyed, and had their details thoroughly unravelled, and placed in their proper and regular order. Many of the events, therefore, which are now supposed to have occurred contemporaneously in different places may in reality have occurred in succession; many which are supposed to have directly succeeded each other may have been separated in reality by great spaces of time, of which there are no records as yet discovered, or of which none may ever be found. It is obvious that all future discoveries may add to the time we know to have elapsed, but cannot diminish it.

As the structure of the British Islands is better known than that of any other part of the globe of equal dimensions, and contains a more complete series of rocks in a small space than any other district, we shall take that as our principal authority, as it were, for our history, pointing out the several groups of rock which were produced in this part of the globe during the several periods, and then give some of

those other well-known typical groups of rock which are believed, or are known, to have been deposited contemporaneously with them in other parts of the earth. Where a group of rocks is known of which we have no contemporary representative in the British Islands, it will of course be best to describe it from its best known locality. Our history, therefore, will be chiefly that of the formation of the Celtic or British province, as we may call it, with occasional reference to the history of other provinces.

Chronological Nomenclature.—One difficulty meets us at the outset as to our nomenclature; that is, as to the names we are to give to the different periods of past time. This difficulty must at present be evaded, since the time is not yet come; that is to say, our knowledge is not yet complete enough to enable us to overcome it.

The early geological observers described certain kinds of rock, to which particular names were given. These names were in the first instance lithological, or descriptive of the kind of stone, of which Chalk, Oolite, Granite, are instances. In other cases they were petrological, such as Trap, Mountain Limestone, Coal Measures, &c. Others again were geographical, of which Wealden, Neocomian, Silurian, Oxford Clay, are examples; while others were local terms adopted by geologists, such as Lias, Cornbrash, Gault, &c. Such terms as Old and New Red Sandstone were combined lithological and geological terms, referring at once to the kind of rock of which they were composed and their relative place in the series.

Gradually, as extended observation showed that all the aqueous rocks occurred in a certain order, and formed a series or succession of beds regularly and invariably superimposed one upon the other, a chronological sense began to be extended to these terms, having reference to this order of occurrence or corresponding relative date of formation. Thus the Oolite and the Chalk came to mean not only the rocks to which those names were first and truly applied as descriptive of their lithological character, but also all other kinds of rocks which, having been formed about the same period as these, occupied the same relative place in the general series, and contained the same fossils. Used in this sense, Cretaceous or Chalk rocks might be made either of white chalk, of black marble, of brown sandstone, or blue slate; "cretaceous rocks" meaning in reality only rocks of *the same age* as the chalk. Silurian rocks, in like manner, mean those of *the same age* as the rocks of Siluria; and so of the rest. This double signification of words is almost unavoidable, and the student will find himself naturally and inevitably falling into it in the course of his geological pursuits. It may, however, conduce to the more ready understanding of the classification of the great series of stratified rocks, and the history of their formation, if we confine our attention to the chronological signification only of the principal terms, speaking of them as periods of time during which such and such beds were deposited. I shall not attempt to invent new terms for these periods, but shall take those most ordinarily used and accepted. When, then, we speak of Silurian, or Carboniferous, or Oolitic, or Cretaceous *periods* of time, the reader must pardon the apparent contradiction in the terms, and look on the names as *names only*, and not as descriptive designations.[1]

We may, again, group the great periods of geological time into still larger epochs, to which it is usual to apply the simple terms Primary, Secondary, and Tertiary. As synonyms of these, the words Palæozoic, Mesozoic, and Kainozoic, proposed by Professor Phillips, have been pretty generally adopted, signifying the periods of ancient, middle, and modern life. Geological time, then, may be thus arranged:—

3. Tertiary or Kainozoic Epoch.
   - *n.* Human, Historical, or Recent period.
   - *m.* Pleistocene period.
   - *l.* Pliocene period.
   - *k.* Miocene period.
   - *j.* Eocene period.

2. Secondary or Mesozoic Epoch.
   - *i.* Cretaceous period.
   - *h.* Oolitic period.
   - *g.* Triassic period.

1. Primary or Palæozoic Epoch.
   - *f.* Permian period.
   - *e.* Carboniferous period.
   - *d.* Devonian period.
   - *c.* Upper (or True) Silurian period.
   - *b.* Lower (or Cambro-) Silurian period.
   - *a.* Cambrian period.

It will be advisable, perhaps, to say a few preliminary words as to the commencements of each of these great epochs.

The commencement of the Primary epoch has been already spoken of; and it was shown that by the very nature of the case this must be lost in the dark uncertainty of the remote past, with no clear and definite starting-point to be determined. The earliest formations of all must necessarily have been all long ago destroyed by the erosive action of water, or re-absorbed by the melting agency of internal heat; and even of those later, but still very early rocks, some of which do yet remain in a recognisable state, most of the contemporaries must have been destroyed or so metamorphosed as to be no longer recognisable. The commencement, then, of the Primary epoch must necessarily be uncertain, doubtful, and irregular.[1]

The commencement of the Secondary epoch is a marked one, depending on a great change having taken place in the character of animal and vegetable life in the interval between the formation of the last of the Primary or Palæozoic rocks, and the first of the Secondary ones. This change was coincident with the occurrence of great disturbances and great denudations in the parts of the world now occupied by Europe, and perhaps some other parts. It is probable, however, that the greater break, both in the position of the rocks and the character of the fossils, here than elsewhere in the series, is more apparent than real, and is owing to a great chasm in our documents, and the absence of a vast number of beds which may yet be discovered in other parts of the earth.[2] However that may be, there is a decided line to be drawn between Primary and Secondary rocks and fossils.

The commencement of the Tertiary epoch is more arbitrary, though it is marked also by a decided change in the

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[1] We may dismiss all reference to the derivation of the terms just as readily here as in many other cases. When using the term "sycophant," we rarely think of a "false fig merchant;" nor do the words "bishop" and "overseer" convey to us the same ideas, although really identical in meaning.

[1] The term "primary" was formerly attached to granitic and highly metamorphosed rocks only; and another term, namely, "transition," was used to designate many of those which are now called "primary." In consequence of this uncertainty as to the meaning of "primary," it is more usual now to speak of this epoch as Palæozoic. It is undoubtedly true that much of the granite we know is of primary or palæozoic age, and that many metamorphic rocks were formed during the same epoch. As, however, some granites are secondary or tertiary, and some secondary and tertiary rocks are just as much metamorphosed as any primary ones, the old use of those terms is now properly abandoned.

[2] This was written while we had but a very faint knowledge of the nature of the St Cassian beds. The publication of Sir C. Lyell's Supplement makes English readers acquainted with the existence in the Austrian Alps of a large mass of beds of the very character here anticipated, namely, the St Cassian or Hallstatt beds, and others associated with them, having fossils of an intermediate character between those found in palæozoic and those in mesozoic rocks.

rocks and fossils, and a probable absence of a number of beds. The most marked character of the Tertiary rocks is derived from the fact that a few of the animals which came into existence at the commencement of the Tertiary epoch are still living on the globe. It would follow, then, that if these few species were now to die out and become extinct, the boundary between Secondary and Tertiary rocks would have to be shifted, or else it would be left with a still more arbitrary character than now. There is no essential difference between Secondary and Tertiary fossils. The genera are mostly the same, though the species are all different, and often not very widely different. It was for this reason that the late Professor Edward Forbes proposed to do away with the distinction between them, and to group the whole of the great series of stratified rocks, or, in other words, to divide the whole lapse of past geologic time into two great epochs only, namely, Palæozoic and Neozoic.

In drawing up the following summary, it will be best to give under each period a brief description of the groups of rocks that may be taken as typical of those formed during the period in different parts of the earth, with their maximum thickness,[1] as the measure of the time elapsed, and the possible importance of the group.

Reference will be made chiefly to the Celtic province, or British area, in these statements.

PRIMARY OR PALÆOZOIC EPOCH.

CAMBRIAN PERIOD.

(Lower Cambrian of Professor Sedgwick.)

Typical Rocks.—*Wales.*—A great series of gritstones, or sandstones, and slates, generally of purple and green colours, the sandstones sometimes becoming conglomeritic, and containing fragments of still older slates and grits. In the Longmynd (Salop) there is an apparent thickness of 26,000 feet of these rocks; but this enormous thickness may perhaps be due to concealed folds or reduplication of the beds. In Anglesea these rocks are largely metamorphosed into chloritic and micaceous schists and gneiss, the metamorphism having apparently taken place at a very early period.

Ireland.—A great series of grits and slates, generally of purple and green, or brown and liver-coloured hues, often interstratified with large beds of yellowish quartz rock, which are most abundant in what appears to be the upper portion of the group. In this upper portion the fossils also are found.

Cumberland.—The Skiddaw slate of Professor Sedgwick is probably of nearly the same age as the rocks above mentioned.

None of the Cambrian rocks of Wicklow and Wexford are known to be metamorphosed, though it is possible that much of the mica schist and gneiss, with altered limestone of the north of Ireland, and of Scotland, and other parts of the world, are the metamorphosed clays, sands, and limestones of this period.

Bohemia.—Probably stage A (crystalline schist) and stage B (slate and conglomerate) of M. Barrande. No fossils known.

Scandinavia.—Regio 1. Fucoidarum of M. Angelia almost certainly is of this period.

America.—Sir W. Logan described rocks, apparently of this period, below the Potsdam sandstone in Canada. No fossils.

Much of the metamorphic series of America,—as of Europe the great masses of gneiss and mica schist,—are doubtless altered Cambrian, or else still more ancient rocks, the unaltered members of which may never be known to us.[1]

LOWER OR CAMBRO-SILURIAN PERIOD.

(Upper Cambrian of Professor Sedgwick.)

Typical Groups of Rock.—*Wales and the Border Counties.*—

	Feet.
1. Lingula flags[2]	5000?
2. Llandeilo flags	5000?
3. Caradoc Sandstone and Bala beds	9000
4. Lower Llandovery beds	1000

1. The Lingula flags.—Dark brown and blue flags and slates, interstratified in their lower beds with sandstones, and seeming to pass down by insensible gradations into the gritstones and slates of the Cambrian rocks below, to which they are quite conformable. Thickness several thousand feet.

2. Llandeilo flags.—Brown, fine-grained, rather sandy flags, and black earthy rotten slates. Thick beds of contemporaneous traps and ashes in some places. Thickness several thousand feet independent of the traps.

3. Caradoc Sandstone and Bala beds.—In Shropshire these are chiefly thick brown and yellow sandstones, often calcareous. In Merioneth, &c., they are gray grits and sandy slates, sometimes black slates with beds of sandstone. Near Bala they have a band of concretionary limestone 20 or 30 feet thick about their middle portion, called the Bala Limestone, and another smaller occasional band near the top called the Hirnant Limestone. Great masses of contemporaneous traps and ashes are interstratified with the slates and grits in some places. Thickness, without trap, about 9000 feet.

4. Lower Llandovery beds.—Gray and brown grits and conglomerates, with dark shales. Thickness several thou-

[1] It is evident that the maximum thickness must be taken as the true measure of time, or rather as the nearest approximation to it. Any less thickness at other localities merely shows that a greater portion of the period elapsed without any deposition taking place there. Much time may pass without leaving any record of its passage, but proof that time elapsed in any one locality proves that it elapsed everywhere.

[1] Although few traces of life have hitherto been found in the Cambrian rocks, and no unaltered rocks below them are at present known, yet the conclusion that life now first began upon the globe is one that is anything but satisfactory to our mind. Even on the supposition that no more fossils should ever be found in Cambrian or still earlier rocks, the possibility of the existence of full assemblages of earlier life remains the same. Had general metamorphic action spread a few stages higher than it has, and the Silurian and Devonian rocks of Europe and America, and other parts of the globe, been affected by it, so as to have their organic remains obliterated and become generally converted into crystalline schists, it would have been argued that the carboniferous period was that in which life commenced upon the globe; and had large parts of the south-west of Ireland and South Wales been left unaffected by metamorphism, great formations of sandstones and slates of Devonian age, many thousand feet in thickness, might have been appealed to as utterly destitute of a single trace of organic existence, and therefore a proof that, during their deposition, life did not exist upon the globe. In Ireland, as in Wales, calcareous bands (cornstones, &c.) might be shown without a trace of a fossil for miles and miles, and ranging through a thickness of 10,000 or 12,000 feet of rock at the least. The present known districts where unaltered Cambrian rocks are visible may be just the parallels of such a case; and their metamorphosed contemporaries and still earlier formations may once have been crowded with organic forms, none of which we shall ever see. We do not assert that it was so, but merely that we have not yet arrived at *any proof* that it was not, nor has the accumulation of negative evidence been yet of anything like sufficient extent to preclude even its probability.

[2] Sir C. Lyell, in his Manual, draws the boundary between Cambrian and Silurian at the top of the Lingula flags, and, palæontologically, such a boundary seems well founded. It is, however, impossible to draw any physical boundary in North Wales between 1 and 2, since they are both similar dark-coloured slates and flags, and there is conformity of position throughout.

sand feet, occupying all Cardiganshire, great part of Glamorgan and Radnor—the Plynlumon rocks.

Ireland.—The Lingula Flags are not yet known in Ireland. Their discovery would be of interest, as it would be of importance to know whether they would be conformable to the Cambrian or to the Lower Silurian rocks, or would, as in Wales, introduce conformity throughout the series.

The Lower or Cambro-Silurian rocks of Wicklow, Wexford, and Waterford, are of the Bala and Caradoc sandstone age, as shown by their fossils, with unfossiliferous beds below them that may or may not belong to the Llandeilo flags. They consist of dark blue or black and gray flags, slates and grits, sometimes, as in Wales, becoming purple, green, olive, &c. They contain many contemporaneous beds of trap and ash (felstone, &c.) like those of Wales, and one or two calcareous bands (very like the Bala limestone), near Courtown, and at Tramore. Their thickness must be many thousand feet, but there are no good continuous sections sufficient to determine it exactly.

They repose on the Cambrian rocks below, quite unconformably, stretching directly across the ends of the beds, and coming into contact with different portions of the lower rocks.

The fossils are found only in the upper part of the series in the neighbourhood of the traps[1] and calcareous bands, and the exact relations of the lower beds are accordingly unknown.

Another great tract of apparently similar beds stretches from the centre of Ireland (Cavan, &c.) to the coast of Down. It contains a bed of anthracite, which is worked and locally used for coal, and this is said to reappear in one or two spots in Tipperary, &c.

On the flanks of the Dublin and Wicklow granites the Lower Silurian slates and grits are greatly metamorphosed into mica and other schists, and occasionally into gneiss, full of crystals of andalusite, staurolite, schorl, feldspar, and other minerals.

Other metamorphic tracts in the north of Ireland may be also composed of metamorphosed Lower Silurian rocks.

Cumberland.—The Coniston group of Professor Sedgwick is doubtless the equivalent of the Caradoc sandstone and Bala group. Whether the group below (his chloritic slate and porphyry) ought to be placed with the Llandeilo flag or the Lingula flag, is difficult to decide in the absence of fossil evidence. The latter is perhaps the more likely of the two, and seems to be the belief of Professor Sedgwick himself.

Scotland.—The rocks of the border Highlands from Dumfries to the Lammermuir Hills belong to this period, probably both to the Llandeilo flags and the Caradoc sandstone.

Bohemia.—Stage C, argillaceous schist, and stage D, quartzites, &c., of Barrande, are of this period. Stage C probably corresponds to the Lingula flags, but is more fossiliferous, containing twenty-seven species of trilobites alone. Stage D will then answer either to the Llandeilo flags or the Caradoc sandstones, or both.

Scandinavia.—M. Angelin's Regio A, Olenorium, and Regio B, Conocorypharum, consisting of aluminous schists and limestone, approximately = stage C of Barrande, and therefore approximately = Lingula flags.

Angelin's Regions.—BC, Ceratopygarum (aluminous schist and black limestone); C, Asaphorum (gray and reddish impure limestones); and D, Trinucleorum (marly schists with calcareous concretions) are together approximately = stage D of Barrande.

[1] The eruption of igneous rocks at the bottom of the sea, though doubtless occasionally destructive of animal life at the moment, seems generally favourable to its development during the period. Contemporaneous trap rocks have often highly fossiliferous beds intimately associated with them.

North America.—According to Professor H. D. Rogers, the following is the series of the Lower Silurian rocks of North America:—

		Feet.
Hudson Group.	11. Lorraine shale and sandstones	2000
	10. Utica slate	
	9. Trenton limestone	500
Black River Group.	8. Black River limestone	2500
	7. Bird's-eye limestone	
	6. Chazy limestone	
	5. Calciferous sandstone	100
Potsdam Group.	4. Upper Primal slate	700
	3. Potsdam sandstone	700
	2. Lower Primal slate	1200
	1. Conglomerate, with quartzose, feldspathic, and slaty pebbles	150

The beds described by Mr Dale Owen are an extension and development of the Potsdam sandstone, in the country west of Lake Michigan. They are probably of the age of the Lingula flags, or may be still older.

At the close of this period, or immediately after it, very considerable movements of elevation and disturbance took place over the area now occupied by the British Islands, and some parts of Western Europe. Denudation consequently occurred, removing large portions of the upper rocks, and exposing the surfaces of those below. The rocks of the next period, therefore, are very frequently unconformable to those of this and the preceding period, resting now on one and now on another portion of them. This unconformity always involves the supposition of a vast lapse of time to allow of the slow action of elevating and denuding forces to produce the effect. Wherever unconformity is noted in future, the student will be careful to apply these remarks.

UPPER SILURIAN PERIOD.

Typical Groups of Rocks.—*England.—Siluria; the Border Counties of England and Wales.—*

		Feet.
Ludlow Group.	10. Tilestone	800
	9. Upper Ludlow rock	650
	8. Aymestrey limestone	100
	7. Lower Ludlow rock	1000
Wenlock Group.	6. Wenlock limestone	300
	5. Wenlock shale	1500
	4. Woolhope limestone	50
May Hill Group.	3. Denbighshire sandstone	2000
	2. Tarannon shales	1000
	1. Upper Pentamerus beds, or May Hill sandstone, or Upper Llandovery beds	1000

The sandstones of the May-Hill group were at one time confounded by the geological survey with the true Caradoc sandstone, which they often greatly resemble in lithological character. Professor Sedgwick first pointed out their difference; and the officers of the Geological Survey afterwards traced the boundary between the two, and showed that the sandstones of the Upper Silurian period rested unconformably on those of the Lower. The first mistake unfortunately had a bad influence on the survey of North Wales, where a thick sandstone formation, lithologically resembling the true Caradoc formation of Shropshire, was taken for it, and therefore the Bala beds were presumed to be below the Caradoc, while in reality they were themselves its true representative. (*Ramsay MS.*) This thick sandstone formation of North Wales, then, described first by Mr Bowman (British Association), and then by Professor Sedgwick, under the name of *Denbighshire grits*, together with the other beds associated with it, requires to be admitted as a new, and, locally, a very important member of the Upper Silurian series. It has other beds underneath, more or less intimately associated with it; and the group forms the true base of the Upper Silurian series, reposing

Geology.

almost invariably, in an unconformable position,[1] on the perfectly distinct Lower or Cambro-Silurian rocks below. (See Professor Ramsay's forthcoming *Memoir on North Wales.*)

1. Upper Llandovery sandstone, or Pentamerus beds, or May-Hill sandstone.—Gray and brown sandstones and conglomerates, with (in Shropshire) very calcareous bands, almost limestones. Thickness, 800 to 1000 feet.

2. Tarannon shales.—Generally pale gray, nearly white shales or slates, very fine grained (spoken of by Professor Sedgwick as "paste rock"), sometimes becoming of a bright-red colour. Thickness, 500 or 800 feet.

3. Denbighshire sandstones and flags.—Generally thick-bedded yellowish or brownish sandstone, largely made up of angular grains of white feldspar, with grains of quartz occasionally as large as peas, and passing into conglomerate. These are interstratified with beds of brown slaty shale, and occasionally dark, nearly black slate, overlaid by hard brown and blue flags. Thickness at least 2000 feet.

4. Woolhope limestone.—A locally occurring group of beds of gray, argillaceous, nodular, concretionary limestone, interstratified with gray shales, occasionally attaining a thickness of 100 feet.

5. Wenlock shale.—Generally dark-gray, sometimes black shale, with occasional calcareous concretions, capped by

6. Wenlock limestone.—An irregularly-occurring set of concretionary limestones, sometimes thin and flaggy, sometimes massive, highly crystalline bosses of carbonate of lime; sometimes in one, sometimes in two or three sets of beds, with interstratified shales, forming a thickness of 100 to 300 feet.

7. Lower Ludlow rock of Shropshire is generally a brown or gray sandy flag, or argillaceous sandstone, locally called mudstone.

8. Aymestrey limestone.—A nodular concretionary limestone, sometimes pure and crystalline, at others argillaceous and impure; like the Wenlock, but more local in its occurrence.

9. Upper Ludlow of Shropshire, &c.—A gray argillaceous sandstone, often calcareous, and containing calcareous nodules passing up into shales with sandstones, which gradually acquire a red colour.

10. Tilestone.—Red, shaly, and flaggy sandstones. At the base, near the junction of the Ludlow and tilestone beds, are one or two little thin but very widely extended bands, called "bone beds," full of the teeth and bones of small fish. Wherever these widely-extended but very thin beds full of peculiar fossils (the inhabitants generally of a clear sea) are met with, it may be expected that there is a great gap in the series, and that many intermediate beds, perhaps a formation or so, will be found elsewhere.

Cumberland, &c.—According to Professor Sedgwick, the following are the typical groups of rocks deposited during the Upper Silurian period in the north of England:—

3. Kendal group = Ludlow rocks.
2. Ireleth slates = Wenlock rocks.
1. Coniston grits = May-Hill sandstone.

1. The Coniston grits have few fossils, and their identity with the May-Hill sandstone is therefore doubtful, although very probable.

2. The Ireleth slate group is divided into four stages: *a.* Lower Ireleth slate; *b.* Ireleth limestone; *c.* Upper Ireleth slate; *d.* Coarse slate and grit. Fossils are rare, but generally of the Wenlock type.

3. The Kendal group is divided into three stages: (*a.*) A great group of flags and grits; fossils abundant and of the Lower Ludlow type. (*b.*) Thick grit and flagstone, with bands of coarse slate; fossils locally abundant, and of Upper Ludlow type. (*c.*) Tilestones, resembling those of Shropshire, &c. (Sedgwick, *Synopsis of Classification, &c.*)

[1] So long as the Denbighshire grits were supposed to be the same as the Caradoc sandstone, the unconformity of the Upper on the Lower Silurian, which in Derbyshire and Merionethshire is not very striking, was entirely overlooked.

Scotland.—Not much has hitherto been known as to the existence of Upper Silurian rocks in Scotland. The representatives of the tilestones, however, and probably the lower groups, have lately been discovered by Mr Slimon of Lesmahago, and described by Sir R. Murchison. (*Geological Journal.*) These are dark-gray schistose rocks, with lighter and more siliceous stony bands, and other schists containing calcareous concretions.

Ireland.—No detailed descriptions of the Upper Silurian rocks of Ireland have yet been published. The labours of Mr Griffith, however, and more recently of the Geological Survey, have shown the existence of rocks of this age on the western side of the island. The Dingle promontory contains the representatives of both the Ludlow and Wenlock rocks, and possibly of part of the May-Hill sandstone group also. Abundance of most of the characteristic fossils, and some not found in England, though occurring in the Upper Silurian rocks either of Scandinavia or of North America, have been found.

In Galway, as shown by Mr Griffith, and confirmed by Sir R. I. Murchison and others, there is a vast series of gray grits and slates reposing unconformably on mica schist, &c., and having frequently red sandstones at its base, and sometimes great beds of conglomerate in its upper part, containing perfectly-rounded pebbles and boulders of quartz rock and syenite up to 18 inches in diameter.[1] Abundance of fossils have been found near the base of this series, comprising all the characteristic species of the May-Hill sandstone or Pentamerus beds, and in other parts an assemblage of corals like those found in the Wenlock rocks. This great group of rocks in Galway must have a thickness of several thousand feet at least, but its details have yet to be worked out.

Somewhat similar rocks form a small range of high land at Ughool, near Ballaghadereen in Mayo, from which a great series of Wenlock corals and other Upper Silurian fossils had been collected by Mr Griffith, and also last year by Mr Kelly and ourselves.

One feels inclined to speculate from these facts on the former existence of a range of mountains rising where the Irish Sea now flows, and composed of an axis of Cambrian and Lower Silurian rocks, with Upper Silurian on their flanks sloping down into the border country of England and Wales on the one side, and to the west coast of Ireland on the other.

Bohemia.—The rocks deposited during the Upper Silurian period in what is now Bohemia are divided by M. Barrande into—Stage E, Calcaire inferieur. Stage F, Calcaire moyen. Stage G, Calcaire superieur. Stage H, Schists culminaux.

Scandinavia.—M. Angelin similarly divides the Upper Silurian rocks of this district into his Regio D, E, Harparum—shales and white limestones; and Regio E, Cryptonomorum—limestones resting on sandstones and shales.

Of these, Stage E of Barrande and Regio E of M. Angelin certainly equal very nearly the Wenlock rocks of Sir R. Murchison, there being 18 species of Brachiopods, besides corals and other fossils common to this group of rocks in the three countries. Sir R.

[1] In an excursion last summer with Mr John Kelly, we measured some of the smooth round boulders of syenite embedded in these Silurian rocks, and found them frequently a foot, and sometimes, though rarely, eighteen inches in diameter. Other almost equally massive conglomerates occur in the Silurian rocks of Lisbellaw, south of Enniskillen. In Galway, on the northern side of the beautiful promontory of Kilbride, on the shores of Lough Mask, a magnificent assemblage of fossils is to be seen in the rocks of the beach.

Murchison gave in 1847 a list of 74 species found in the rocks of Gothland (Regio E), 47 of which occur in Britain, 13 in Ludlow rocks, and 14 in the Wenlock, the 20 others being found in both. The Regio D. E. of M. Angelin is not represented in Bohemia. It may possibly be equal to May-Hill sandstone. The stages F, G, H of Barrande are not recognisable in Scandinavia.[1]

North America.—The rocks of this region of the age of the Upper Silurian period are—

		Feet.
HELDERBERG GROUP.	10. Upper Pentamerus limestone......... 9. Encrinal limestone......... 8. Delthyris shaly limestone......... 7. Pentamerus limestone......... 6. Tentaculite limestone.........	300
ONONDAGA AND NIAGARA GROUP.	5. Onondaga salt group, a gray ash-coloured shale, with gypsum and rock-salt. 4. Niagara limestone, compact gray limestone, resting on blue calcareous shale..........	1000
CLINTON GROUP.	3. Clinton group. c. Variegated red marls and calcareous shales......... b. Shales and argillaceous limestone and calcareous sandstone......... a. Greenish and yellowish slates with ferruginous sandstone.........	2400
MEDINA GROUP.	2. Medina sandstone. b. White fine-grained sandstone, alternating with red and greenish shale at top.........	450
	a. Soft brown argillaceous sandstone, and red shale.........	600
	1. Gray sandstone, with thick beds of siliceous conglomerate, containing fragments of the lower rocks.........	400

According to Professor Rogers (Johnston's *Physical Atlas*, 2d ed.), not only does the Medina group contain a conglomerate made of pebbles of the lower rocks, but the whole Upper Silurian rocks are distinctly unconformable to the Lower, as they are in Wales and other parts of the world.

DEVONIAN PERIOD.

TYPICAL GROUPS OF ROCK.—There has long hung much obscurity over the classification of the rocks which belong to this period. This has chiefly been owing to the fact that we have in the British Islands two distinct types of rock which never come into close contiguity with each other, and do not contain any fossils in common, but are yet undoubtedly intermediate in age between the Silurian and Carboniferous periods. One of these types has long been known to British geologists as the Old Red Sandstone; the other, confined to Devon and Cornwall, was not classed with the former till Mr Lonsdale, and Professor Sedgwick, and Sir R. I. Murchison worked it out. The Old Red Sandstone type is not known on the Continent; but the rocks and fossils of Devon re-appear in the Eifel and other parts of the Continent. The Old Red Sandstone was formerly placed as the lowest rock of the Carboniferous series by some authors (Professor Phillips and others); while a part of what was formerly called Old Red Sandstone by others (Tilestone) is now placed as the upper part of the Silurian series. Recent researches by the Geological Survey in Kerry and Cork induce us to believe that what has hitherto been called Old Red Sandstone, and treated as one great group, must in reality be separated into two—the upper part, or Old Red Sandstone proper, being really the base of the Carboniferous; while the lower portion must be separated from the rest under another designation, and looked upon as more closely allied to the Silurian system. In the Dingle promontory there are good representatives of Wenlock and Ludlow rocks, the latter containing abundance of *Pentamerus Knightii* and other Ludlow fossils, surmounted quite conformably by two great groups of purple and green gritstones and conglomerates; while over all these, widely and utterly unconformable to them and to the Silurian rocks, there sweep red sandstones and conglomerates 3000 or 4000 feet thick, which pass up conformably into the base of the Carboniferous series. This upper group of red sandstones and conglomerates also contains fossils (plants in Ireland, plants and fish in Scotland) that place it in more close connection with the Carboniferous than with any formation.

We shall also separate from the rocks of this period those which are called Upper Devonian in Devonshire (the Marwood, Pilton, and Petherwin beds), and treat them as belonging to the Carboniferous period.

There remains some little doubt, perhaps, whether the middle and lower Devonian groups of Devonshire be strictly contemporaneous with the middle and lower Old Red Sandstone. The latter contain fish and a few plants only, while the former have neither fish nor plants in them—in the British Islands at all events. We shall therefore describe them separately as belonging to this period, but without attempting to draw them more closely together. In Russia, indeed, the fish of the one are found with the fossils of the other, as shown by Sir R. I. Murchison; but questions of geographical distribution arise to complicate any deductions as to exact synchronism in two such distant localities.

Devon and Cornwall.—A great series of slates, sandstones and conglomerates, and limestones, of various textures and colours, brown, blue, and red. According to Professor Sedgwick, they may be classed as follows:—

3. DARTMOUTH SLATE GROUP.—Coarse roofing-slates and quartzites, ending upwards with beds of red, green, and variegated sandstone.
2. PLYMOUTH GROUP.
   - c. Coarse red sandstone and flagstone.
   - b. Calcareous slates.
   - a. Great Devon limestone.
1. LISKEARD OR ASHBURTON GROUP.

Belgium and the Rhine.—A series of rocks of a similar type, and with similar fossils to those just mentioned, are found in this district. They are divided by M. Dumont into—

3. EIFEL GROUP.
   - c. Eifel limestone.
   - b. Gray shales, occasionally calcareous.
   - a. Red sandstone and conglomerate.
2. AHRIAN GROUP.—Bluish-gray grits, sandstones, and shales.
1. COBLENTZ GROUP.—Green and gray grits, sandstones, and shales.

Sir R. I. Murchison, in his *Siluria*, gives a slightly different classification into Lower, Middle, and Upper Devonian; the Upper containing some beds above the Eifel limestone, as follows:—

3. UPPER.
   - b. Clymenia and Cypridina schists.
   - a. Goniatites retrorsus schists.
2. MIDDLE.
   - b. Eifel or Stringocephalus limestone.
   - a. Calceola schists = Ahrian group.
1. LOWER.
   - b. Wissenbach slates.
   - a. Coblentz or Spirifer sandstone.

The upper division, however, is clearly the same as that which we have thought it best to transfer to the Carboniferous period.

Rocks and fossils like those of Devon and Cornwall not being known in any other part of the British Islands, we must speak of those now to be described as Devonian, with a certain reserve as to the exact propriety of the name. They have hitherto all been described as Old Red Sandstone, which has been taken as synonymous with Devonian.

Scotland.—The labours of the late lamented Hugh Mil-

[1] We have perhaps dwelt at a little greater length on these facts relating to the Silurian period than the relative importance of the rocks of that period might warrant, because they bring before the reader's notice principles which are equally applicable to the rocks of all other periods.

Geology.

ler on the so-called Old Red Sandstone of Scotland have made that district classic ground. According to his classification, as given by Professor Sedgwick in his Synopsis, the series of rocks are the following:—

UPPER.	7. Yellow siliceous sandstone.
	6. Impure concretionary limestone.
	5. Red sandstone and conglomerate.
MIDDLE.	4. Gray sandstone and earthy slate.
LOWER.	3. Red and variegated sandstone.
	2. Bituminous schists.
	1. Great conglomerate and red sandstone.

The upper division we should now relegate to the base of the Carboniferous series; and Miller, in his *Testimony of the Rocks*, throws some doubt on the superposition of No. 4 above 3 and 2. It appears that they nowhere come actually into contact, and that it is possible that No. 4 may be a fresh-water deposit, more or less contemporaneous with the marine beds 3 and 2. The balance of evidence, however, both in Miller's opinion and that of Professor Sedgwick, recently confirmed to ourselves, is in favour of the order given above.

Herefordshire and South Wales.—The Old Red Sandstone of this large district is composed of the following groups:—

	Feet.
2. Red and yellow sandstone marls and conglomerate	3000 or 4000
1. Cornstone group	5000 or 6000

Of these we believe No. 1 only properly to belong to the Devonian period, and shall describe No. 2 in the Lower Carboniferous period.

1. The Cornstone group consists of a great series of red and white sandstones and red and green marls and shales, with frequent partial bands of impure concretionary limestone, locally known as "cornstone." It graduates down quite conformably and insensibly into the tilestone of the Upper Silurian period.

Ireland: Kerry and Cork.—In the Dingle promontory we have the following groups lying conformably on the Ludlow rocks:—

	Feet.
3. Dingle beds	4000
2. Glengariff grits	6000
1. Red slates and sandstones	1000

1. The red slates and sandstones lying conformably over the rocks containing *Pentamerus Knightii* and other Ludlow fossils, may possibly be the representatives of the Tilestone group; but as it contains no fossils in Kerry it is impossible to determine this satisfactorily.

2. The Glengariff grits consist of very thick-bedded massive green or purple sandstones or gritstones, of a very peculiar lithological aspect, interstratified with beds of red or green slate. Sometimes the sandstones, sometimes the slates, are calcareous, forming concretionary beds not unlike debased cornstones. Steady sections of 5000 or 6000 feet may not unfrequently be seen in these rocks in the promontories of Dingle, Iveragh (between Killarney and Valentia), and those lying between the bays of Kenmare, Bantry, Dunmanus, and Roaring Water.

3. Dingle beds.—These consist of red sandstones and slates, with beds of conglomerate, which in the Dingle promontory are thick and prominent, containing angular and subangular fragments of red jasper, hornstone, felstone, and other rocks, together with pebbles of Silurian limestone or calcareous sandstone containing *Pentamerus oblongus* and other fossils of the May-Hill sandstone group.

Over the upturned and denuded edges of all these beds, as well as across the edges of the Silurian beds below, sweep the thick beds of red sandstone and conglomerate which form the Old Red Sandstone. This is the case throughout the Dingle promontory; but in that of Iveragh, on the south side of Dingle Bay, and over all the rest of the country, this unconformity is no longer perceptible, and the conglomerates also rapidly die out to the south, so that we get only the Glengariff grits covered by red and purple slates and sandstones, with no very obvious boundary between them and the Dingle beds, nor between the latter and the Old Red Sandstone.

Geology.

North America.

	Feet.
9. Catskill group, red shales and red and gray sandstones, with a few white quartz pebbles	5000
8. Chemung group, gray, blue, and olive-coloured shales, and gray and brown sandstones	3200
7. Portage group, fine-grained gray flagstone, with blue shale partings	1700
6. Genesee slate, brownish-black and bluish-gray slate	300
5. Hamilton group, bluish-gray, brownish and olive shale, with thin dark-gray sandstones	600
4. Marcellus shales, black and bituminous, with thin argillaceous limestone at base	300
3. Upper Helderburg or Corniferous limestone, straw-coloured, light-gray or bluish, with chert nodules	350
2. Caudagalli grit, argillaceous, calcareous, thin-bedded sandstone	300
1. Oriskany sandstone, coarse yellowish calcareous sandstone	200

The Oriskany sandstone is considered by its fossils to be undoubtedly contemporaneous with the Lower Devonian group of the Rhine. The others represent the superior parts of that formation, and it is possible that some of them are rather Lower Carboniferous than Devonian.

Formations possibly belonging to the Devonian period are largely developed in Australia; and characteristic fossils have been brought from China, where they are used as medicines.

The Cape of Good Hope, too, has large formations, believed to belong to the Devonian period, of which we may shortly hope to hear more from the labours of Mr Andrew Wyley.

CARBONIFEROUS PERIOD.

Preliminary Observations.—In the account of the deposits of the preceding period it will be seen that we have ventured to detach from it the rocks called Upper Old Red in Scotland and Upper Devonian in Devonshire; and by parity of reasoning, the Upper or Old Red Sandstone proper of the south of Ireland and of South Wales; and to consider the rocks so detached as forming the base of the Carboniferous system of rocks. This conclusion has been forced upon us rather unwillingly, and against our previous belief, by the examination of the structure of the south of Ireland. It has always been the opinion of the Irish geologists, especially of Mr Griffith and Mr John Kelly, of whom the latter has published this opinion in a paper in the *Journal of the Geological Society of Dublin*. The correctness of their view on this point, however, was obscured by the endeavour to identify all below the Old Red Sandstone proper with Silurian rocks, and altogether to obliterate the Devonian period. Admitting the existence of a Devonian period as intermediate between the Silurian and Carboniferous, and placing in it the rocks and fossils just described as belonging to it, we may retain the Old Red Sandstone proper, that which stretches round the Carboniferous rocks of the south-east of Ireland and those of South Wales and the border counties, and the thin skirts and patches of Old Red in North Wales and North England, and the upper part of that of Scotland, as forming the true commencement of the Carboniferous period. There is in many places a perfect blending of the Old Red into the Lower Carboniferous rocks, or into beds which contain fossils having commonly a generic and often a specific identity with undoubted Carboniferous forms. Still there are a sufficient number of peculiar species, both of plants and shells in these lower rocks, to warrant the separation of the Carboniferous sys-

tem of the British Islands into an upper and a lower series, the general terms of which may be stated as follows:—

Upper.	4. Coal measures.
	3. Carboniferous limestone.
Lower.	2. Carboniferous slate, or Lower Limestone shale, with Coomhola grits and yellow sandstones.
	1. Old Red Sandstone, passing up into Yellow Sandstone.

Typical Groups of Rock.—*Ireland.*—We have already said, that in the Dingle promontory there is a mass of 3000 or 4000 feet of red Sandstones and conglomerates, the true Old Red Sandstone, utterly unconformable to the Devonian and Upper Silurian rocks below, but conformable to the Carboniferous rocks above. The junction, however, of the Old Red and Carboniferous is not very well seen there, but is admirably shown when the rocks are traced round to the neighbourhood of Glengariff, at the head of Bantry Bay. In this district the Glengariff grits are the lowest rocks seen, having the characters before described, and being surmounted by a great series of purple, and red, and green sandstones and slates which must represent both the Dingle beds and the Old Red Sandstone, all lying apparently conformably, and without any marked boundary between them.

The upper part of this red series alternates with many green and gray coloured beds, and some liver-coloured slates, and in these fragments of plants are found. A little higher the red colour disappears, and we have grits and slates of various shades of green, yellow, or gray, eventually interstratified with black shales or slates. These black beds rapidly increase in thickness as we ascend, still interstratified at first with numerous sets of beds of thick massive gritstone; but above these black shales or slates alone occur, eventually becoming calcareous, and containing thin beds of impure concretionary limestone.

The fossils of these calcareous bands, which are the highest beds seen in Bantry Bay, are all Carboniferous fossils such as are found in the Lower Limestone shale of South Wales and elsewhere. Carboniferous species, shells, and encrinites, likewise occur in the shales, interstratified with the grits below, and also in the grits themselves; but there are here also other fossils which are not found in the higher part of the series. Together with these fossils are some plants similar to, but not exactly identical with, the plants usually found in the Carboniferous series, and these plants extend down into the green and gray shales interstratified with the red beds, where, however, they are not accompanied by marine species. We would group these beds, then, as follows:—

		Feet.
Carboniferous Slate.	5. Lower Limestone shale with calcareous bands	150
	4. Dark-gray and black slates and shales	2000
	3. Coomhola grit series	2500
Old Red Sandstone.	2. Yellow Sandstone series	1000
	1. Red Sandstone and slate	2000

1. The Red or purple Sandstone and slate contains a few green or gray beds, but no fossils. It stretches continuously from the extreme west of Cork and Kerry into Waterford and Tipperary, where it reposes unconformably on the Lower Silurian rocks, having a conglomerate at its base, partly made of the fragments of the rocks it rests on, partly of well-rounded quartz pebbles. It still retains a thickness of 2000 or 3000 feet, till it dies away rapidly towards Wexford in one direction, and towards Carlow in the other, reappearing afterwards merely as little local patches here and there in the hollows of the lower rocks.

2. The Yellow Sandstone series can only be separated from No. 1 by the greater abundance of greenish, grayish, and yellowish beds among the red ones, and by the occurrence of remains of plants in the former. It is continuous with No. 1 over all the south of Ireland, and probably extends a little further than it, since the thinning out of the Old Red Sandstone seems to take place from below upwards, higher and higher beds extending further and further, showing gradual depression to have been taking place during the period.

3. The Coomhola grit series can only be separated from the yellow sandstone by the shales between the grits being dark-gray or black, and the occurrence of some marine species in some few of the beds together with the plants.

4. The dark-gray shales and slates are perfectly well marked by the absence of grit beds, but they contain few or no fossils in Bantry Bay.

5. The Lower Limestone shale cannot be separated from the shales and slates below, except by the occasional appearance of calcareous bands together with an abundance of some Carboniferous fossils. The latter rocks, Nos. 3, 4, and 5, preserve the characters and the thickness first assigned to them over all the country from Bantry Bay to the Old Head of Kinsale and the mouth of Cork Harbour, the only variation being a diminution in the number and thickness of the gritstones in the Coomhola grit series, and a corresponding increase in the dark-gray slates above. They likewise preserve their character and thickness northwards as far as Sneem on the north side of Kenmare Bay. But when we proceed to the head of this bay about Kenmare itself we find a remarkable change to have occurred. The Carboniferous limestone there makes it appearance in its ordinary form, having under it a thickness of about 50 feet of the beds first described as Lower Limestone shale, precisely similar to the shales with calcareous courses in Bantry Bay, and containing the same fossils. But at Kenmare these beds rest directly on red slates and sandstones, forming the upper part of the Old Red Sandstone; the great mass of the Carboniferous slate series, with all the Coomhola grit group that is so strongly developed 10 or 15 miles to the westward and southward, being entirely absent at Kenmare. Neither does this absence of a group of beds nearly 5000 feet thick produce any apparent unconformity, though, as all the beds are at very high angles, and a good deal contorted, it is impossible to decide whether they were originally conformable or not. North and east of Kenmare, over all the rest of the south of Ireland to Tralee, Ballybunnion, and Limerick on the north, and to Cork, Youghal, and Wexford on the east, this latter type prevails, the whole of the Carboniferous slate group being absent except the small portion of it called here the Lower Limestone shale.

We believe, then, that all the beds mentioned above as lying below the Lower Limestone shale form in reality a Lower Carboniferous series, which is only locally developed in its true proportions,—introducing when it is so developed a perfect apparent continuity and blending from the base of the true Old Red Sandstone, or perhaps in some places even from the Devonian rocks themselves, up into the highest of the Carboniferous series.

Devon and Cornwall.—The Petherwin slates, the Pilton beds, the Marwood sandstones, and others belonging to the same period as the Carboniferous slate and Coomhola grits of Ireland.

South Wales.—The Old Red Sandstone surrounding the South Welsh coal-field has a base of conglomerate reposing on the Devonian cornstones, over which are red sandstones and marls, which in their upper parts have yellow sandstones interstratified with them, containing fragments of plants, and appearing to graduate upwards into the black shales and sandstones of the Lower Limestone shale, which in its upper part is interstratified with beds of limestone, passing thus into the base of the Carboniferous limestone.

Scotland.—In accordance with the classification here adopted, we must place in the Lower Carboniferous series the beds called Upper Old Red Sandstone of Scotland, which, if our present views be correct, should be called Old

Geology.

Red Sandstone only; the so-called Middle and Lower Old Red Sandstone being termed Devonian.

They consist of red sandstones and conglomerates, having in their upper part yellow sandstones, in which plants and fish remains are found, and these are believed to be connected more or less with the base of the Upper Carboniferous rocks, through the group called Calciferous sandstone by Mr Maclaren, which is possibly of about the same age as the Coomhola grits of the south-west of Ireland.

The Rhine.—If the views here given as to classification be correct, we must place as Lower Carboniferous the rocks called Upper Devonian in the Rhenish provinces, which are subdivided by F. Roemer into

4. Schists with *Rhynconella cuboides* and *Producta subaculeata*.
3. Schists with many Clymeniæ, Goniatites, and Cypridina.
2. Limestone with *Goniatites auris*, &c.
1. Schists with *Receptaculites Neptuni*.

No. 1 may possibly be a Devonian rock, as the undetermined fossil called *Receptaculites Neptuni* occurs in Ludlow rocks at Ludlow; but the other three groups are identified with the so-called Upper Devonian of Devon, especially by the presence of the little *Cypridina serratostriata* in great abundance. (Murchison, *Siluria*, p. 372.)

UPPER CARBONIFEROUS ROCKS.

Taking the Old Red Sandstone proper as the true base of the great Carboniferous system of Britain, and understanding that the great mass of the Carboniferous slate group above it is found only in the south-western corners of Ireland and England, dying out everywhere rapidly to the north and east, except a few of the upper beds, known as the Lower Limestone shale, which seems also to die out towards the north and east in England, though they spread over all Ireland; and taking into account that the Old Red Sandstone proper appears to be entirely wanting in Devon and Cornwall, where the Carboniferous slate rests on true Devonian rocks,—we have now to trace the range of the upper part of the Carboniferous system through the British Islands. In doing this we will again commence with the south-west portions of—

Ireland—Kerry, Cork, and Waterford.

	Feet.
2. Coal Measures	+ 2000
1. Carboniferous limestone	1500
Old Red Sandstone.	

No. 1. Over this district the Carboniferous limestone forms a nearly unbroken series of beds of gray limestone, sometimes compact, sometimes crystalline, generally in very highly-inclined positions, and often so traversed by slaty cleavage as to have its stratification entirely obscured. It occurs only in the plains and bottoms of the valleys.

No. 2. Directly on the upper beds of the limestone occur black indurated shales, likewise traversed by slaty cleavage, but never making good roofing-slate; higher up, these alternate with greenish or olive-coloured fine-grained grits and flags; and among these, or above them, occur two or three thin bands of coal, together with abundance of coal plants. The shales have often curiously concretionary globular forms, of one or two feet in diameter, appearing in them, piled one over the other; a single spheroid sometimes embracing parts of two or more beds. Except weathering into these singular spheroidal forms, the shales do not appear different from those which are not concretionary. These Coal Measures are commonly highly-inclined and contorted, and often inverted, and the coals are not only changed into anthracite, but squeezed and crushed so as to be only got in small dice-like fragments. The regularity of the beds is also interfered with, so that beds of which the original thickness was probably a couple of feet or so, have now for many yards only one or two inches, and then suddenly expand into large pockets of coal 20 or 30 feet in thickness. Coal-mining here is conducted like vein-mining.

Geology.

Clare, Limerick, Tipperary, Kilkenny, &c.

	Feet.	Feet.
5. Coal Measures		+ 2000
4. Upper Limestone	250 to	1000
3. Calp or Middle Limestone	400 to	1000
2. Lower Limestone		1000
1. Lower Limestone shale	50 to	150
Old Red Sandstone.		

No. 1 is everywhere the same as before described.

No. 2 is a series of thick gray limestones, generally light-coloured, sometimes crystalline, sometimes compact; large parts of it are magnesian, sometimes becoming a true dolomite. In some parts of the district some of the beds become as Oolitic as the Bath stone, still, however, retaining their gray colour. In some places, especially in Limerick, contemporaneous traps and trappean breccias are interstratified with these beds and with the upper or yellow part of the Old Red Sandstone below them.

No. 3. Black limestones, sometimes very earthy, interstratified with black shales, that become in some places more important than the limestones. The limestones of this group are usually unfit for burning into lime. Chert bands and nodules are very abundant in the Calp.

No. 4. Thick and thin bedded crystalline and compact limestones of various colours, but usually light-coloured. Chert bands and nodules are also abundant occasionally.

No. 5. The Coal Measures are exactly the same as those previously described in Kerry and Cork, except that they are little contorted, lying generally horizontal or nearly so, and the coal beds retain their thickness apparently unaltered,—this thickness, however, being rather inconstant between 6 inches and 2 or 3 feet. The fossils found in the lower part of these coal shales are marine—Goniatites, Bellerophon, and *Pecten papyraceus*. Coal plants, however, are abundant in the higher part near the beds of coal. It is possible that these Coal Measures may be of the same age as the millstone grit of central and northern England.

North of Ireland.—As we trace the Carboniferous series from the central to the northern districts of Ireland, a still further change takes place always in the same direction; that is, always becoming more complicated and subdivided as we proceed from south to north. The typical rocks then become—

7. Coal Measures.
6. Millstone grit.
5. Upper Limestone.
4. Calp { Upper Calp shale. / Calp sandstone. / Lower Calp shale.
3. Lower Limestone.
2. Lower Limestone shale.
1. Yellow Sandstone and Old Red Sandstone.

1. The Yellow Sandstone of Dr Griffith, as shown in the north of Ireland, is interstratified with dark shales and gray limestones, containing common Carboniferous fossils in great abundance. It has also red beds of shale interstratified with it, but may perhaps be a rather different group from the yellow sandstones forming the top of the true Old Red Sandstone in the south of Ireland.

2. This group does not appear to differ in any respect from the Lower Limestone shale of the south of Ireland.

3. The Lower Limestone is also apparently just like that of the south.

4. The Calp becomes more purely an earthy deposit, and the shales are split up by a considerable group of sandstone beds in its middle portion, sometimes containing traces and thin seams of coal.

5. The Upper Limestone is probably the same as the Great Scaur Limestone of the north of England.

6 and 7. These also are similar to the corresponding beds in Derbyshire and Yorkshire, shortly to be described.

Let us now turn to England, and trace in like measure the Carboniferous series from south to north.

South Wales and the Border Counties.—The rocks of the Carboniferous period may here be grouped as follows:—

	Feet.
4. Coal Measures	12,000
3. Millstone grit, or Farewell rock	1,000
2. Carboniferous limestone	2,000
1. Lower Limestone shale	500
Old Red Sandstone.	

1. The Lower Limestone shale consists of dark earthy shales, occasionally interstratified with yellowish sandstones below, and always with thin flaggy limestones in its upper part. It seems therefore to graduate downwards into the top of the Old Red Sandstone, as well as upwards into the Carboniferous limestone.

2. Carboniferous limestone.—A great series of compact limestones, thick and thin bedded, of various shades of gray and red, interstratified with brown, gray, and red shales below, and with shales and sandstones (often red) in the upper portion.[1] Thickness, 1800 to 2000 feet.

3. Millstone grit or Farewell rock.—A series of sandstones, hard, quartzose, white or gray, and near Bristol, red. Maximum thickness about 1000 feet.

4. Coal Measures.—An enormous series of alternations of many hundred beds of shales, sandstones, and coals, the latter varying from 1 inch to 7 or 8 feet in thickness. The total thickness of the whole group is not less than 7000 feet, and is believed in some places to be even as much as 12,000 feet.[2]

Near Bristol it is thinner, and is divisible into three subgroups, having a central band of hard sandstones called Pennant.

	Feet.
c. Upper Coal Measures	1800
b. Pennant series	1725
a. Lower Coal Measures	1565

This central band of sandstones is traceable also in South Wales by means of a hard quartzose sandstone called Cockshort rock.

In the Forest of Dean coal-field the thicknesses given above are diminished to about one-third, or—

	Feet.
Coal Measures.	
Millstone grit	270
Carboniferous limestone	480
Lower Limestone shale	165

(*Mem. Geol. Survey*, vol. i., p. 129.)

Derbyshire, &c.—The base of the formation is not here seen, but we have the following groups:—

	Feet.
4. Coal Measures, more than	2700
3. Millstone grit	1600
2. Upper Limestone shale	400
1. Carboniferous limestone, more than	600

1. The Carboniferous limestone is a series of pure pale-gray, thick-bedded limestones, with scarcely a trace of clay or shale interstratified with them, over large areas, and through a thickness of several hundred feet. On the south-west, however, towards Staffordshire, shales alternate with its upper portion. Over the centre and north of Derbyshire two contemporaneous beds of greenstone, called toadstone, are interstratified with the limestones. The thickness of these toadstones is sometimes as much as 100 feet, but generally 20 or 30.

2. Upper Limestone shale.—This is a series of beds of black shale, without either limestone or sandstone in all the central part of the district, and about 500 feet thick.

It is not recognised as an independent group in the South Welsh district.

It is generally devoid of fossils.

3. Millstone grit.—Thick, yellow, white or brown sandstones, sometimes fine-grained, sometimes very coarse, containing quartz grains as large as peas. Separated into four groups of sandstones by three little intervening coal-seams and their associated shales.

4. Coal Measures.—Alternations of sandstones and shales, with interstratified beds of coal generally resting upon fire-clay. The Lower Coal Measures in Derbyshire and Yorkshire contain many beds of hard sandstone called "ganister," and it is difficult to draw any decided boundary line between them and the Millstone grit.

Proceeding northwards from Derbyshire, we find a gradual change taking place in the arrangement and grouping of the beds mentioned above. The Coal Measures retain their characters, but the Millstone grit first becomes more separated by beds of shale and coal, while the Upper Limestone shale becomes split up by beds of sandstone above and of limestone below, and eventually likewise contains beds of coal; and, lastly, the limestone itself has its beds separated by shales and sandstones, which finally, as we go farther north, include beds of coal; so that the whole series becomes a great series of Coal Measures containing interstratified limestones in its lower part only. This change is perceptible by examining the rocks of *North Yorkshire* and *Durham*. (Phillips.)

	Feet.
4. Coal Measures, more than	2000
3. Millstone grit	414
2. Yoredale series	540
1. Great or Scaur Limestone group, more than	1119

1. The Great or Scaur Limestone, as described by Foster in Teesdale (Phillips' *Manual*, p. 163), consists of ten sets of beds of limestone from 7 feet to 130 feet in thickness, separated by as many sets of shale and sandstone varying from 12 to 240 feet thick, the total thickness of the whole being 1119 feet, with the bottom not seen.

2. The Yoredale series contains nine sets of limestone from 2 to 30 feet thick, with as many alternations of shales and sandstone from 17 to 70 feet thick, with occasional beds of coal, the whole being 544 feet thick.

3. The Millstone grit here contains one central band of limestone, called Feltop lime, between alternations of sandstone, shale with ironstone, and coal, having a total of 414 ft.

4. The Coal Measures of the Tyne district (Newcastle, &c.) are about 2000 feet in thickness, containing about 600 separate beds (or measures), and a total of about 60 feet of coal. The coal lies in many beds, two of which are 6 feet in thickness, and three others 3 feet and more. The Lancashire coal-field, containing higher beds than are to be seen on the Tyne, is more than double this thickness, or about 5000 feet, including 75 beds of coal over a foot thick (some being 6 feet), and a total thickness of 150 feet of coal.

Scotland.—The Carboniferous rocks of the country between Edinburgh and Glasgow may be judged of from the following section, of which the upper 600 feet is taken from the Monkland district, and the rest from that of Carluke:—

	Feet.
Red Sandstone (Carboniferous)	
Alternations of sandstones and shales with coal and ironstone	130·0
Limestone	1·0
Alternations, &c., five beds of coal 4 feet thick, many others less	1635·0
Forward	1766·0

[1] Section near Bristol (*Mem. of Geol. Survey*, vol. i, p. 113). Along South Wales the group is more purely limestone, and much thinner, especially to the northward and westward.

[2] It was in the examination of the South Welsh coal-field, while on the geological survey of the United Kingdom, that Sir W. Logan was first struck with the invariable position of the beds of coal upon an "under-clay," crowded with stigmaria (roots of Sigillaria, &c.), which he inferred was the old soil on which the plants grew that formed the coal.

	Feet.
Brought forward	1765·0
"Gare" limestone	4·9
Intermediate strata	150·
"Ochrey" limestone	3·0
Sandstone with shale, &c., one coal	51·0
Limestone	4·0
Alternations, &c., four coals of 2 or 3 feet, many ironstones	405·0
1st Cawmey limestone	1·6
Shale	8·6
1st Kinshaw limestone	1·0
Alternations, &c., one little coal	16·4
2d Kinshaw limestone	2·10
Shale, with ironstone balls	29·5
2d Cawmey limestone	4·6
Shale, with ironstone band	42·0
Foulband limestone	3·6
Alternations, &c., one coal of 1 foot 8 inches	86·0
3d Cawmey limestone	2·6
Shale, with ironstone band	20·0
Main limestone	4·6
Shale and fire-clay, with one coal	29·0
Coarse limestone, with intermediate band of fire-clay	5·6
Sandstone, with shale and little coal	54·0
Limestone	2·0
Fire-clay, sandstone, and shale, with one small coal	34·0
Oyster-shell limestone (Producta, &c.)	4·0
Alternations of shale, whitish sandstone, and fire-clay	104·0
Old Red Sandstone to an unknown depth.	
	2779·10

Devon and Cornwall.—This district contains beds belonging to the Upper as well as the Lower Carboniferous series, but they are very anomalous and scarcely comparable with any degree of certainty with those of the rest of Britain. They consist of—

2. Culm Measures.
1. Shales and limestones, probably the Lower Limestone shale.

1. The shales, &c., over the Marwood sandstone group resemble more or less the Lower Limestone shales of South Wales, except that they are traversed by slaty cleavage, and have in their upper parts a dark-coloured limestone that may be a debased representative of the Carboniferous limestone.

2. The Culm Measures are a great series of alternations of shales (sometimes cleaved into slates), sandstones, and fine conglomerates, into a few beds of earthy anthracite or culm. Whether they are of the same age as the true Coal Measures is doubtful. They may perhaps have been deposited contemporaneously with part of the Carboniferous limestone, but under different conditions, and probably in water (fresh or salt) altogether separated from the seas of the north. Or if we suppose with Sir R. I. Murchison that the black limestone of group 1 represents the whole of the Carboniferous limestone, then the Culm Measures may be of the age of millstone grit, and possibly that of the coal-bearing rocks of the Kilkenny and the Kerry coal-field.

Midland Counties.—The Carboniferous rocks of the midland counties of England are by no means typical groups. They consist generally of the upper portion or Coal Measures only, resting unconformably on Silurian or still older formations. It is probable that during the time of the deposition of the Carboniferous limestone there was land existing where the midland counties of England now are, which land only became covered with water in consequence of a gradual depression taking place in the latter part of the Carboniferous period.

Belgium.—According to M. Dumont—

Systeme Houllier.	4. Alternations of "ampelite" (sandstone) shale, and coal.
Systeme Condrusien.	3. Crinoidal limestone, dolomite, Productus limestone, with chert and anthracite. 2. Gray sandstone, soft sandstone, and anthracite. 1. Gray shales, calcareous shales, dark limestone, and pisolitic iron ore (oligiste).

Carboniferous rocks occur in small detached localities in many other parts of Europe, but do not admit of description as *typical* rocks of the period. The fossils contained in them agree with those already mentioned, with just that amount of difference that might be expected to arise from the laws of geographical distribution.

North America: Nova Scotia.—According to Mr Dawson—

Upper Group.	3. Grayish and reddish sandstones and shales, with beds of conglomerate, and a few thin beds of limestone and coal. 3000 feet and more.
Middle or Good Coal Group.	2. Gray and dark-coloured sandstones and shales, with red and brown beds, coal, ironstone, and bituminous limestone. 4000 feet and more.
Lower or Gypsiferous Group.	1. Red and gray sandstones and conglomerates, and red and green marls and shales, with thick beds of gypsum and limestone. 6000 feet and more.

Altogether there is a thickness of more than 14,000 feet, without reaching any exact base, or arriving apparently at the very highest beds of the series. There are seventy-six beds of coal, of which, however, most are only 1 or 2 inches thick, and the thickest not more than 4 feet. (Dawson's *Acadian Geology.*)

Some of the beds of group 1, consisting of sandstones with variegated marls and gypsum, and a few beds of coal, were seen formerly by ourselves in Newfoundland, on the south shore of St George's Bay, and at the northern extremity of the Grand Pond. (*Report on Geology of Newfoundland.*)

United States.—According to Professor Rogers—

3. Upper Carboniferous or Coal Measure Group.	Coal Measures, alternations of sandstones, shales, and coals, like groups 2 and 3 of the Nova Scotia district, but thinning out westward, so as to be only 3000 feet in Pennsylvania, 1500 in the Illinois basin, and not more than 1000 in Iowa and Missouri.
2. Middle Carboniferous Group.	Soft red shales and argillaceous red sandstones in Pennsylvania, 3000 feet. In Virginia— c. Blue, olive, and red calcareous shales, with thick red and brown sandstone. b. Light-blue limestone, sometimes Oolitic. a. Buff, greenish, and red shales, with sandstone. Total thickness, 3000 feet. In the Western States— b. Gray and yellow sandstone. a. Light-blue and yellow limestone,[1]—1000 feet.
1. Lower Carboniferous Group.	White, gray, and yellow sandstones, alternating with coarse siliceous conglomerates and dark-blue and olive-coloured slates. In some places contains black carbonaceous slate, and a bed or two of coal. 2000 feet thick in Pennsylvania, thinning out to nothing in the north-west.

Australia: New South Wales.

5. Dark-brown shales, with impressions of plants, 300 feet and more.
4. Sydney sandstone, thick white or light-yellow sandstone, with quartz pebbles occasionally, and partings of shale, 700 feet.
3. Alternations of shales and sandstones, 400 feet.
2. Shales containing two or three good beds of workable coal 6 feet thick, 200 to 300 feet.
. Wollongong sandstones, thick dark-gray reddish-brown, often calcareous, with large calcareous concretions, 400 feet and more.

[1] The light-blue limestone mentioned above thickens toward the south-west and dies away to the north-east in Pennsylvania.

This is only a part of the series, as there may be beds below No. 1, and others above No. 5.

Victoria.—The same formations as New South Wales. We may expect shortly to receive more definite information respecting them from Mr A. N. C. Selwyn and the geological survey under his direction.

In Tasmania similar rocks occur, similarly associated with a thin group of shales, containing one or two good beds of coal.

India.—We may shortly expect more definite information than we yet possess, from the labours of Professor Oldham and his staff, on the geological survey of that country.

PERMIAN PERIOD.

TYPICAL GROUPS OF ROCKS.—*Durham, &c.*—According to Professor Sedgwick—

	Feet.
6. Red gypseous marls	100
5. Thin-bedded gray limestone	80
4. Red gypseous marls, slightly saliferous	100
3. Magnesian limestone	500
2. Marl slate	60
1. Lower Red Sandstone	200

1. Is a coarse pale-red sandstone, resting unconformably on the Coal Measures, often containing large fragments of coal plants, that *may* have been drifted out of the Coal Measures, and sometimes fragments of coal.

2. Marl slate, a brown indurated fissile shale, with occasional beds of thin compact limestone.

3. Magnesian Limestone.—A singularly diversified mass of limestones, sometimes compact, at others crystalline, brecciated, earthy, globular, oolitic, cellular, &c.; some beds like piles of cannon or musket balls, others like bunches of grapes, &c.; some very hard, some quite friable, some thin and flexible. General colour, shades of yellow, sometimes red and brown.

Nos. 4, 5, and 6, are sufficiently described already; they are destitute of fossils, except a few traces of bivalves in No. 5.

Midland Counties of England.—A great series of red and variegated sandstones and conglomerates, with breccias containing angular fragments of trap and of Silurian and Carboniferous rocks, together with thick dark-red marls, and in some places mottled calcareous bands, like the cornstones of the Old Red Sandstone. The total thickness in many places exceeds 1000 feet.

Ireland and Scotland.—The red sandstones of Roan Hill, near Dungannon, containing abundance of *Palæoniscus catopterus*, are probably Permian. Yellow magnesian limestones, exactly like those of Durham, and with many of the characteristic fossils previously mentioned, occur in patches at Artrea,[1] county Tyrone, and at Cultra, near Belfast.

The red sandstones of Dumfries, with tracks of reptiles so beautifully figured by Sir W. Jardine in his *Ichnology of Annandale*, may also possibly belong either wholly or in part to the Permian rather than the Triassic period.

South of Russia: Government of Perm.—According to Sir R. I. Murchison, the district of Perm exhibits so great a development of the rocks of this period as to induce him to select that name for it. These beds are said to be very various, but in one locality they have the following type:—

c. Conglomerate and sandstone.
b. Red sands and copper beds.
a. Sandstones, limestones, gypsum, and grit beds.

The limestones are often numerous, and contain fossils like those of the magnesian limestone of England and the Zechstein of Germany, while other beds contain Thecodontosauria and fishes.

In Thuringia so great is the accordance with the British series, both in the rock groups and their included fossils, that Professor King in his monograph places them side by side as follows:—

THURINGIA.	NORTH OF ENGLAND.
Stinkstein	Crystalline limestone.
Rauchwacke	Brecciated limestone.
Dolomit	Fossiliferous limestone.
Zechstein	Compact limestone.
Mergel, or Kupfer schiefer	Marl-slate.
Rothe todle liegende	Lower Red Sandstone.

Professor Sedgwick long ago pointed out the remarkable similarity of the fish in the "Mergel schiefer" and his Marl slate. (See Sedgwick's paper on *Mag. L. Trans. Geol. Society.*)

During the Permian period, and at its close, the part of the earth now occupied by Western Europe seems to have been more than usually affected by movements of elevation and disturbance, attended with consequent large denudation of the previously existing rocks. We are obliged, therefore, to look to other parts of the globe, where tranquillity reigned during the portion of time that elapsed at the close of the Primary and the commencement of the Secondary epochs, for the typical deposits during this part of the earth's history. Future research will probably be prolific of future discovery of records now unknown to us belonging to the Permian and Triassic periods. Some of these discoveries are even now being made, but many others will doubtless follow. As a consequence of this disturbance and denudation, the Permian rocks are frequently unconformable to the Carboniferous, and the Triassic to the Permian.

CHAP. II.—SECONDARY OR MESOZOIC EPOCH.

TRIASSIC PERIOD.

TYPICAL GROUPS OF ROCK.—*Germany.*—

	Feet.
3. Keuper	1000
2. Muschelkalk	600
1. Bunter Sandstein	1500

1. The Bunter Sandstein, or "variegated sandstone," is a red and white sandstone interstratified with red marls and thin bands of limestone, sometimes oolitic, sometimes magnesian. This is the "Gres bigarré" of the French.

2. *Muschelkalk.*—A compact reddish-gray or yellowish limestone, rarely oolitic, but in some places magnesian, especially in the lower beds, which include beds of gypsum and rock-salt. It might accordingly be divided into two sub-groups:—

b. Upper Muschelkalk, regularly-bedded limestone, more than 300 feet thick.
a. Alternations of limestone, dolomite, marl, and gypsum or anhydrite, and rock-salt, 280 feet.

3. *Keuper.*—"Marnes irisées" of the French. Principally red and green marl, but is locally divisible into three subgroups, namely:—

c. Keuper sandstone, of a yellowish-white, sometimes green and reddish colour, containing calamites and other plants.
b. Keuper marls, with gypsum and dolomite, containing coprolites, fish, and saurian bones, scales, and teeth.
a. Lettenkole (clay-coal) group, a dark-gray shale or gray sandstone, containing small irregular beds of impure earthy coal, with remains of Mastodonsaurus (Labyrinthodon), Gervillia, Posidonomya, and Lingula.

This latter group rests directly on the Muschelkalk, and

[1] See Professor King's paper (*Dublin Nat. Hist. Review*, No. x.), or *Journal of the Geological Society*, Dublin, vol. vii.

seems, from its animal remains, to belong to it, but its plants are those of the Keuper.

Near Stuttgart, and in other parts of Germany, the Keuper sandstone is capped by a layer of sandstone breccia, full of the remains of saurians and fish in fragments, exactly like that known in England as the "bone bed." It is still doubtful whether this belongs more properly to the Trias or the Lias. Like the bone bed at the top of the Ludlow, it may perhaps be taken as an indication of a great gap in the series of beds.

In the *Supplement* of Sir C. Lyell before mentioned we have the latest intelligence regarding a set of beds which fill up the gap indicated by these "bone beds;" and, moreover, give us the true marine fossiliferous equivalents of the elsewhere fresh-water or unfossiliferous Keuper, and possibly also of part of the Bunter.

Near Hallstatt (south-east of Salzburg), on the north side of the Austrian Alps, and at St Cassian, on the south side, are a set of beds composed of red, pink, and white marble, from 800 to 1000 feet in thickness, and containing more than 800 species of fossils.

Underneath the Hallstatt and St Cassian beds are others called the Guttenstein and Werfen beds. They consist of—

	Feet.
b. Guttenstein beds, black and gray limestone, alternating with red and green shale	150
a. Werfen beds, red and green shale and sandstone, with gypsum and rock-salt.	

It is yet doubtful whether these are only a lower portion of the St Cassian beds, or are to be considered as equivalents of the British or Lower Trias

Over the St Cassian beds again come 2000 feet of white or grayish limestone, known as the Dachstein beds, and above these 50 feet of gray and black limestone with calcareous marls, called the Kœssen beds. Each of these groups contain a peculiar set of fossils of a character which renders it uncertain whether they should be classed as Upper Triassic or as Lower Liassic groups.

We would press upon the reader's attention that we have in these beds one or two of the missing links that are to reward the researches of future geologists, and fill up the many gaps in our geological history.

England.—The Triassic rocks of England are anything but typical, notwithstanding that they occupy a greater surface than perhaps any other formation. The important central division, the Muschelkalk of Germany, is entirely wanting, as are the still more important Hallstatt and St Cassian beds. The labours of the Geological Survey of the last few years have shown the following to be the groups in the midland counties, where the formation is best developed:—

3. Red and variegated marls.
2. White sandstone.
1. Red and mottled sandstone.

1. The Red and Mottled Sandstone has a base of "brick-red" sandstone, very fine grained and thick-bedded. Over this come reddish-brown sandstones, or red and white sandstones, with beds of marl, and thick, rather irregular bands of partially consolidated conglomerate, called "pebble-beds." Mottled calcareous concretionary sandstones, not unlike some varieties of "cornstone," occur occasionally in this "brown" division, often associated with the marls. The whole group seems to be locally represented by a dolomitic conglomerate, unless that should be referred rather to the Permian period.

2. The White Sandstone is a very persistent and well-marked group over a very wide area, forming the hill on which Beeston Castle (Cheshire) stands, and spreading through a great part of the midland counties of England. It is generally white, sometimes mottled with red, and is often used as a building stone, for which purpose it is occasionally sufficiently well adapted.

3. The Red and Variegated Marls contain irregular beds of sandstone, and almost invariably beds and veins and strings of gypsum, and frequently thick masses of rock-salt. In Cheshire, near Northwich, the following section shows a part of the thickness of these beds:—

	Feet.
Upper strata (marl, &c.)	127
1st bed of rock salt	85
Indurated marl (locally called "stone")	30
2d bed of rock salt	106
Indurated marls, with thin beds of salt	151
	490

Over this thickness of 500 feet are other beds of marl, &c., before we reach the base of the Lias, and under them others before we should attain the top of the whitestone, so that the entire depth of the group must be 700 feet with, or 500 without, the salt.

An occasional set of beds of a pale-coloured sandstone, called by ourselves formerly the "Dove-coloured Sandstone," in the upper part of this group, contains fossil plants and fragments of reptiles, enabling us to identify this group, No. 3, with the Keuper of Germany. No. 1 is almost certainly the same as the German Bunter Sandstein, and the French "Gres Bigarré."

Ireland.—In the north, near Belfast, a considerable mass of red sandstones belong either to the Bunter sandstone or the Permian. Over them is a group of red and variegated marls, which, near Carrickfergus, contains beds of gypsum and rock-salt, of which the following is a section:—

	Feet.
Red marls, with gypsum.	510
Red salt	22
Marl and salt	26
Pure rock-salt	84
Mixed rock-salt	14
Pure rock-salt	39
Blue bands and freestone, &c.	25
	700

These have other beds of red marl above them, about 100 or 150 feet thick, over which is the base of the Lias. They in all probability therefore belong to group No. 3, and = Keuper of Germany.

THE OOLITIC OR JURASSIC PERIOD.

TYPICAL GROUPS OF ROCK.—*England.*—If we arrange the whole series of the rocks of this period in their order of occurrence, in slightly different but neighbouring localities, we shall have the following list:—

		Feet.	
D. PORTLAND, or UPPER OOLITE.	12. Purbeck beds	150	*c.* Upper. *b.* Middle. *a.* Lower.
	11. Portland beds	170	*b.* Stone. *a.* Sand.
	10. Kimmeridge clay	600	Dark clay.
C. OXFORD, or MIDDLE OOLITE.	9. Coral rag	180	*c.* Upper Calcar. grit. *b.* Oolitic limestone. *a.* Lower Calcar. grit.
	8. Oxford clay	600	*b.* Dark clay. *a.* Kelloway rock.
B. BATH, or LOWER OOLITE.	7. Cornbrash	80	*c* Cornbrash. *b* Forest marble. *a.* Bradford clay.
	6. Great Oolite	130	*b.* Freestone and rag. *a.* Stonesfield slate.
	5. Fuller's earth	130	
	4. Inferior Oolite	230	*c.* Ragstone. *b.* Freestone. *a.* Pea grit.

		Feet.	
A. Lias.	3. Upper Lias	300	b. Lias sands.
			a. Upper shale.
	2. Marlstone	200	b. Rock beds.
			a. Sands.
	1. Lower Lias	600	c. Lower shale.
			b. Limestone and shale.
			a. Bone bed or beds.

A. The Lias.—Essentially a great clay deposit, with occasional bands of a peculiar compact argillaceous limestone near the bottom, and an argillaceous sandstone near the middle, with a loose sandy deposit at top connecting it with the group above.

1. Lower Lias.—At the top of the red marls of the Triassic Keuper group below is a little layer of hard sandstone full of fragments of bones and teeth of reptiles and fish. In some places bones of Keuper reptiles have been seen in it, and the layer therefore referred to the Trias; in other places it is full of undoubted Lias fossils. It is probable that there is in reality more than one bone bed, the diminutive representative of the great passage beds between the Trias and the Lias, 2000 feet and more in thickness, which are found at Dachstatt and Kœssen.

In some places the black shales of the Lower Lias rest on the red marls without any bone bed and without any limestone, while in others a group of limestones, interstratified with clays, having a thickness of 20 to 50 feet, is seen. Over these limestones occur the ordinary blue clay of which the Lower Lias is generally composed.

2. The Marlstone is a well-marked division of the Lias, being more arenaceous, though still fine-grained, and often bound by calcareous or ferruginous cement into a hard stone. In Gloucestershire it is divisible into the hard "rock bed" above, and the sands, often rather argillaceous, below.

3. Upper Lias.—This consists of a great thickness of blue clay, over which are some brown and yellow sands, hitherto classed with the Inferior Oolite, but separated from it on good palæontological evidence by Dr Wright of Cheltenham, and called by him Upper Lias sands, capped by a particular band called the "Cephalopoda bed," from the abundance of those fossils which it contained.

The lithological type and the characteristic assemblages of fossils are applicable to the Lias throughout England from Lyme Regis to Whitby, if we allow for some variations in thickness and in the character of the minor groups of rock, and for a local distribution in the fossils.

B. The Lower or Bath Oolite, composed of the four groups called,—4. The Inferior; 5. Fuller's earth; 6. The Great Oolite, and 7. The Cornbrash.

4. The Inferior Oolite near Cheltenham, where it contains its greatest development, consists of—*a.* The Pea grit, a pisolitic limestone, made up of flattened oval concretions rather larger than peas, sometimes 40 feet thick; *b.* The Freestone, a fine pale-coloured oolitic or shelly limestone, 164 feet thick, containing a bed of marl 7 feet thick near the top; *c.* The Ragstone, a brown sandy limestone, sometimes hard, sometimes incoherent, 38 feet thick.

In the Cheltenham district even the subdivisions of the Inferior Oolite mentioned above have their lists of peculiar and characteristic fossils. (*Memoirs of the Geological Survey*, 1857; Mr Hull *On the Geology of Cheltenham.*)

5. Above the Inferior Oolite comes in the Gloucestershire district, a series of blue and yellow shales, clays, and marls, some of which are of the peculiar kind of clay called Fuller's earth, the name assigned to the group. Interstratified with these are occasional bands of limestone.

The maximum thickness is about 150 feet, rather rapidly diminishing in all directions.

6. Great Oolite.—This, like all the other oolitic groups, except the clays, has a very variable lithological character. Mr Lycett says that near Minchinhampton it is made up of weatherstones, sandstones, and limestones; the weatherstones, shelly calcareous sandstones, being always at the base of the group, but passing laterally into sandstones, which are commonly covered by limestones, while the weatherstones have never any of the limestones above them. (*Jour. Geol. Soc.*, vol. iv.; and *Palæontolog. Soc.*, 1850.) Mr Hull divides the Great Oolite near Cheltenham into two zones,—*a.* The Under zone, a variable series of sandy flags, "slates," and blue limestones, with white oolitic freestones, showing much oblique lamination. The flaggy limestones, and sometimes the thick-bedded ones, split in some places into very thin slabs, which are called, though erroneously, "slates."[1] The Stonesfield slate, so celebrated for its terrestrial reptiles and mammalian remains, belongs to these beds, and it might therefore give its name to the zone. The Collyweston slate belongs to this group; thickness, 35 feet. *b.* The Upper zone is well marked in Gloucestershire by the occurrence of a bed of marl at its base, and a band of hard white limestone at its summit, the intermediate beds being oolitic limestones, sandstone, or sandy limestone, greatly marked by oblique lamination; thickness, 100 feet. (*Memoirs of the Geological Survey*, 1857.)

7. Cornbrash group.—This is a very variously composed set of clays, sands, and limestones, containing local divisions, such as the Bradford clay, the Forest marble, and the Cornbrash itself.

The Bradford clay is a blue unctuous clay occurring at Bradford, and extending for a few miles around it; it is never more than 40 or 50 feet in thickness; locally full of *Apiocrinites Parkinsoni* (*rotundus*). The Forest marble (so named from Wychwood Forest) is composed of coarse fissile oolite, with much oblique lamination, hard shelly limestones, blue marls and shales, yellow siliceous sand, with large spheroidal blocks of limestone, and fine oolitic freestone. It is rarely more than 40, never more than 80, feet thick. The Cornbrash is generally a rubbly cream-coloured limestone in thin beds, always nodular and concretionary, each fragment having a deep red coating. Not more than 15 feet thick.

The foregoing description of the Bath Oolite is applicable, with more or less accuracy, to all the country south of the Humber. Proceeding into Yorkshire, however, a very remarkable change takes place both in the rocks and the fossils.

The little insignificant-looking band of the Cornbrash continues lithologically and palæontologically the same; below this, however, instead of limestones, there is a great mass of shale and sandstone, with a band of shelly oolite in the centre, and, underneath all, ferruginous sands and calcareous sandstones that may either represent the Inferior Oolite or the Upper Lias sands.

Professor Phillips gives the following as a condensed account of this Yorkshire type:—

	Feet.
5. Shelly Cornbrash limestone of Gristhorp and Scarborough	10
4. Sandstones, shales, ironstones, and coals of Gristhorp, Scarborough, and Scalby, inclosing some calcareous shelly bands	200
3. Shelly oolite, and clays of Cloughton and West Nab	60
2. Sandstones, shales, ironstones, and workable coal of the Peak, Stainton Dale, and Haiburn Wylie	500
1. Irony sandstone and subcalcareous beds, with bands of shells and plants	60

Some Equisetites are found erect in these beds, and everything tends to show that we have in this type a true secondary coal formation of the Oolitic period, in addition

[1] We have formerly pointed out the advisability of confining the term "slate" to those rocks of which the thin plates are the result of "cleavage," not of deposition.

Geology.

to that primary coal formation formed in that which is distinctively called the Carboniferous period.

C. The Oxford or Middle Oolite consists of two principal groups—the Oxford Clay and the Coral Rag.

8. The Oxford Clay is generally a dark blue clay, sometimes dark gray, approaching to black. In its lower portion it has some beds of tough calcareous sandstone, with brown sands called Kelloway rock, from a place in Wiltshire. This Kelloway rock appears to be wanting in the midland counties, but reappears in Yorkshire with the same characters and fossils. The maximum thickness of the Kelloway rock is 80 feet. That of the whole Oxford clay, including it, cannot be less in some places than 600 feet.

9. The Coralline Oolite or Coral Rag.—Like all the other calcareous or arenaceous groups of the Oolite, this is very irregular, and subject to great variations in character and thickness. There is a pretty close general resemblance in the Yorkshire and Wiltshire types, while in the intermediate district the whole group seems to disappear. It may be divided into three sub-groups,—

		Feet.
c. Upper Calcareous grit, maximum thickness		60
b. Coralline oolite,	"	50
a. Lower Calcareous grit,	"	80

a. The lower beds in Yorkshire are a series of gray marly sandstones, 70 feet thick, passing up into cherty limestone, covered by sands full of great calcareous concretions, capped by strong calcareous sandstones.

b. A variable group of irregular masses of nodules made of corals compacted together, often earthy, and connected by blue clay, passing into blue crystalline limestone, alternations of hard shelly oolite, and soft perishable limestone, and in Wiltshire a rubbly nodular oolite, sometimes pisolitic.

c. The upper group obscurely indicated in the south is, in the north, like group *a*, but more ferruginous and less cherty, passing up by intercalation into the Kimmeridge clay above. (Phillips.)

D. The Portland or Upper Oolite is composed of three principal groups, each capable of subdivision into two or three sets of beds.

10. The Kimmeridge Clay is in some places a dark gray shaly clay, in others brownish or yellowish, and containing bands of sand, or of calcareous grit, or ferruginous oolite, and layers of nodules of septaria. In some places, especially in the district about the Isle of Purbeck, it becomes very bituminous, and the bituminous shale sometimes passes into layers of "brown shaly coal." Layers of a particular kind of oyster, called the *Ostræa deltoidea*, occur abundantly in some places, always appearing "in broad continuous floors, parallel to the planes of stratification, the valves usually together, with young ones occasionally adherent to them, and entirely embedded in clay, without nodules or stones of any kind, and without any other organic remains in the layers." (Phillips.)

11. The Portland beds.—These, like most of the other members of the Oolitic series, have a variable composition, consisting of sands and sandstones below, becoming calcareous and passing into oolitic limestone above. They are therefore divisible into

	Feet.
b. Portland stone, consisting of white oolite and beds locally termed "stonebrash" and "roche," &c., interstratified with clays, and containing layers of flint, about	90 to 100
a. Portland sands, consisting of brown or yellow sands and sandstones, full of green grains, like those afterwards to be described in the Greensands, about	80

12. The Purbeck beds are remarkably distinguished from the Portland, on which they rest, by being chiefly of fresh-water origin. They contain, however, some marine species, which are allied to Oolitic more closely than to any other types. Edward Forbes therefore detached them from the base of the succeeding formations, and placed them at the top of the Oolitic series. They are also distinguished from most other aqueous rocks by containing one or two beds of "vegetable soil," called by the quarrymen "dirt beds," with the stems of trees and cycadoid plants still erect, and the trunks of trees prostrate alongside of them. This clearly points to a tranquil and gradual elevation of the surface of the rock into dry land, the growth of a forest through hundreds or thousands of years, and its as tranquil and gentle submergence beneath some stagnant water without sufficient current to disturb the soil or carry off the buried plants.

Edward Forbes divides the Purbecks of Dorsetshire into three groups, each characterized by a peculiar assemblage of organic remains, without any other very marked distinction between them, and with no sign of any physical disturbance or denudation.

a. The lowest division, 70 or 80 feet thick, consists of calcareous flags, marls, and limestones, with cypridiferous shales and some siliceous bands, with one large and two or three smaller "dirt beds" near its lower portion. These are all either fresh-water or aërial, except 20 feet in the centre of the group, which are brackish water deposits, containing Rissoæ (Hydrobia), Protocardium, and Serpulæ.

b. The Middle Purbecks, 40 or 50 feet thick, consist first of shales and limestones with thick bands of cherty stone, having impressions of leaves and many fresh-water shells; then the conspicuous "cinder bed," a great heap of small shells of *Ostræa distorta*, over which are other limestones and shales, some fresh-water, some brackish, and some purely marine, containing yet undescribed species of Pecten, Modiola, Avicula, and Thracia, together with a Protocardium distinct from that in the lower beds. Many fish—Lepidotus and *Microdon radiatus*—and reptiles of the genus Macrorhyncus also occur. It is in a little band not more than 6 inches thick, about 20 feet below the "cinder bed," that the very remarkable discoveries of a number of remains of mammalian animals belonging to several genera and species have been made. (Lyell's *Supplement.*)

c. The Upper Purbecks, 20 or 30 feet thick, are another series of beds full of fresh-water shells, distinct from those below, and new forms of fish. The fresh-water snail-shells are sometimes so abundant as to form a hard limestone, much used formerly as Purbeck marble.

It is remarkable that the fresh-water shells have a much closer resemblance to those living at other and more recent periods, or those now existing, than the marine species have. The three changes of life in this small group of Purbecks appear to be due solely to lapse of time, and to those slow and gradual changes in the physical geography of the district which took place, and not to any sudden or violent revolutions or disturbances of which there is no trace.[1]

Ireland.—The Oolitic series is represented in Ireland by a few thin beds of Lias only, not exceeding thirty feet in thickness, resting on the summit of the red saliferous marls of the Trias of the county of Antrim. It contains, however, a considerable abundance of characteristic Lias shells.

Scotland.—On the west coast, opposite the north-east of Ireland, Lias is found also in Scotland, together with Oxford clay, and other representatives of the Oolitic series;

[1] Professor E. Forbes mentions one set of beds as curiously dislocated and disturbed, apparently by causes not affecting the beds below; but this band of local disturbance is included in the lower division, and is not accompanied by any change in the species, while, on the other hand, the great changes in the species take place at certain lines where there is no lithological or petrological boundary whatever. (*Report of British Association*, 1850.)

while on the east coast at Brora, &c., representatives of the Yorkshire oolites are found, containing also impure coal.

The series of rocks deposited in the British Islands during the Oolitic period is so complete, both petrologically and palæontologically, that they serve as a type for those known all over the world. In Europe, the term Jurassic is commonly used instead of Oolitic; the Jura mountain being principally composed of rocks belonging to this period. In tracing the rocks across Europe, differences, both lithological and palæontological, occur, as might be naturally expected; but on the whole a wonderful similarity in both characters extends over very large areas.

It will perhaps be most useful to give a few of the foreign synonyms of the different rock groups adopted by different Continental geologists.

A 1. Lower Lias.—Terrain sinémurien, grès du Luxembourg, calcaire de Valognes, grès de Linckefield, Gryphiten kalk. Lower black Jura.

A 2. Marlstone.—Terrain liasien, marnes de Balingen, amaltheen thon, mumismalen mergel. Middle black Jura.

A 3. Upper Lias.—Terrain toarcien, schistes de Boll, Posidonomya schiefer, Jurensis mergel, Apalinus thon. Upper black Jura and Lower brown Jura.

B 4. Inferior Oolite.—Terrain Bajocien, calcaire Lædonien, calcaire à polypien, marnes vésuliennes, Eisen-Rogenstein discoidien mergel. Middle brown Jura.

B 5. Fullers' Earth; 6. Great Oolite; and 7. Cornbrash.—Terrain Bathonien, calcaire de Caen et Ranville, Parkinsoni Bank. Part of brown Jura.

C 8 *a*. Kelloway Rock.—Terrain Callovien, Oxfordien inférieur. Part of brown Jura.

C 8. Oxford Clay.—Terrain Oxfordien, terrain argovien, terrain à chailles, ornaten thon, Impressa kalke, Spongiten layer. Part of brown Jura and Lower white Jura.

C 9. Coral Rag.—Terrain corallien, schistes de Nattheim, calcaire à nérinées. Middle white Jura. (The lithographic flags of Solenhofen are believed to be in this group.)

D 10. Kimmeridge Clay.—Terrain Kimméridgien, argiles noirs de Honfleur, marnes du Banné, calcaire à astartes. Part of the terrain portlandien of the geologists of the Swiss Jura, who call the lower part Terrain Séquanien; part of Upper white Jura.

D 11. Portland Beds.—Terrain portlandien, Upper white Jura, calcaire à tortues de Soleure.

D 12. Purbeck Beds.—These do not receive any exact synonym either in Pictet or in Vogt, the only two authorities accessible to me.

In other parts of the world the rocks of the Oolitic (or Jurassic) period appear chiefly in their Yorkshire type—that is to say, as sandstones and shales with beds of coal and ironstone, or as Oolitic Coal Measures. Sir Charles Lyell gives a brief description of the Oolitic coal-field of Richmond in Virginia, which has one bed of coal forty feet thick. In India also coal occurs in beds, some of which contain ammonites, shells, and plants very similar to those found in the Oolitic rocks of Britain.

One of the most remarkable localities for rocks of the Oolitic period to occur in, with fossils very closely allied to those of Europe, is the Arctic regions. Captain M'Clintock brought home several fossils from the Arctic regions, consisting of ammonites and other shells, closely analogous to Oolitic species; and Captain Sir E. Belcher brought part of the remains of an ichthyosaurus from the same regions.

The questions thus raised as to the climate of the globe, when cephalopods and reptiles, such as we should expect to find only in warm or temperate seas, could live in such high latitudes, are not very easy to answer.

CRETACEOUS PERIOD.

It is perhaps doubtful whether it would not be more advisable to divide the Oolitic period into two, calling the first portion *Liassic*, and treating it by itself. It is still more doubtful whether it would not be advisable to do the same with that on which we are now commencing, and

treat the early part of the period as a distinct one, under the name of the *Neocomian*, or some other designation. For the present, however, it will be best to follow the classification adopted by Sir C. Lyell and others, calling the whole *Cretaceous*, but dividing the series of rocks into two strongly-marked divisions, called Lower and Upper, or the period of time into Earlier and Later Cretaceous.

Typical Groups of Rock.—*S.E. England, N.W. France, Belgium, &c.*—The following is the entire series of rocks deposited during the great Cretaceous period in this area:—

		Feet.
Upper Cretaceous.	8. Maestricht and Faxoe beds, Pisolitic chalk	100
	7. White chalk, with flints	500
	6. White chalk, without flints	600
	5. Chalk marl	100
	4. Upper Greensand	100
	3. Gault	150
Lower Cretaceous, or Neocomian.	2. Lower Greensand	850
	2 *a*. Speeton clay[1]	60
	1. Wealden beds	1300

This classification is derived from the study of different parts of the area lying between Yorkshire and Orleans, and Dorsetshire and Denmark. As happens in other cases, there is no place where the whole series is present at once, and some of the members are very local and inconstant. The middle part of the Upper Cretaceous series is the most constant and best-marked part of the group, giving us generally an easily recognisable geological horizon or band of demarcation between the beds below and above it.

We saw that at the close of the Oolitic period fresh-water deposits began to prevail within the area we principally contemplate. This involves the existence of large spaces of dry land in the neighbourhood, some of the surfaces of which have even their "soils" still preserved. It appears that a very large portion of the earth's surface must have been converted into dry land at this time in the neighbourhood of our area, for we have, in the commencement of this period, evidence of the existence of a great river, and the earliest deposit of this period appears to have been formed by the matter thrown down at the mouth of this river, and to be in fact a *fossil delta* as large as that of the Ganges or Mississippi. As, however, marine depositions must have been taking place in some other localities, it is to these that we should look if we wish to carry on our history with equipollent data; and it is believed that certain marine rocks, known as Neocomian, from their occurring at Neufchatel (Neocomiensis) in Switzerland, are those which were the contemporaries of our fresh-water beds.

We will, however, first describe the beds of our own area, and take separately the *Lower Cretaceous* or *Neocomian* beds to begin with.

1. The Wealden beds, so called from their now forming a district known as the Weald of Kent and Sussex, consist of a great series of sandstones and shales, with a few beds of limestone and ironstone occasionally, often full of large fragments of drift-wood, and of the remains of fresh-water shells, and of some fresh-water and some land animals (reptiles). In general appearance the Wealden rocks not unfrequently resemble some of the Coal Measures of the true Carboniferous period.

The Wealden rocks are commonly divided into two groups:—

	Feet.
b. The Weald clay	280
a. The Hastings sand	1000

These distinctions, however, seem hardly to be carried

[1] The exact position of the Speeton clay is a little uncertain. Professor E. Forbes, in Johnston's *Physical Atlas*, placed it at or below the base of the Lower Greensand on palæontological evidence alone.

out by any precise line of demarcation. The lower beds are more arenaceous, and the upper more argillaceous; but great beds of clay occur interstratified with the sandstones of the Hastings sands, and beds of sandstone with the clays of the Weald clay. It is probable that these beds change their character laterally as well as vertically, great banks of sand and large deposits of mud having been formed side by side. The sandstones are sometimes impregnated with carbonate of lime, so as to become calciferous grits; and small beds of limestone, forming Petworth or Sussex marble, chiefly consisting of fresh-water snail shells (Paludina), occur here and there. Local names are given to the different parts of the Wealden series in different places, as Ashburnham beds, Worth sands, Tilgate beds, Horsham beds, &c. (Phillips.)

2. The Lower Greensand was formerly considered the base of the Cretaceous series, separated only by the occasional bed of clay called Gault from the Upper Greensand. When the Gault is absent, and the Upper rests on the Lower Greensand, it is difficult to separate them by any lithological distinctions, but when they are separated they are found to be very distinct palæontologically.

Where best shown (as at Atherfield, Isle of Wight, and Hythe, Kent; Fitton, Forbes, and Ibbetson, *Jour. of G. S.*, vols. i. and iii.), the Lower Greensand is found to be a great series of alternations of sands, sandstones, and clays, with occasional calcareous bands. The calcareous sandstones form hard bands, known as Kentish rag; the clays are sometimes excellent fullers' earth, 60 feet in thickness, and are most abundant in the lower part of the formation, the upper being almost entirely sands. The general colour is dark-brown, sometimes red, and the sands are often bound together by an abundance of oxide of iron, from which the formation was formerly called Ironsand. It derives its name of Greensand from the occurrence of a number of little dark green specks (silicate of iron), which are sometimes so abundant as to give a greenish tinge to some of the beds; but the term "green" is generally quite inapplicable as a *description*, though it still remains as a commonly received *name*. The whole formation in Britain is very various in character. Its maximum thickness is 843 feet.

The beds immediately above the Wealden show sometimes a sort of passage lithologically, as if partly made up of those below, while the fossils are quite distinct, being entirely marine. It appears that a depression had taken place and allowed the sea to flow over the area which had been previously covered with fresh water. The change may thus be one of conditions rather than one of great lapse of time—a supposition strengthened by the fact of the bones of the *Iguanodon Mantelli* being found in the Lower Greensand, showing that that great reptile still lived on some neighbouring land, and that an occasional carcase of it was swept out to sea.

2 *a*. The Speeton clay of Yorkshire, a local band of dark clay, is almost certainly of the same age as the Lower Greensand, if not, as thought by Professor Forbes, a little older than it.

Switzerland.—The rocks of Neufchâtel in Switzerland, which are looked upon as one of the best continental types of the beds deposited during this part of the Cretaceous period, are the following:—

	Feet.
5. Yellow limestone, at least	130
4. Yellow limestone, with siliceous masses	43
3. Yellow limestone, in broken beds	22
2. Blue marl	32
1. Lower yellow limestone	22

These beds rest *unconformably* on the beds of the Portland Oolite. (*D'Archiac*, vol. iv., p. 556.)

France.—D'Archiac gives the following as the type of the rocks of this period in the basin of the Seine:—

C.	6. Green and ferruginous sand.
	5. Clay, with *Plicatula* and *Exogyra sinuata*.
B.	4. Variegated sands and sandy clays, with iron ore.
	3. Clays, with oyster shells, &c.
A.	2. Neocomian limestone and blue marl.
	1. White sand and ferruginous sand, with iron geodes.

He says that these groups overlap each other from east to west, but that the upper group (*C*) also spreads much more widely than the rest from north to south.

The following continental names for groups of rock belong to this part of the period, being more or less nearly contemporary with Lower Greensand:—Hils clay and Hils conglomerat; Biancone; Spatangus and Exogyra limestone; Marls of Hautrive; Terrain Urgonien, or "premier zone de rudistes;" and Terrain Aptien,[1] or argile à plicatules of D'Orbigny; the Hippurite limestone, &c.

Upper Cretaceous Beds.—We may now proceed to the examination of the Upper Cretaceous beds of our original area.

3. Gault.—This is a stiff dark-gray, blue, or brown clay, often used for brick-making. It can be seen very well at Cambridge and at Folkestone, but is by no means invariably present. The shells in it are often beautifully preserved, having been well packed and protected from atmospheric or other influences.

Mr Sharpe was inclined to the opinion that the sands of Blackdown were of the same age as the Gault, being the littoral deposits of the same sea, in the deeper parts of which the clay was deposited.

4. Upper Greensand.—This set of beds often resembles the Lower Greensand in lithological character, but the same caution is to be used in taking its designation for a *name* only, and not for a *description*. The sands are by no means always green, and other sands, especially some Tertiary sands, are to be found quite as green, or greener, than those which have received the name of Greensand. Beds and concretionary masses of calcareous grit occur in it, sometimes called firestone, sometimes malm rock. Concretions, probably coprolitic, containing phosphate of lime, also occur, and are valuable to the agriculturist. It has been surmised that the Upper Greensand may be in part a shore deposit, and therefore contemporaneous with, rather than preceding, the lowest beds of the chalk, but wherever the two are together, we always find the Upper Greensand underneath the Chalk Marl.

5. Chalk Marl.—The top of the Upper Greensand becomes argillaceous, and passes upwards into a pale buff-coloured marl or argillaceous limestone, sometimes of sufficient consistency to be used as a building stone. This in its higher portion begins to lose the argillaceous character, and gradually passes into the soft white pulverulent limestone familiar to every one as chalk.

6. White Chalk without flints.—This is a great mass of soft and often pulverulent limestone, thick-bedded, the stratification often obscure, partly by the obliteration of the bedding planes, partly by the abundance of quadrangular and diagonal joints, the surfaces of which are often weather-stained, dirty-green, or yellow. Nodular balls of iron pyrites, radiated internally, are frequent in it, and produce rusty stains about the rock.

[1] M. Renevier, after a detailed comparison of the British and continental rocks, determined that the Lower Greensand of England was strictly contemporaneous with the Aptian beds, and therefore not according to him Neocomian, of which he says the Urgonian is the upper part. We should be inclined, however, to give a wider sense to the term Neocomian (in default of a better), and to include in it all beds of an age intermediate between the Purbecks and the Gault. If M. Renevier be right, it is probable that the Urgonian and other Neocomian beds of Switzerland, &c., are the exact marine representatives of the fresh-water Wealden series.

7. White Chalk with flints.—There are no lithological distinctions between the Lower and Upper Chalk, except the occurrence in the latter of rows of nodules of black flint, and occasionally of seams and layers of the same substance. These occur either along the planes of stratification or parallel to them, so that they point out clearly the original bedding of the rock.

It is rare to find, either in the Upper or Lower Chalk, anything but pure limestone or pure flint. Little pebbles, however, sometimes occur in it, probably carried by the roots of plants; and in a cliff a little east of Dieppe, we once observed in the heart of the Upper Chalk a little band about 8 inches thick and 20 feet long of brown clay or marl, perfectly interstratified with the chalk. This was quite distinct from the seams and irregular patches of sand which may now and then be seen in the chalk, having been washed in subsequently from the drift on the surface, along the open joints and fissures, which are formed in it, as in all limestones, by the action of acidulous water along the original joints of the rock.

Although the Chalk and the Carboniferous limestone are so different in texture and induration, there is yet a certain resemblance in the forms of the country they produce. Their hills have equally broad undulating grassy downs, the escarpments of which are quite smooth in the chalk, while they are notched into steps in the mountain limestone. Their valleys are equally marked by scaurs, and tors and pinnacles, as any one may see by comparing the forms of the rocks on the sides of the valley of the Seine with those in the valleys of Derbyshire. The forms are, of course, bolder, larger, and more durable in the latter than the former.

8. Maestricht or Pisolitic Chalk.—At Mendon and Laversines, and in other parts of the north of France, there occur curious banks of a white Pisolitic limestone, resting apparently in hollows of the Chalk, not always on exactly the upper portion of it, and being therefore apparently slightly unconformable to it. It occurs also sometimes on the same level as the lower beds of the Tertiary rocks about it. The fossils are rather peculiar, but some of them are Cretaceous, while none I believe are Tertiary.

Near Maestricht in Holland, also, the Chalk with flints (No. 7) is covered by a kind of chalky rock with gray flints, over which are some loose yellowish limestones, without flints, and being sometimes almost made up of fossils.

Similar beds containing some of the same fossils occur also at Faxoe in Denmark.

North of Ireland.—The Chalk of the north of Ireland is generally a rather hard compact stone, and usually goes by the name of "the White Limestone." It contains flints and a large assemblage of the characteristic fossils. Its thickness, however, rarely if ever exceeds 150 feet. Underneath it occur occasionally some beds of a whitish sandstone speckled with green, very much resembling some of the beds of greensand in the S.E. of England. Professor E. Forbes, however, once remarked to us that he thought it was more nearly of the age of the gault from its fossils. It is called in the country "Mulatto stone." Its thickness is rarely more than 15 or 20 feet.

CHAP. III.—TERTIARY EPOCH.

Preliminary Observations.

The nomenclature of the Tertiary periods proposed by Sir C. Lyell, and now all but universally adopted, is more systematic than that of the Primary or Secondary periods. It is based on the gradual increase of recent (*i.e.*, living) species in the newer rocks. The earliest of the periods is termed Eocene, from the Greek words ἠὼς and καινὸς, signifying the dawn of the recent; the second, Miocene, from μείων, the minority; the third, Pliocene, from πλείων, the plurality of recent species; and the next, Pleistocene, which expresses the recentness of the great majority of the species.

To these we may add the present period itself, which we may perhaps most conveniently designate as the Recent or the Human Period.

The adoption of this principle of classification was rendered more necessary in the case of the Tertiary than the preceding epochs, from the nature of the physical conditions of Western Europe, on the structure of which our classification is chiefly based.

In the primary and secondary epochs, the part now occupied by Western Europe seems to have always contained more sea than land, and the rocks deposited are accordingly so widely spread as frequently to overlie and rest one upon the other. We can therefore often determine their order of superposition by their geognostic relations only; that is, by actually tracing each group of beds till we find it plunging under the superior group on the one side, or till the inferior group rises up to the surface from underneath on the other. When, however, we come to examine the Tertiary rocks of the same area, we find them more isolated and occurring in smaller and more detached patches, each patch ending before it comes in contact with the rest, so that their order of superposition can rarely be determined by simple inspection. To take a conspicuous instance at once:—The Chalk of the S.E. of England is continuous with that of France[1] and Belgium, and no mistake could possibly be made as to the relative position of the beds above and below it. The Oolites below the Chalk are even still more extensive, and can be traced both geognostically and palæontologically. The Tertiary beds above the Chalk, however, form isolated districts in the hollows of the Chalk, one being called the Hampshire basin, another the London, and a third the Paris basin; and if we wish to determine whether the beds of these three districts are of the same age, or whether one be older than another, it is obvious that we can no longer employ the positive evidence of an inspection of their superposition, but must have recourse either to the petrographical evidence of their being made exactly of the same kinds of rock occurring in the same order, or to the palæontological evidence of their containing the same assemblages of fossils occurring in the same order; or if neither rocks nor fossils were the same, then we should have to fall back on the general rule or principle just spoken of, and see which contained an assemblage of fossils having the greatest approximation to living forms, and this in the case of Tertiary rocks is most easily determined by the relative percentage of actually existing species.

THE EOCENE PERIOD.

TYPICAL GROUPS OF ROCK.—*S.E. of England, London and Hampshire Basin*—

			Feet.	
UPPER.	8. Hempstead series.	d. Corbula beds	25	175
		c. Upper fresh-water and estuary marls......	40	
		b. Middle	50	
		a. Lower	60	
	7. Bembridge series.	d. Upper marls c. Lower marls b. Oyster bed	90	115
		a. Limestone...	25	
		Carry forward,		290

1 That the shallow furrow of the Straits of Dover has been worn down a little way below the level of the sea into the body of the Chalk, does not, of course, affect this assertion.

				Brought forward,	290
			Feet.		
Middle, or Paris Eocenes.	6. Osborne series.	b. St Helen's sands.......	50	70	
		a. Nettlestone grits........	20		
	5. Headon series.[1]	c. "Upper fresh water"	85	182	
		b. Middle marine	30		
		a. "Lower fresh water"	67		
	4. Bagshot series.	d. Upper Bagshot	200	1270	
		c. Barton clay	300		
		b. Bracklesham beds	110		
		a. Lower Bagshot	660		
					1522
Lower, or London Eocenes.	3. London clay, or Bognor series	... ...			480
	2. Plastic clay	... ...			160
	1. Thanet sands	... ...			90
					2542

The Lower Eocene Group.

The surface of the chalk on which the Eocene beds rest is generally eroded into hollows and undulations, showing a marked but not a very wide unconformity, as when the Chalk is greatly tilted, the Lower Eocene beds partake of the disturbance to an equal amount.

1. Thanet Sands.—Light-coloured quartzose sand, mixed in the lower beds with much argillaceous matter, but never passing into actual clay; containing occasionally dark-green grains like those mentioned before in the Greensands. It rests almost invariably on a stratum of Chalk flints, from which the chalk seems to have been washed away without wearing or fracturing the flints, and these are of a bright olive colour externally, by which they may be recognised in other beds (Tertiary or drift) to which they may have been subsequently carried. The Thanet sands are very constant in character from the Isle of Thanet throughout the London basin, but thin out to the westward, till a little north of Windsor they are only 4 feet thick, shortly beyond which they disappear entirely. (Prestwich, *Geological Journal*, 1852, p. 235.)

2. The Plastic Clay, or the Woolwich and Reading series of Prestwich.—This group is more variable in character than that of the Thanet sands, and also more widely extended, becoming thicker from east to west, or in the opposite direction to the Thanet sands.

On the east, near Herne Bay, we have in it—

	Feet.
c. Argillaceous green sand............................	12
b. Dark-gray argillaceous sand with nodules of iron pyrites..	7
a. Light ash-green and yellow sands...............	9
	28

At Black Heath it consists of—

	Feet.
e. Pebble beds..	12
d. Brownish sand...	2
c. Comminuted shells in light-coloured clay with pebbles..	6
b. Light-green sandy clays..............................	7
a. Light-green sands with pebbles....................	6
	33

Near Reading the beds are—

	Feet.
e. Mottled red and light bluish-gray clay	20
d. Laminated yellow sands............................	2
c. Light-gray and greenish sandy clay.............	4
b. Fine yellow sand....................................	8
a. Green sand with *Ostræa Bellovacina*	2
	36

But these beds are more than 50 feet thick in other parts of the district.

At New Haven, an outlier of the Hampshire district—

	Feet.
i. Gray clay and dark-yellow sand................	12
h. Round flint pebbles in gray clay and yellow sand..	1
g. Laminated gray clay with seams of yellow sand..	8
f. Concreted oyster rock (*O. Bellovacina*)	2
e. Comminuted shells in yellow sand and gray clay	6
d. Yellow, brown, and red sand in layers	5
c. Dark-gray clays with ironstone	20
b. White, ochreous, and green sand..............	25
a. Green and ferruginous coated flints in sand..,	2
	81

In Alum Bay, Isle of Wight, these beds are from 90 to 140 feet thick, consisting of bright-coloured tenacious mottled clays, the prevailing colour being blood-red, but having mixtures of light bluish-gray and yellow, light and dark slate colour, lavender, puce, yellow, and brown, almost free from any admixture of sand.[1] (Prestwich, *Geol. Jour.*, 1854, vol. x., p. 75.)

The Druid Sandstones, Gray Weathers, Sarsenstones, and Puddingstones, scattered in loose blocks over many of the Chalk downs around the London basin, are believed by Mr Prestwich to be consolidated portions of the sands and gravels of the Plastic clay series.

3. The London Clay.—In the London basin this consists of—

b. Dark-gray and brown clay, with layers of septaria or cement-stones, varying from 200 feet on the west to 480 on the east about Sheppey Island.

a. Basement bed, yellow, green, and ferruginous sands, and occasionally clays with layers of rounded flint pebbles, having a total thickness of about 5 feet, and resting on slightly eroded surface of beds below.

In the Hampshire basin we have—

b. Dark-blue clays and sands, containing nodules of argillaceous ironstone with bands of gray clayey sands and dark-greenish sands, sometimes compacted into hard stone called Bognor rock, having a total thickness varying from 193 to 363 feet.

a. Basement bed of sand and clay, with a conglomerate of round flint pebbles and partly rounded fragments of chalk and of the mottled clays below, 4 to 5 feet.

The Middle Eocene Groups.

4. The Bagshot series, which takes its name from Bagshot Heath, but is best seen in the Isle of Wight. These consist of four groups, namely:—

4 a. The Lower Bagshot beds, composed of alternations of sand and clay; the sands generally pale yellow or gray, but sometimes dark and ferruginous, at others fawn-coloured or rose-coloured; the clays are white pipe-clay, or gray or chocolate-coloured clay. Thickness, 660 feet.

4 b. The Bracklesham beds (so called from Bracklesham in Sussex).—Dark chocolate-coloured marls and carbonaceous clays below, over which are whitish marly clay and white sands capped by a band of conglomerate of flint pebbles. Thickness, 110 feet.

[1] The total thickness of the fluvio-marine strata of the Isle of Wight, reckoning from the base of the Headon series, will be about 340 feet.

[1] I have given these beds in a little more detail than their relative importance deserves, as a good example of the variable character of some of the Tertiary beds of Western Europe.

4 c. The Barton beds.—Greenish-gray sandy clay below, passing up into bluish green and brown clay, interstratified occasionally with beds of sand and loam. Thickness, 300 feet. This was formerly supposed to be the London clay.

4 d. Upper Bagshot beds.—Yellow and white sands with ferruginous stains. Occasionally 120 feet.

(Mr Bristow's section in *Mems. Geol. Survey*, 1856; Forbes' *Isle of Wight Mem.*)

The arrangement is different from that given by Mr Prestwich in his papers in the *Geological Journal*. It appears that No. 16 of Mr Bristow's section, p. 157, is the same as No. 24 of Mr Prestwich's in *Geological Journal*, vol. ii., p. 258. All below that Mr Bristow called Lower Bagshot, while Mr Prestwich includes many of the sands below in his Bracklesham series. (*Geological Journal*, vol. xiii., p. 99.)

5. The Headon series.—All the beds hitherto described, except part of the Plastic Clay series, are of marine origin. With the commencement of the Headon series, however, we meet with indications of fresh water having prevailed over what is now the Hampshire area, as well as at the corresponding period of the Paris Tertiaries. In the London area no beds higher than the Bagshots are known.

5 a. The Lower Headon beds consist of clays and marls in Whitecliff Bay, while at Headon Hill and Colwell Bay they contain thick limestones; and they are still more varied at Hordwell on the opposite coast. They are the "Lower Fresh-water formation" of Webster.

5 b. The Middle Headon beds consist principally of sands, showing at Headon Hill brackish water conditions, but containing beds of oysters; while at Colwell Bay and Hordwell, and still more strongly at Whitecliff Bay, the beds have a purely marine character. Webster called them the "Upper Marine formation."

5 c. The Upper Headon beds contain the strongest limestones of Headon Hill, which, however, thin out rapidly towards the north. They are represented by a few very thin and inconspicuous sandy concretionary bands in Whitecliff Bay. The uppermost beds of the group are marls. Webster gave the name of "Upper Fresh-water formation" to this group.

6. Osborne (or St Helen's) series.—This is divisible into two groups, of which the first or lowest is—

6 a. The Nettlestone grits, consisting of hard rag and shelly sandstone below, capped by marl and bright-yellow limestone. The whole about 20 feet in thickness.

6 b. The uppermost has an alternation of white, and green, and yellow sands, with blue, white, and yellowish clays and marls, having a total thickness of about 50 feet.

The Upper Eocene Groups.

The fluvio-marine conditions are still continued in the Isle of Wight district, without any very marked line of distinction, between the top of the middle and the base of the Upper Eocene groups.

7. The Bembridge series, of which the first or lowest division is—

7 a. The Bembridge limestone, a pale yellow or cream-coloured limestone, interstratified with clay or crumbling marl—the limestone full of cavities, and often quite tufaceous and concretionary, and sometimes conglomeritic, sometimes a true travertine; contains siliceous or cherty bands in some places. Thickness, 20 to 25 feet.

7 b. The oyster bed, a few feet of greenish sands containing oysters (*Ostrœa Vectensis*) in great abundance, capped by a band of hard septarian stone, which is constant over a large area. About 10 feet altogether.

7 c. Unfossiliferous mottled clays, alternating with fossiliferous laminated clays and marls. Containing Cyrena pulchra.

7 d. Marls and laminated gray clays, containing *Melania turritissima*; capped by the *Black Band* forming the base of the Hempstead series.

8. The Hempstead series—the three lower divisions of fresh-water and estuary origin.

8 a. The lowest bed of this group is a firm carbonaceous laminated clay, highly fossiliferous, about two feet thick, known as the Black Band, over which are pale-bluish and yellow shaly marls, with ironstone concretions. The whole about 40 feet thick.

8 b. The base of this group, called the White Band, is a bed of mingled broken and entire shells, more or less consolidated, often very ferruginous, from 6 inches to 2 feet thick; over which are mottled, yellow, and pale-green marls, capped by shaly clays and dark marls, and blue-green ferruginous clays, with ironstone concretions. Total thickness about 50 feet.

8 c. Variegated red and green marls and gray clays, covered by greenish clay, passing up into pale and dark gray or lead-coloured clays. Thickness about 40 feet.

8 d. Clays with septaria, and gray and bluish clays with concretions containing abundance of Corbula; marine. About 25 feet thick.

France and Belgium.—The labours of Mr Prestwich, continued so long and assiduously, have gradually made plain to us the correlation of the English and French Eocene beds, and joined with those of Sir C. Lyell and M. Dumont, have also taught us the relation of these with those of Belgium. The following table exhibits these relations as they are now believed to be, taking Mr Prestwich's classification for all below the Upper Bagshot sands, and Professor Edward Forbes' for these and all above them:—

ENGLAND.	BELGIUM.	FRANCE.
11. Hempstead.	Rupelien.	Calcaire de la Beauce. Grès de Fontainebleau. Sables et bancs de coquilles, marnes marines.
10. Bembridge.	Tongrien.	Calcaire siliceux, calcaire lacustre moyenne, Gypseous series of Montmartre, &c.
9. Osborne. 8. Headon.	Laeckenien, part of ?	Calcaire marin et Grès de Beauchamp.
7. Upper Bagshot.	Système Laeckenien superieur ?	Sables moyennes, upper zone.
6. Barton clay.	Système Laeckenien inferieur.	Sables moyennes, lower zone.
5. Bracklesham.	Système Bruxellien.	Calcaire grossier,[1] and Glauconie grossière.
4. Lower Bagshot.	Système Ypresien superieur ?	Lits coquillières, and Glauconie moyenne.
3. London clay.	Système Ypresien inferieur ?	Wanting.[2]
2. Woolwich and Reading.	Système Landenien superieur.	Grès de Poudingues, Lignites et Argile Plastique, Glauconie inferieur.
1. Thanet sands.	Système Landenien inferieur.	Wanting.

According to Mr Prestwich, the London Tertiaries were

[1] Mr Prestwich gives (*Geol. Jour.*, vol. xiii., p. 99) the following detailed description of the Calcaire grossier:—

	Feet.
4. Compact white marls, passing down into alternations of greenish marls and thin yellow limestones, with seams of chert......	20
3. Thin-bedded fissile calcareous flags and sandstones, alternating with white marls and limestones	15
2. Thick main mass of soft, light yellow calcareous freestone (the building stone of Paris got by mining or subterranean quarrying), passing sometimes into calcareous sands	40
1. Variable, more or less calcareous greensands, sometimes concreted, flint pebbles often at base..	25
	100

[2] Some part of it, however, formerly extended into Normandy, as some clay at the top of the cliff of Ailly, near Dieppe, is believed to be London clay. (Prestwich, *Geol. Jour.*, vol. xi., p. 230.)

deposited in a sea open to the north, spreading at least over South-East England, Belgium, and north of France, whilst to the south of that area, dry land prevailed over the great part of the Paris Tertiary district and still further south. Gradual depression then took place, extending the limits of the sea over the Paris area, leading to the introduction of Nummulites and more southern forms of marine life than had hitherto prevailed. Dry land was still in the immediate neighbourhood, as shown by the occasional presence of terrestrial forms, and alternations of elevation and depression doubtless took place, modifying here and there the physical geography of the district. The Barton Clay, for instance, seems to have been deposited in a sea of a more northern character than that in which the Bracklesham Clays and sand were formed. Fresh-water conditions finally became prevalent, large estuaries opened into the seas over the British and north of France areas, while large lakes existed in the centre and south of France, where, soon after, volcanic eruptions commenced to break forth, and continued for many thousand years in subsequent periods. Edward Forbes pointed out that the upper part of the Bembridge series was probably of the same age as the Molasse of Fronsadais and the associated beds, and also as the Calcaire à Astéries of the S.W. of France. Part of the Tertiary beds of Malta, Corsica, Greece, Crete, Cerigo, S. of Spain and Portugal, Azores, and North Africa, are also believed to be contemporaneous with these beds. Contemporaneous with the Hempstead also were the Molasse ossifere and the Faluns jaunes of Dax, the lower division of the Vienna Tertiaries; and the marine beds, the Cerithium kalk and Upper Brown Coal of Mayence. (*Mems. Geol. Soc.* 1856, p. 100.)

Sir C. Lyell, however, in his *Supplement*, thinks that it would be more convenient to retain a nomenclature common on the Continent, and to class the Hempstead series and its contemporaneous beds as Lower Miocene, taking the beds from the Barton Clay to the Bembridge series inclusive as Upper Eocene, and the Bracklesham and Lower Bagshot beds only as Middle Eocene. He remarks, however, that we must in this case look on the boundary between Eocene and Miocene as an arbitrary and purely conventional line.

Certainly, as far as England (Isle of Wight) is concerned, the Hempstead beds are linked to those below by a greater number of species than they have peculiar to themselves.

The Alps, the Borders of the Mediterranean, Egypt, India.—Through these countries, from the Alps to the Himalayas, occurring at intervals through 25° of latitude and near 100° of longitude, are found great masses of rock, sometimes even thousands of feet in thickness, crowded with Nummulites, and sometimes almost made up of them. These are of Middle Eocene age. Associated with these are still higher beds called Flysch and Macigno in the north of Italy, and the black slates or shales of Glarus containing quantities of fossil fish, &c. The Monte Bolca fish-beds are also of about this age. (Murchison, *Geol. Jour.*, vol. v., p. 157, &c.)

North America.—Sir C. Lyell places the Claiborne and Alabama beds among the productions of the Middle Eocene period.

THE MIOCENE PERIOD.

The proportion of living to extinct species is taken at about 25 per cent. If we include the Hempstead series in the deposits of the Eocene period, we have no stratified rocks in the British Islands representative of the formations of the Miocene period, unless it be the "ash" beds and lignites associated with the basalts of the north of Ireland and west of Scotland. Edward Forbes thought that the fossil leaves found by the Duke of Argyll in the Isle of Mull more nearly resembled Miocene forms than any other, and were certainly not the same with those of any known Eocene forms.

If we adopt the classification usual on the Continent, and consider the Hempstead beds and their equivalents the earliest of Miocene beds, then the Bembridge series of the Isle of Wight, and the Gypseous series of Montmartre, will be the uppermost or newest of the Eocene period. There is, it appears, a palæontological reason for this arrangement on the Continent, inasmuch as if we draw the line at the top of the Montmartre beds, and at the base of the Calcaire lacustre superior (or Calcaire de la Beauce), certain generic and even specific forms of Mammalia are kept wholly within the Miocene groups which otherwise would be made common to the Eocene and Miocene periods. The genera Dorcatherium, Cainotherium, Anchitherium, and Titanomys, and the species *Rhinoceros incisivus*, and others, are examples. (M. Lartet, in Lyell's *Supplement*.)

We shall then have the following as

TYPICAL GROUPS OF ROCKS OF THE MIOCENE PERIOD.—*Belgium and France.*—Limburg beds, Rupelian of Dumont, the Bolderburg beds, the Fuluns of Touraine and Bourdeaux, the principal part of the lacustrine strata of Auvergne and Central France. Associated with the latter were the earliest beds of lava and volcanic breccias, which began now to be poured forth in the districts of Auvergne,[1] Velay, and Cantal, and continued to break forth at intervals to far later times.

Germany and Switzerland.—The Mayence basin, the principal part of the Vienna basin, part of the Molasse of Switzerland, containing the "nagel-flue," a conglomerate 6000 or 8000 feet thick.

Italy.—Part of the beds in the hill of Superga, near Turin.

North America.—The sands of Richmond, and the James River in Virginia.

India.—The Sewalik formations, which compose the sub-Himalayan range of hills. (Lyell's *Manual.*)

PLIOCENE PERIOD.

TYPICAL GROUPS OF ROCKS.—

	Feet.
2. Red Crag	50
1. Coralline Crag	40

1. The Coralline Crag is composed chiefly of soft marly sands of a white colour, sometimes speckled with green, containing occasionally thin bands of flaggy limestone. It is generally about 20 feet, but sometimes as much as 50 feet in thickness. Near Ipswich it has been denuded, and the Red Crag is seen to lie in the hollows that have been eroded in it, which is the only direct evidence of the superposition of the Red Crag on the Coralline; otherwise they lie side by side, the Coralline[2] Crag being confined to a strip of country 20 miles long by 3 or 4 wide, stretching through Ipswich from the Stour River to the Alde River.

2. The Red Crag consists of beds of red quartzose sands and gravel, with accumulations of rolled shells. It is very variable in character, sometimes regularly stratified, sometimes more confused.

[1] It is, however, most probable that the great volcanoes of the Mont Dor and the Cantal, &c., are of a still earlier period, as may be surmised from their more ruined and eroded character, the obliteration of their craters, and the great valleys worn deep into the flanks of their wide-spread mounds.

[2] It appears that this term of Coralline is a mistake, inasmuch as true corals are rare in both the divisions of Crag, while the coral-like bodies which are common in the Lower Crag are Polyzoa, and are also found, though not so abundantly, in the Red Crag. (Edward and Haime, *Palæontographology*, vol. i.)

Both groups resemble the deposits which we may now suppose to be taking place in the shallow bed of the German Ocean.

Antwerp.—Sir C. Lyell (*Manual*, p. 174) describes strata around Antwerp, and on the banks of the Scheldt below that city, containing 200 species of shells, of which two-thirds are the same as those of the Crag of Suffolk. More than half are living species, principally belonging to the Celtic, though containing some Lusitanian (Mediterranean) species.

Normandy.—The same authority mentions a patch of Crag near Valognes in Normandy, and at other places, extending to a little south of Carentace, but none farther.

Italy.—The sub-Apennines or low hills intervening between the Apennines and the sea, on each side of Italy, are made of Tertiary strata, of which part are of Miocene, part of Pliocene, and part of a still more recent period. The beds of Asti and Parma, and the blue marl of Sienna, which near Parma is 2000 feet thick, over which are yellow sands and conglomerates formed on the shallowing of the sea, belong to this period, as do the Tertiary marine beds forming the base of the seven hills of Rome.

South Russia.—Sir R. Murchison and M. de Verneuil describe limestone and sands, rising occasionally to the height of several hundred feet above the sea around the coasts of the Caspian and Aral Seas, and the north-western parts of the Black Sea, as belonging to this period. They call them the Aralo-Caspian formation. The fossils are partly fresh-water, partly marine.

PLEISTOCENE PERIOD.

Without attempting to draw any very nice or accurate distinction between the deposits of this and the preceding period, we may take, as a rough definition of the Pleistocene deposits, "those in which more than three-fourths of the fossils are of existing species."

We know of no remarkable living generic forms, with the exception only of man, that may not have been in existence during this period. The horse, the ox, the dog, and all the variety of terrestrial Mammalia, seem now to have been disseminated over the earth, each species in its own province, very much as they are now distributed. The species of Mammalia were almost always, and in some cases even the genera were, different from those now occupying the province, while the species of Mollusca, &c., were nearly the same.

Typical Groups of Rocks.—*Britain.*—The assemblage of sands and gravels about the county of Norfolk, known as the Mammaliferous or Norfolk Crag, containing both marine and fresh-water shells, and the bones of mammoths, together with those of the horse, dog, pig, deer, &c.,—deposits of Brentford (Middlesex), of Gray's (Essex), and of Maidstone (Kent), containing the bones of the mammoth or woolly elephant (*Elephas primigenius*); the extinct woolly rhinoceros (*Rhinoceros tichorhinus*), a monkey (*Macacus pliocenus*), and fresh-water shells, which, though not extinct entirely, are no longer inhabitants of Britain; one of them, for instance (*Cyrena consobrina*), being now only found in the Nile; the elephant bed near Happisburgh (Norfolk), underlying "the drift" there, and stretching under the sea, from which, according to Woodward, 2000 mammoths' grinders were dredged up by the fishermen in thirteen years; the clay deposit at Chillesford, Suffolk, described by Prestwich. (*Jour. Geol. Soc.*, vol. v., p. 345.)

Other similar partial superficial patches of clays, sands, and gravels, some of the gravels being widely spread over high ground, and known as the "high-level gravels," having the present river valleys excavated through them, others occupying these valleys and the lower grounds, and known as the "low-level" gravels. Some of these deposits are older, and some newer than the Glacial beds to be mentioned presently.

It was about this time, perhaps, unless it were still later after the close of the Glacial period, that the caves of the British Islands were inhabited by large hyænas and bears (*Hyæna spelæus* and *Ursus spelæus* and *priscus*). Into these dens many bones of other animals then inhabiting the neighbourhood were dragged by them. These remains are generally found in mud, under a layer of stalagmite.

The *Glacial Deposits* are chiefly clays, sands, and gravels, sometimes stratified, sometimes rudely piled together, and containing great blocks of rock, which also sometimes occur scattered loosely over the surface. They are variously called by the terms of "Great Northern Drift," "Till" (in Scotland), a brown clay with boulders; "Marls" in Wexford and Wicklow, where fossiliferous marl is interstratified with sand and gravel; "Limestone Gravel" in Central Ireland, chiefly consisting of pebbles of Carboniferous limestone, heaped sometimes into narrow ridges 40 or 50 feet high, and from 1 to 20 miles long, which are called "Escars;" "the Boulder Clay" in Northern and Central England, &c.; and "Drift" almost universally. The "Erratic Block group" of Delabeche is likewise a well-known name for these deposits.

The fossils of the Coralline Crag have a southern, while those of the Red Crag have a more northern aspect; those which are found at Gray's, &c., still point to a climate more like that of the south of Europe than our own, though as far as the woolly elephant and woolly rhinoceros are concerned, they might well have inhabited Britain at the present day, or even countries with a still severer climate.

A change, however, now took place, of a kind different from any we have yet met with, unless Professor Ramsay's ideas as to the glacial origin of the Permian and other old conglomerates be well founded. Simultaneously with a gradual, but eventually a great and wide-spread, depression of land, amounting in many places to 2000 or 2500 feet, there was a refrigeration of the climate of our own latitudes, so that the glens of our present mountains were encumbered with glaciers, even where their valleys were penetrated by the sea, and our low lands were entirely submerged. By the action of these glaciers, the rocks were scored and rounded, polished and grooved, and masses of rock carried down and heaped into moraines, while great blocks of rock were transported on fragments of those glaciers which dipped into the sea, and formed icebergs, being often carried far over the shallow seas, and dropped many miles from their parent sites,[1] sometimes resting on hill-tops, which were then banks and shallows in the sea, and so arrested the icebergs in their course. Alternations of elevation and depression doubtless took place, and the ordinary action of the breakers along the beach was aided by the quantity of detritus poured into it by the glaciers, and modified by that of the shore ice which formed along it in the winter seasons.

The Escars of Ireland were probably formed in the eddies at the margins of opposing and conflicting currents, the materials being piled up from each side.

These Glacial deposits are not confined to the British Islands, but extend over all the north of Europe and North America, down to a certain curved boundary, which in

[1] The largest boulder I know in the British Islands is near the head of the Devil's Glen in county Wicklow. It is 27 feet long, by 18 wide, and 15 high. It is of granite, resting on Cambrian grits and slates, six or eight miles from the nearest granite *in situ*, with a wide shallow valley between the hill on which it now stands and the granite district. At the recent meeting of the British Association at Dublin, Mr Godwin Austen described a large boulder of granite (apparently Scandinavian) found in the chalk near Croydon, showing that occasional icebergs wandered southwards even in the Cretaceous period.

Geology.

Europe, according to Sir R. I. Murchison, only stretches so far S. as Lat. 50° in one part of its course, namely, near Cracow. Great blocks of Swedish or Norwegian rocks, as large as cottages, lie scattered over the plains of North Germany.

Towards the close of the Glacial period, or after it, our present low lands seem to have been again above water, and to have been more extensive than they now are, the British Islands being probably united to each other, and to the Continent, by plains which have since been widely eroded, and the shallow seas formed out of them that now separate our present lands. On these plains the Irish elk, the reindeer, the musk-ox, and other animals roamed, sometimes becoming drowned in the lakes or mired in the swamps, and leaving their skeletons as records of their former existence.

During the prevalence of the cold climate of the Glacial period many species of Molluscs which previously inhabited the British seas, and are found fossil in the Crag, retired southwards, and occur fossil in the Mediterranean Pleistocene deposits; but at the close of the Glacial periods they again came northwards, and are now inhabitants of our seas for the second time, while some of them no longer live in the Mediterranean.

Dr Falconer has recently shown that a similar history might be told with respect to the Mammalia. The *Elephas primigenius* has, according to him, never been found south of the Alps, where an allied species, *E. antiquus*, has left its remains (Lyell's *Supplement*); that species having previously roamed much farther north, and left its remains in the earlier Pleistocene deposits of Britain. Mr Godwin Austen informs us that Dr Falconer believes that the relative ages of the different drifts or superficial deposits may ultimately be worked out by paying attention to the different species of elephant found in them. (Austen "On Newer Tertiary Deposits of Sussex Coast,"—*Geological Journal*, vol. xiii., part. i.,—in which Mr Austen now would write *E. antiquus* for *E. primigenius*, on p. 50, line 18, and p. 55, line 8 from bottom, on Dr Falconer's authority.)

In like manner the Arctic or Boreal fauna and flora which prevailed over our islands and shores during the Glacial period, have receded towards the north again, but have left some traces of their former existence in the Arctic or Boreal plants which are found near the summits of our mountains, and the Boreal shells which may be dredged from certain deep hollows in our sea. Edward Forbes showed that the present fauna and flora of the British Islands is derived from five sources.

1. The remnant of a Spanish (Lusitanian) flora in the W. of Ireland, probably dating from the Miocene period.

2. A Gallican or Norman flora in the S.W. of England and S.E. of Ireland, with a remnant of a corresponding fauna.

3. A Kentish or north of France flora, and corresponding fauna, extending over the S.E. of England. These two may both perhaps be of Pliocene date.

4. The Arctic flora and fauna just spoken of, diminishing in numbers from the N. of Scotland towards the S. of England.

5. The great Germanic flora and terrestrial fauna, occupying all the central and northern parts of England and Ireland and south of Scotland, and spreading through the other districts in co-tenancy with the rest, dating from the time when the British Islands were united by the great plain to each other and the Continent.

The Celtic marine fauna comes in with this; its peculiar species being apparently created to occupy the shallow seas formed by the erosion of this great plain, and inhabiting them together with the Arctic or Boreal species that remained about the coasts and spread into the new sea, and such of the southern species as returned to it from the Lusitanian province. One or two Arctic or Boreal outliers occur in deep cold hollows of the British seas, containing species not found elsewhere till we go much farther north, just in the same way that the tops of our loftiest mountains have plants not found on our lower grounds and plains, but occurring down to the waters' edge in Scandinavia.

It appears that just as the present surface of all land is formed by the outcrop of a number of beds of different ages, the newest being generally the most widely spread, and concealing the others, except in some particular localities where they rise up to view; so the population of animals and plants—the fauna and flora—of many countries, may be made up of different assemblages of different dates and different origins,—the newest perhaps spreading over, and more or less concealing, the others, the oldest only perhaps becoming apparent in one or two separated and isolated localities.

Besides the "Great Northern Drift," consisting of far-travelled boulders and fragments, there is also a much more generally diffused local drift, the materials of which are always derived from the immediate neighbourhood. This may be either contemporaneous with, or of earlier or later date than, the Glacial period, but is most probably later, and much of it perhaps of subaërial origin. It is occasionally of very considerable thickness and importance in the British Islands, and similar "drifts" are found in other parts of the world in all latitudes, and not confined, like that of the Glacial period, to high northern or southern regions.

Raised Beaches and Submarine Forests.—Neither is our history brought to a close after the formation of all our present deposits, and the coming into existence of all our present species. Changes of level have since taken place, as shown by the occurrence of raised beaches, in the shape of banks of sand and shingle with shells, above high-water mark, round our coasts, containing just such species as occur in the beaches below them; and in the fact of peat bogs, containing the stumps and roots of oak, and fir, and other common trees, to be seen at dead low water, passing under the sea. In many of the bays along the south coast of Ireland peat is dug from such situations at low water of spring tides, and dried and used as fuel.

These facts show us that some of our peat bogs, at all events, may date back from a considerable antiquity. Beds of peat, indeed, sometimes occur beneath the clay and gravel of the Glacial deposits, or interstratified with such deposits.

Soil and Subsoil, Vegetable Mould, &c.—As long as the geologist is engaged only with the local facts, as to the formation of regularly stratified rocks or of large masses of earthy matter, whether regularly or irregularly accumulated, he proceeds with pretty confident steps towards his conclusions. Those conclusions are general ones, and often of a sufficiently sweeping character. Certain districts, now high dry land, were formerly deep sea, in which certain beds were deposited, including the remains of creatures that lived in the sea. The time when these things took place was a very remote one, and the interval occupied by them a long one,—hundreds, thousands, or millions of years, as the case may be. We are not compelled to be more definite, nor have we any inducement to be so. In proportion, however, as we approach the recent or human period, our steps necessarily become more cautious, since we have more of a personal interest in ascertaining precisely the nature of the processes and the period of their occurrence.

We are naturally anxious to know, if possible, the actual date, in years, of the last elevation of the lands we inhabit out of the sea in which they have been so often immerged, and what has taken place upon them between that last emergence and the historic times. Indications, then, which

would be at other times overlooked, become now of importance; but in proportion to the interest attached to the investigation becomes its difficulty, since observations now are required to be more accurate and minute, as well as more widely spread, and more strictly checked and compared, than when larger generalities are dealt with. Hence it arises that we have not yet arrived at any satisfactory union of the history of the pre-human and the human periods, and possibly no very satisfactory union may ever be arrived at.

One strictly geological subject has yet scarcely been commenced upon, and that is the formation of soil. The natural formation of soil is certainly not always a rapid one. On many coral islets, crowded with birds and covered with vegetation, some even having considerable trees, there is little that could be called soil. The loose coral fragments and coral sand are slightly discoloured, and from their interstices small particles of "mould" could be picked up with the finger and thumb, but there is no layer of pure soil. Neither does soil always follow vegetation, however long continued. The great gum-tree forests of Australia rise from wide tracts of bare ironstone gravel or bare sandstone rock, slightly covered with an inch or two of rubble, without anything that could be called soil for scores of miles at a stretch. The ground looks like a great untidy gravel walk, from which a few straggling blades of grass spring up here and there between the trees. Neither are even calcareous rocks always covered with vegetation. In Galway and Mayo considerable flats of low ground may sometimes be seen formed of horizontal sheets of Carboniferous limestone, perfectly bare except in the crevices of the joints, where a short sweet grass springs up. On some of the fine corn land of the Cotteswold Hills, too, on the Oolitic limestones, the soil is not half an inch in thickness, and is composed principally of the rubble of the rock below, just such a soil as that of a coral islet would be if ploughed.

On some of the downs of the Carboniferous limestone, as also on Chalk downs, the soil consists of about an inch of close green turf, that may be cut with a knife and peeled off[1] the rock below in great rolls. I am not aware of any experiments for determining how long such bared spots would require to be reclothed with turf by unassisted nature.

Mr Darwin, in a paper in the *Trans. Geol. Soc.*, vol. v., attributes the formation of "mould" to the digestive action of worms, who swallow finely-divided soil, and eject it after extracting the nutritive matter therefrom, and thus improve the nature of the soil.

Foreign Pleistocene Deposits.

It has been said that, during the Glacial period, many of the Molluscs which previously inhabited the British seas retired southwards, and that their remains are to be found fossil in the Pleistocene deposits of the Mediterranean, while they do not now live on that sea, but have returned to their original province. In Sicily, especially, there are two if not more groups of rock, the Lower argillaceous and the Upper calcareous, consisting of thick beds of hard limestone, having an aggregate thickness of 700 or 800 feet. These beds cover half the island, and rise to a height of 3000 feet, the lower portions having as much as 30 per cent. of extinct species, while the upper parts contain shells mostly identical with species now living in the Mediterranean. (Lyell's *Manual*, chap. xii.) Some of these beds appear to be interstratified with lavas, part of the early outflows of the volcanic focus of Ætna.

[1] Excellent fossils may often be procured from the surface of the Carboniferous limestone by this process of stripping it.

These thick deposits, which are found in Sicily and the Grecian Archipelago, and some of which may exist in Spain and Portugal, were shown by Edward Forbes to be the contemporaries of the Glacial deposits, or northern "drift" of the higher latitudes, by the evidences already described.

It is perhaps to a later part of this period that we must assign the formation of the "loess" or "lehm" of the valley of the Rhine and its tributaries. This, as described by Sir C. Lyell in his *Manual*, p. 122, is a deposit of fine loam, of a yellowish-gray colour, occasionally laminated, but never separated into distinct beds, although it is often 200 or 300 feet thick, and rises occasionally to a height of 1200 feet above the sea. It seems to have been formed in consequence of the gradual depression of the whole country, after it had assumed its present external shape and "mould," and the filling up of a great part of the Rhine valley and its tributaries with matter brought down by the floods of the upper parts of the rivers. These materials being then spread from side to side of the valleys, would again be greatly eroded on the gradual re-elevation of the country, when every stream would cut down through the soft loess and re-occupy its old bed. Land and fresh-water shells of the same species that now inhabit the country are found in the loess; and in some places near the extinct volcanoes layers of pumice and lapilli are found, seeming at first sight as if ejected during an eruption, but perhaps merely washed away from the old previously existing cones. One crater, indeed,—that of the Roderberg, near Bonn,—is partly filled by the loess. Bones of the mammoth and other contemporaneous mammals have been found in it.

A similar deposit is described by Sir C. Lyell as found in the valley of the Mississippi, and forming the cliffs called the "Bluffs," which often rise to a height of 200 feet above the present alluvial plain of the river.

It is also to the Pleistocene period that we must assign the deposits of clay and sand which spread over the plains called the Pampas in South America, in which the bones of the Megatherium, Mylodon, and Glyptodon have been found. Similar superficial deposits are found in most countries; and either in these or in the bottoms of caverns, mostly buried under stalagmite, are found more or less of the remains of the extinct animals that preceded the existing races in their occupation of the globe.

There are two remarkable agencies now at work in various parts of the world which are probably more or less intimately connected with the period we are now considering, or perhaps with still earlier periods. Many of our present coral reefs, and many of our active volcanic mountains are of an incalculable antiquity, if we measure them by mere years or centuries, and not by geological periods.

Coral Reefs.—In a former part of this article these most singular, and at first sight most mysterious phenomena, were alluded to as illustrations of the method of formation of marine Calcareous rocks. Mr Darwin, however, has shown them to be also proofs of movements in the crust of the earth, and of great depression having taken place in the bed of the ocean where they prevail. He showed that since reef-making corals could not live at a greater depth than 15 or 20 fathoms (Forbes' *Circumlittoral Zone*), and since vast reefs (Atolls and Barriers) now rise with steep wall-like sides from profound depths in the great Pacific and Indian Oceans, just to the level of low water, their existence is only to be accounted for on the supposition, that when these reefs commenced to grow, the water was shallow enough for the animals to live in it near enough to the surface to enjoy that amount of light, heat, and play of the waves which is necessary for their existence. After the reef was thus commenced and built up to the level of low water (but how long after we cannot say), a slow and gradual motion of depression must have set in,

either gentle and continuous, or acting by little fits and starts, never producing during any interval of time an amount of depression so great as to prevent the polyps continuing to raise the reef towards the surface, by the growth and multiplication of the calcareous framework of their own bodies. In this way the ocean bed that was once only fifty or sixty feet, is now hundreds and thousands of feet below the sea-level; and vast masses of calcareous rock are thus erected, as distant barriers encircling islands, some of whose loftiest summits still rise above the water, or as great massive tombs utterly enveloping and burying in their secret recesses the bodies of lands and islands, once rising high into the air, and now lying enveloped in coral rock deep beneath the sea.

It may well be that in some, if not many, of these instances the first movement took place in Pleistocene, Pliocene, or still earlier periods: it is possible even that some of these enormous submarine masses of coral limestone may be based upon corals of species different from those that form their summits—species that have died out in the lapse of time.

Volcanoes.—When we study the structure of a volcanic district such as Ætna, Teneriffe, and many others, and find that the lower parts of the volcanic rocks that are open to our observation are interstratified with marine limestones, or sandstones full of sea-shells, we perceive at once that great changes have taken place in the district since the first commencement of volcanic activity. In many instances, such as in the Andes, in Java (see Horsburg's Map), and perhaps, if they were worked out, in every large volcanic district now at work upon the globe, we are enabled to trace back this commencement of volcanic action to some Tertiary, sometimes, perhaps, to a rather early Tertiary, period. One other result which we should arrive at is, that volcanic districts are, as pointed out by Darwin in his volume on *Coral Reefs*, districts of elevation, and that these in some parts of the world alternate with the districts of depression occupied by coral reefs. Volcanic districts never have atolls and barrier reefs in them.

But even if we dismiss from consideration all the aqueous rocks with which volcanoes are connected, and look solely at the igneous products themselves, we are in most instances compelled to assign an age to the volcano far greater than that of the human race.

Even so small an example as Ætna forms, compared with the gigantic volcanoes of Asia and America, will enable us to prove this. This mountain has a base of some 30 miles in diameter, and a height of about 11,000 feet. It has been built up by the ejection of ashes, dust, lapilli, and other fragmentary matter from the interior of the earth, and an occasional outpouring of streams of molten rock. It is made up of an indefinite number of conical heaps of such materials, arranged variously around one central and dominant mound, from which the greatest quantity of matter has been ejected. Some of these external cones are fully shown; some are half buried by the ejectamenta from other cones, or from the central one; and many others are doubtless altogether concealed under the great piles of materials heaped over the central parts of the mountain. On one side a huge ravine, 3000 feet deep and 5 miles long, has either been scooped out of the mountain by erosion or formed by subsidence.

Now the sensible additions made to this great mass of materials during the last 2000 or 2500 years bear a very trifling and insignificant proportion to the whole mass; and yet nothing we know of the structure of Ætna, or of volcanic action in any other parts of the globe, warrant us in concluding that it has been built up by a process much more rapid in its action than the one that has been going on during the last 2500 years. Even if we make allowance for a considerably more energetic action during the earliest periods of its activity (which, however, nothing that *we know* of volcanic action would *compel* us to do), and suppose that it did not assume its present slow rate of growth till it became as large as Vesuvius, for instance, still the additional matter added to the bulk of Ætna since it attained that size must be so great that, judging from our experience of the rate of volcanic action all over the world, we could not allow a less period than one or two hundred thousand years for the process.

The mention, however, of such a period as a hundred thousand years is only introduced here to show the long period of time necessary; a million may have been nearer the truth for all anybody can show to the contrary; and if once even so much as 20,000 or 30,000 years be allowed as possible, no one would, I suppose, be inclined to insist upon further limitation from any considerations relative to human history.

But if such conclusions may fairly be drawn from the consideration of the structure of the comparatively small hill of Ætna, what period of time are we to allow for the slow and gradual piling up of the lofty cones of Chimborazo, Cotopaxi, Aconcagua, and others of the Andes, rising to twice the height of Ætna, spreading their bases over a width equal to the whole island of Sicily, and running through hundreds and even thousands of miles in length. We cannot conceive all the vast chain of the Andes ever to have had all its fiery vents in fierce activity at once. We know that in all volcanic chains eruptions take place successively, now from one, now from another; their very number therefore increases the time we must allow for the gradual accumulation of each, especially when we have to intercalate vast periods, during which they may have been all quiescent together. And yet these are most recent geological events; their operation is most obviously continued into our own times, and directly link our own history with the far receding past.

These are not unnecessary or superfluous speculations, but considerations requisite to enable us the better to understand and appreciate the geological facts of our own islands. When we see that hundreds of thousands, or even millions, of years have probably elapsed, during which other countries have stood pretty much as we now see them, except that the grand monuments that rise from them have been slowly elaborated, we can make proper allowance for the great spaces of time which have elapsed during the process of the comparatively insignificant changes that have taken place in our own lands. We learn to look upon the Glacial period, for instance, as separated from our own days by the lapse probably of millions of years, and we begin to understand how it is that physical causes, acting with infinitesimal slowness, have so changed the climate and the physical geography of our own part of the world, as to have caused the gradual extinction of whole races of large animals that once flourished in it.

Large, indeed, as the demands of the geologist may have been thought upon the bank of time, they probably fall far short of the capital stored up there for his future use. Some of the more recent of geological events are probably in reality of an antiquity as great as we have been accustomed to assign in our imaginations to the most remote. The Pleistocene period is probably really as far separated from us in past time as we have hitherto been accustomed to consider the Silurian or Cambrian periods removed from us. Geologists themselves have perhaps hardly formed adequate conceptions on this subject; and yet without those conceptions, difficulties are perpetually rising in the science which with them would disappear. (J. B. J.)

MINERVA, in ancient mythology, was a goddess worshipped by the Romans under that name, and by the Greeks under that of Athene, or Pallas Athene. According to the earliest traditions among the Greeks, Athene was the daughter of Zeus. Homer says nothing of the mode of her birth; but Hesiod and other authorities say that she sprung from the head of Zeus after that god had swallowed his wife Metis. Various other legends concerning the origin of Athene were afterwards current, which arose, in all probability, from local traditions, or from the identification of the Greek Athene with similar deities of foreign nations. In the Greek religion Athene seemed to represent the union of power and wisdom. Thus she appears in Homer as the patroness and protectress of all those heroes who were distinguished for wisdom or courage, such as Achilles, Ulysses, Diomede, and others. She is likewise represented as the deity of agriculture, and the giver of the olive to the citizens of Athens, the city called after her name; as the inventress of all sorts of arts and contrivances; as the protectress of cities and states; and the upholder of law and order. Although a warlike deity, she was not regarded, like Ares, as bloodthirsty and delighting in war for its own sake; but rather as succouring and encouraging the defenders of the righteous cause, and as resisting and checking the mere brute strength of the god of war. The Roman goddess Minerva, who was identified with the Greek Athene, was represented as possessed of the same attributes. Her name seems to be derived from the same root as *mens* and *monere*. Minerva accordingly appears as the impersonation of wisdom, learning, and mental power. In Rome she was worshipped as one of the three Capitoline deities, and a festival was celebrated in her honour on the 19th of March, called *Quinquatrus* or *Quinquatria*, on account of its taking place on the 5th day after the Ides of that month. Minerva was also believed to have been the inventress of numbers; and a nail was annually driven into the wall of her temple to mark the number of the years. To this virgin deity calves untouched by the yoke were sacrificed, and the spoils of war were often dedicated. Minerva is generally represented as an armed virgin of masculine mould and majestic bearing, with sky-coloured eyes and an earnest countenance, wearing a plumed helmet on her head and an *ægis* round her breast, and holding in her right hand a spear, and in her left the round Argolic shield faced by the petrifying head of Medusa.

MINES AND MINING.

The object of the present article is to present a view of British mines, the practice of mining in general, based upon the methods pursued in Cornwall and other mining districts of Britain, and to furnish accurate and recent statistics of the produce of our mines as well as their progress. Previous to these particulars, brief notices will be given of some principal facts concerning mineral veins and deposits, British and foreign, the rocks in which they are found, and the circumstances affecting their course and productiveness. Under the heads of the several metals will be grouped these and similar facts, and descriptions of the most important mining countries and districts abroad, with such statistics as can be obtained concerning them.

MINERAL DEPOSITS, VEINS, AND THEIR PHENOMENA.

Mining, strictly speaking, is limited to large and deep excavations of metallic deposits, like those of Cornwall, the Hartz, and other well-known metalliferous districts; but the term is sometimes improperly applied to the washing of alluvial deposits, such as those in which gold is frequently found. In our own country, in some parts of Cornwall, tin has been found included in gravel and similar diluvial matter. Small pebbles of tin, called "tin stones," have occurred under the surface, covered with gravel, clay, sand, or peat, which had to be removed before the rock was reached upon which the tin stones rested. The collecting and separating of these grains and stones is named "streaming for tin," because the covering gravel or other matter is cast upon an inclined plane over which a fall or stream of water is carried, and the whole mass agitated, so that the heavier tin stones remain upon the inclined plane while the lighter stones and earth are washed away. Tin streamworks are now of little importance, and are chiefly conducted by poor persons for small gains.

Some minerals, as iron, are found in beds rather than in veins. The ironstone beds of the coal measures in our country are very extensive and valuable. They supply the greater portion of the iron produced in Great Britain—the remainder being chiefly furnished by the beds and veins of hæmatite in the mountain limestones of Lancashire, Cumberland, Durham, the Forest of Dean, Derbyshire, Somersetshire, and South Wales. The beds at Ulverstone, Whitehaven, and the Forest of Dean are more extensively worked than any of the others, and appear to be inexhaustible. The older works of Devon and Cornwall likewise contain many veins of black hæmatite. The brown hæmatites also of the north of England merit particular attention. They contain from 20 to 40 per cent. of iron, and are found associated in large masses with the lead veins of the lead-mining country; and occasionally they are seen in distinct and regular beds. They exist as "riders" to the vein, but sometimes they compose its entire mass, and then attain a width of 20, 30, and even 50 yards.

Scientific mining is almost entirely confined to the exploration of mineral veins, or "lodes," as they are termed in Cornwall. It is not a work of difficulty or science to lay open and remove minerals deposited either in alluvial deposits or in regular and massive beds, but it requires much skill, patience, experience, and capital, to explore an important lode of copper, or tin, or lead.

Veins. Mr W. J. Henwood gives an account of Cornish lodes as follows:—"The lodes may be described as quartzose portions of the rock highly inclined, and of no great thickness, which are more or less mixed with metals and their ores. They have commonly one prevailing direction, subject to slight irregularities and curvatures as well in length as in depth, and traverse granite, slate, and porphyries indiscriminately, and almost always without other interruption than what may take place from their interferences with each other, and with the *cross-courses*, *flucans*, and *slides* (interruptions technically so named in Cornwall). But notwithstanding the workings of adjoining mines have often been extended for a considerable distance on lodes in the same directions, it is not at all certain that the same lode has ever been traced for more than about a mile in length. In fact, they invariably throw off into the containing rock *shoots*, *strings*, and *branches*, in such abundance, that instead of one champion-lode (as the larger lodes are provincially called), the whole forms a complex and irregular net-work of veins. Often, too, the lode first discovered dwindles to a mere line, whilst some of its offshoots swell out, enlarge, and rival, or even surpass, both in size and richness, the vein from which they have been separated. It is, however, rather more frequently the case that the lodes split as they go eastward, than the contrary. It is by no means uncommon for lodes to split directly at the point of their inter-

section by a *cross-course* or *flucan*, on one side of which the lode appears in two branches, whilst on the opposite but one occurs." (*Transactions of the Royal Geological Society of Cornwall*, vol. v.)

The metallic parts of a lode do not form regular lines of metal running through the whole extent of the lode, but they occur in what the miners call "bunches," or in patches of various sizes and shapes. These very rarely occupy the whole space between the sides (or "walls," or cheeks") of a lode, even when the lode is rich and of tolerable width, but they are commingled with a variety of other substances, the principal of which is quartz. The vein named Gregorius at Freiberg is composed of nine layers, which may be thus represented:—

	1	2	3	4	5	6	7	8	9	
Wall. — Gneiss rock.	Quartz.	Galena.	Brown spar.	Silver ore.	Calcareous spar.	Silver ore.	Brown spar.	Galena.	Quartz.	Wall. — Gneiss rock.

From this it will be seen that the proportion which the metallic parts bear to the other parts of a vein, even in favourable instances, is not so large as might be imagined. One important department of mining, therefore, is to separate, as far as can be effected by mechanical means, the foreign substances from the metallic portions of the lode, as the two must be brought to the surface together. This mechanical separation gives occupation to women and children, in "dressing" the ores on the "dressing-floors" of the mines, and renders necessary a considerable amount of dressing machinery, as "stamps," "crushing mills," "jigging machines," &c., which are briefly noticed under the heads of Copper, Tin, and Lead.

Size of veins.

The lodes of Cornwall have no determinate size, being sometimes very narrow, and at others exceeding several fathoms in width. Sometimes they extend to a great length and depth, or they terminate after a short course; and they are continually varying in breadth. Certain portions consist of a mere line between the walls or "cheeks" of the lode, while portions have been met with not less than from 30 to 40 feet wide. Such extremes are not common in the same lode. Occasionally, when a vein expands it becomes poor; but instances are known where the thickest part of a lode is also the richest part. There are masses of iron ore in Piedmont 350 yards thick; and the great open mine at Fahlun in Sweden is half a mile long and several hundred yards wide; but these are extraordinary examples. The distance for which lodes range along the surface of a country appears to have some reference to the magnitude of the disturbing forces affecting the district. A certain vein in Chile is 9 feet thick, has been proved for 90 miles, and is accompanied by branches 30 miles in length.

Position.

The lodes commonly occur in a position nearly vertical, Their inclination seldom diverges from the vertical to more than 10° in the north of England lead district; in Cornwall it averages much more (in some cases 70°), yet it does not often exceed 45°; while in many foreign mining countries it is inconsiderable. The inclination of a lode to the horizon is called its *dip*, or *underlie*, or *hade*, in the language of miners, and its intersection with the surface, the *strike*, which determines what is termed its direction.

Systems of veins.

In every mining district there are what are called systems of mineral veins, each system being characterized by some peculiarities of position or contents; and each appears to be referable to a distinct period of formation. Werner observed eight such systems at Freiberg, and the same number has been noticed in Cornwall. The first class appear to have been earliest formed, and constitute a very large majority of the whole number in the district. They are the older tin veins, underlie to the north, and are traversed by those of the second class, which are comparatively few in number and of little importance. These two classes include all the lodes from which tin is extracted. Their breadth varies from a mere string to as much as 36 feet, and most of those which are productive range east and west. The third class are the east and west copper lodes, and these form the greater number of all the copper lodes in Cornwall. They always cut across the tin lodes when the two kinds meet, and they are usually accompanied by small veins of clay. The fourth class comprehend the *contra* (or *counter*) copper lodes, and they are few in number. Their direction is N.W. and S.E., or at right angles to those bearings. The fifth class contain the *cross-courses*, which run due N. and S., or nearly so, and contain no tin or copper, and only a little lead occasionally. They are rather wide, and have been traced on the surface for considerable distances. The remaining three classes are chiefly of importance as adding to the accumulation of facts respecting mineral veins.

Direction.

It is a long observed fact, that in almost every case in Cornwall the productive veins run E. and W., and the cross-courses N. and S. The more recently filled fissures and partings are composed almost wholly of clay; so that, as a general rule, veins which contain a great quantity of this clay traverse those which contain a smaller quantity.

In the Freiberg (Saxony) districts, as described by Werner, we find a number of mineral phenomena somewhat analogous to those observed in Cornwall, but the metals are different, as also are the prevailing directions of the lodes; the first and most ancient running chiefly N. and S., and including those veins from which the chief supplies of lead and silver have been obtained. The *contra* lodes are more argentiferous, but much thinner, and their direction is about N.E. and S.W. The veins of the third system are all N. and S., and those of the fourth at right angles to them, corresponding to the Cornish cross-courses. They both contain lead glance. The lead veins of the north of England and Derbyshire are much simpler than those lodes of Cornwall or Saxony. The direction of the lead veins is almost invariably E. and W., and they are traversed by non-productive cross-courses at right angles to them.

Intersections.

A number of perplexities arise out of the various intersections of lodes by one another; and it is obvious from what has been said, that such intersections in a mining county like Cornwall will be frequent and sometimes complicated. A lode intersected *horizontally* is sure to be *heaved*, and the consideration of all the points connected with heaves would comprehend—(1.) the composition of the intersected vein; (2.) the composition of that intersecting it; (3.) the nature of the containing rock; (4.) the widths of the intersected and intersecting veins; (5.) their horizontally-inclined angles; (6.) their inclinations; and (7.) the extent of the heaves at different depths. Again, the determination of these questions would apply equally to—(1.) the intersection of lodes by cross veins; (2.) the intersection of cross veins by lodes; and (3.) the interferences of lodes with each other. Without entering into these points of inquiry, we may notice that some general laws may be deduced from the average of a great number of observations. *Vertical* intersections, or *leaps*, or *throws*, require similar study, as to—(1.) the nature of the intersecting vein; (2.) the vein intersected; and (3.) the influence the angle at their intersection may have in the direction or distance of the leap or throw. In no instance of vertical intersections has the same vein been seen to intersect another more than once, or to interfere with more

Mines and Mining.

than one vein on the line of its dip. It is considered to be a general law, that in intersections of veins the portion thrown out is always on the side of the obtuse angle, and the more obtuse the angle, the more considerable is the out-throw. (See *Trans. of Royal Society of Cornwall*, vol. v., 1843, by W. J. Henwood; also, *Cornwall: its Mines and Miners*, &c., 1855.)

Supposed laws affecting richness.

The practical object of all researches into the course and structure of lodes is to ascertain, if possible, their general laws, so that the miner may follow their course, may retrace them when dislocated and thrown out, and especially determine what circumstances influence their richness in ore. A few circumstances only of the latter kind are generally recognised, while many others which have been received by some miners are subject to numerous exceptions. We may notice one or two of those generally approved. An old proverbial saying is, "ore against ore,"—arising from the fact that whenever a lode is rich, if there be another lode near it having nearly the same direction and in nearly the same country, whatever be the rock, the second lode will probably be found rich in that part which is opposite to the rich part of the first lode. The proverbial phrase "ore against ore" has been acted upon from an early period. Another fact is, that when *elvans* (porphyritic veins) and tin and copper lodes occur together, they are found in connection, as a whole, with good mines. Most of the ore in the principal mines in the Gwennap district of Cornwall have been found in or near large elvan courses. Not a few of the larger and wider bunches of ore, both tin and copper, have occurred in the immediate vicinity of cross-courses and flucans, and frequently also exclusively on one side of their intersections. It has been generally thought that depth below the surface is influential on the quantity and quality of the ore contained in the veins. It is confirmed by several observations, that mineral veins are generally richer near the surface than at great depths. It is a common opinion in Cornwall that copper, on the whole, occupies greater depths than tin. "At about 80 or 100 feet under the surface the first traces of copper or tin are found; rarely nearer to it than 80 feet. If tin be first discovered, even without a trace of copper, it is not unusual that in the course of sinking 80 or 100 feet or more, all trace of it is lost, and copper only is found. But if, instead of tin, copper be first discovered at a depth of 80 or 100 feet, tin is seldom or never found below it in the same vein." Such was the opinion of Phillips the mineralogist; yet tin is sometimes found 100 feet deep without a trace of copper, and there are many instances of tin ore accompanying copper ore to a great depth,—in one case 200 fathoms below the surface, and even under the copper. The meeting of two lodes, either vertically or horizontally, is generally considered a sign of richness, more particularly when the angle at which they meet is small or not very great. It is also a remarkable fact, that in every lode, whether it yields tin, copper, or lead ore, the portions which are the most perpendicular are the most productive.

Breadth.

In Cornwall the mean breadth of tin lodes is about 3·06 feet, of copper lodes about 2·93 feet, of lodes containing both metals about 4·7 feet; and this greater average breadth of lodes, including a mixture of copper and tin, is found in any rock and at any depth. Generally a diminution of the width of a lode is a precursor of poverty. The average breadth of lodes at less than 100 fathoms deep is 3·97 feet; at more than 100 fathoms deep it is but 3·36 feet.

Limits of districts.

The limits of mining districts are often very decided geologically, and are also marked by peculiar physical features. The neighbourhood of Cross Fell, in the north of England, has been worked with the greatest enterprise, but no instance has occurred of a single vein being traced across the great Penine fault to the west. Similar facts have been observed with respect to the Flintshire veins of lead, occurring in the Carboniferous limestone, and which in no instance enter the Silurian rocks. In this instance, and in many others, the older rocks seem to rise on the line of a great axis of disturbance, and to cut off the whole of the mining ground, as if nature itself marked out the mining districts and set bounds to them.

Affinities of mineral veins for particular rocks.

As a general rule, with some important exceptions, particular metalliferous deposits have affinities for particular rocks or geological formations. Iron at once occurs as an important exception to this rule, for it is found, to speak only of our own country, in the older rocks of Devon and Cornwall. Magnetic oxide and specular iron occur in the granite of Dartmoor. The New Red Sandstone, in its lower measures, yields beds of hæmatitic conglomerate. Important beds of iron are worked in the Lias and Oolites. The greensands of Sussex once furnished a large amount of iron to the ironworks, and recently the greensands of Wiltshire have shown indications of large deposits. But while iron is a marked exception, we shall find the rule hold good in relation to other metals. Thus tin is most plentiful in granite, and the rocks lying immediately above it. Copper is found in various slate formations, and in the *Trias* of geologists; but it is not generally met with in strata more recent than the Old Red Sandstone, although there are in England some exceptions. The celebrated Ecton Mine in Staffordshire, and the Llandudno or Orme's Head Mine in Caernarvonshire, are situated in the Carboniferous limestone. On the Continent copper is mined in a formation still more recent,—viz., the copper-slate of Thuringia, which forms a portion of the New Red Sandstone series. In Cornwall it prevails in the clay slates (*killas*), although one of the most profitable mines in Cornwall (Tresavean) is worked in granite. Lead has a marked affinity with the mountain or transition limestone, as is evident in Derbyshire, Yorkshire, Northumberlandshire, Durham, &c.

There are also other indications of preference more specific even than particular formations. For instance, while copper is found both in granite and slate rocks, the most productive mines are almost invariably situated just upon the junction of these two formations. Experience in Cornwall has shown that no continuous or very abundant supply of this metal is to be expected in any spot far removed from the line of junction. In the serpentine rocks of the Lizard, copper of great purity has been discovered, principally in masses.

The accumulated evidence from all parts of the mineral world proves that the contents of the veins depend on the peculiar character of the rocks they traverse. Although this is an acknowledged truth amongst geologists and miners, yet the ignorance or neglect of it has led to numerous practical mistakes. It has been supposed that because veins were rich in one place, the continuation of the same veins must be a continuation of the same riches. But if the veins intersect unproductive rocks, the riches come to an end. The public are often deceived by a plausible project which is brought forward on the strength of the ground being near a very prosperous mine. Works have been carried on at great expense in unproductive ground without a chance of success, simply because the lode happened to be in the same direction as in a neighbouring rich mine.

The mineralogical modifications, therefore, of the various rocks in metalliferous districts, very commonly bearing the same names, are subjects of careful examination by intelligent miners. When the rocks present certain characters, not perhaps noticed even by geologists, miners find their chances of success increased or diminished. In Cornwall and Devon they prefer a granite or porphyry (elvan) which is to some extent decomposed. Other signs are carefully noticed; so that an experienced miner will at once pronounce whether the "country is kindly" or not for copper or tin. Several instances might be adduced to

strengthen these views. The principal lode in Fowey Consols Mine affords a good example of ore accompanying a particular set of rocks, and it is found that the "bunches" of ore occur in certain directions. In Godolphin the lodes were rich where the *killas* (argillaceous slate) was of a bluish-white colour, but poor when it was black. In Poldice and Huel Fortune the lodes in the killas continued productive until they entered a stratum of blue, hard killas, which *cut out* the riches. At Penstruthal Copper Mine the lode had been tried unsuccessfully at various times in parts where the granite was hard; but trial being made where that rock was soft, it became one of the most profitable mines in Cornwall. In other countries we find indications of similar phenomena. In Upper Hungary the largest copper lodes are found in fine gray slates; in Saxony the silver ores occur in gneiss; and in the Hartz certain ores are intimately connected with the graywacke. At Andreasberg the veins which pass from argillaceous slate into flinty slate lose their riches in the latter. The Wenzal vein at Furstenberg runs nearly vertically from north to south across many beds of gneiss about 60 feet thick, dipping east, and each of these beds forms a distinct variety of rock. In the first bed the vein formed a nearly imperceptible string of clay; in the second it became 12 or 18 inches thick; in the third the thickness of the vein is preserved; in the fourth the silver ores, which had disappeared in the third, become as abundant as they were in the second, but they gradually disappear in depth. The vein is shifted in depth to the westward by several cross-courses, and between two of these it becomes very rich.

THE PRACTICE OF MINING.

From the manner in which mineral accumulations have been deposited in the earth, it is evident that mining operations must be of two very different kinds. Thus coal, salt, many ores of iron, and some of other metals, appear in regular layers interstratified with and forming part of the series of deposits which make up the earth's crust at particular places; while the usual ores of tin, copper, and lead occur in crevices formed in rocks after they have been deposited, and often since their subsequent metamorphosis.

Discovery. If mineral veins are to be sought for in any unexplored or but partially explored district, the geologist can predict favourably or unfavourably, according to the nature of the strata, but he can only predict. The practical miner can give his opinion whether the "country" (or rocks) be "kindly" or not for metallic veins. One course, however, of a surer nature can be also adopted, that of *shoding*,—an old term by which is signified the search for loose masses of ore of all sizes, either in or under the upper soil, sometimes upon the top, *basset*, or outcropping of the vein, but more frequently a little to the lower side where there is a declivity, and where the vein crosses the slope. This shode ore, varying from the size of a pea to large pieces, is produced by the weathering or decomposing of the sides of a vein, causing the ore to stand higher than the superficies of the rock, which in time slides off where the ground is sloping. Miners who go out shoding will traverse rivulets, gullies, scaurs, and other similar places where the surface of the ground is broken, or where the strata rise up to the grass roots; and they will even examine newly-ploughed lands and molehills. Shode ore being found upon a slope, or at the foot of it, the finder must look diligently for other signs of a vein, and then circumstances in each case will determine how a trench may be best opened towards the vein. A number of trial pits may be sunk, and other means of a like character may be adopted to prove the presence and character of the supposed vein.

Another similar course is to search for what is called *float-ore*, or that which has been floated down by water acting upon the veins of ore. *Hushing* is the employment of a reservoir of water on a height, so as, by due direction downwards, to wash out pieces of metalliferous stone. If a quantity of water can be thus conducted down a slope, it will clear the superficies of the rock, wash and clean all the veins showing themselves at the surface, and often lead to a valuable discovery. Frequent applications of water will wear a channel to some depth without digging, which may or may not be subsequently employed.

Many lodes, however, afford no shode; for if the upper part of the lode contains no ore, or the detritus is carried too far, or is too minutely subdivided, there is no metallic indication to guide the miner. He may indeed meet with pieces of *gossan* (a hydrated peroxide of iron), which is always considered an indication of metal being near. Where gossan prevails it has been generally found that copper ore is connected with it. But the mode of search adopted where there are no shodes or gossans is that which is provincially named "costeaning," a word which literally means *fallen-tin*. The process consists in sinking small pits through the superficial deposits to the solid rock, and then driving from one pit to another across the direction of the vein, in such manner as to cross all the veins between two pits. The pits are often sunk several feet in the rock before the communications between them are made. It is necessary to the success of costeaning that the miner should have made out the prevalent strike of the principal systems of right-running veins in the district. In cases where the rock is not extremely hard, and is not thickly covered at the surface, open cuttings may be made at a small cost, which will lay the lodes bare for some distance. But the circumstances of the locality must determine or modify the attempts at discovery.

We have named *gossan* as a favourable sign, and it may be added, that in certain districts, and with certain classes of veins, there is so large a quantity of iron present that the decomposition of this metal near the surface makes itself manifest in ferruginous stones; and the tops of many of the lodes, when found near the surface, are frequently cavernous and abound with gossan. So much importance do Cornish miners attach to it, that they consider no large vein to be of much value without this accompaniment. A similar decomposed ore is named by the German miners *eiserne hut* and *eisenkopf*, and by the French *chapeau de fer*. But although these occurrences and names point to a prevailing feature, yet it is quite erroneous to apply this to all mineral veins, for in some valuable districts scarcely any iron exists, and therefore gossans and ferruginous indications are wholly wanting. The opinion may hold good for Cornwall, where gossan abounds and often extends to as much as thirty fathoms below the surface. It is of no value in itself, but attention has of late years been drawn to it on account of small amounts of gold associated with it, generally a few pennyweights to the ton. It was thought that by the use of Berdan's machine, and other apparatus, the gold could be profitably extracted, but after operating on large quantities, this hope has been disappointed. Gossan also contains silver in small quantities, and operations are sometimes successfully carried on for extracting it. Argentiferous gossans sell at from forty shillings to forty pounds per ton. They are bruised to small pieces and sent to the smelting works, where they are mixed with certain proportions of lead ore of low average for silver. The two are then melted together and run out into pigs, which undergo further processes.

First operations. When the position of a mineral vein is ascertained, and some conjectures have been hazarded, from various signs, concerning its extent, course, thickness, and value, the work of mining properly begins. Shafts must be sunk and *levels* (galleries) must be driven to prepare the way for the extraction of the ore, and at the same time to carry off the

Mines and Mining.

water which either flows into the mine from springs, or drains into it from the surrounding strata. Two sets of galleries must be driven at right angles to each other, and both horizontal, one being in the direction of the strike of the vein, and the other at right angles to that direction. If we suppose a simple instance in which the mineral veins crop out at the sides of a hill, and follow a direction on the whole uniform, we may illustrate the proceedings by the subjoined figure, in which two lodes of moderate thick-

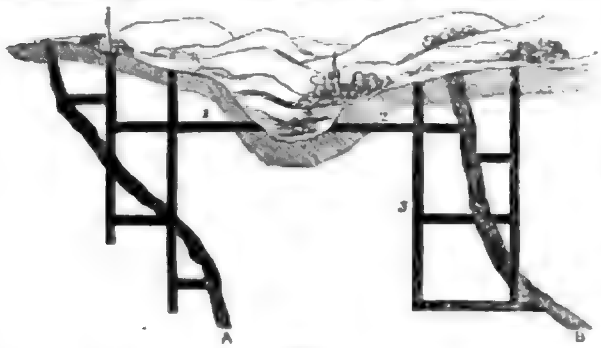


Fig. 1.

ness (A and B) are seen. A shaft must be sunk to reach the vein at a certain depth, but it will depend on the direction of the dip or underlie of the lode,—whether towards or from the valley or slope of the hillside,—and on many similar circumstances, as to where it will be most desirable to commence the sinking. With reference to the lode A, a cross-cut (1) may be driven at the lowest convenient point above the level of the highest water of the valley, and this gallery, having a gentle slope from the lode towards the hillside, will form the adit-level, and be the channel through which the whole drainage of the works will be carried; while it may also serve to convey the ore that is obtained out of the mine. With reference to the lode B, the driving of an adit-level will offer similar advantages, but there is a difference in the arrangement of the shafts. In both cases it is found advisible to sink shafts upon the upper side of the vein, but in B it is also convenient to have a sinking (3) towards the slope of the valley, and which does not cut the lode itself.

Shafts.

Although a perpendicular shaft has many advantages, and is almost always adopted in coal-mining, where extractions are carried on; yet in metallic mining, such a shaft is not in every case employed. Shafts are occasionally commenced at the outcrop, and, where the inclination is not very considerable, are continued in the substance of the vein itself; but in a slanting shaft the difficulty of raising the ore is much increased, and many practical reasons often render it expedient to sink at some distance from the outcrop, so as to meet the lode at a convenient depth.

The labour of sinking shafts in hard rocks like the Primary is very great, and the cost very considerable. From the records of shaft-sinking in Cornwall we may instance some cases showing the slowness of the descent, arising from the hardness of the rock. At one mine only 20 fathoms, or 120 feet, were sunk from 1828 to 1834, being at the rate of between 3 and 4 fathoms per annum. In Levant Mine, from 1830 to 1837, 90 fathoms were sunk, or at the rate of 13 fathoms per annum. In East Wheal Crofty Mine 77 fathoms were got through in the time between 1833 and 1837, amounting to 14 fathoms per annum. A sinking, therefore, of 1 fathom, or 6 feet per week, has sometimes been all the progress that could be made. To avoid the delays that must necessarily occur in sinking at this rate, a plan has been adopted in Cornwall of excavating several portions of a shaft simultaneously, by operating at different levels at the same time, which of course can only be done in a mine already opened, and requiring additional shafts. The great feat is to excavate the several portions so accurately, that when they are finished they may all exactly fit into each other, and form one perfect and perpendicular shaft. One party will work from the surface, another from one of the upper levels, and a third from the lower levels, simultaneously.

Depths of shaft.

Remembering the slow course of excavation in hard rocks, the depth to which some of the Cornish mines have attained is truly wonderful. Rather more than 20 years ago, Wheal Abraham Mine had reached the depth of 242 fathoms, or 1452 feet. Dolcoath Mine had reached 235 fathoms. The Consolidated Mines are 300 fathoms, or 1800 feet deep, and the United Mines 280 fathoms below the adit-level. Tresavean has gradually attained an extraordinary depth; and it was lately reported to the writer by Robert Were Fox, Esq., as being 320 fathoms, or 1920 feet deep below the adit-level, 2112 feet below the surface, and about 1700 below the level of the sea. To realize these depths, the reader may note the height of any lofty public monument or church spire with which he is acquainted, and, standing at its base, multiply in his mind the height of the object in sight by the number of times requisite to reach the depth of one of these mining shafts. Thus, for example, the height of St Paul's in London is said to be 340 feet; now the depth of Tresavean Mine is more than five times, or nearly six times, the height of St Paul's. The shaft of the Monkwearmouth Coal Mine near Sunderland is 1590 feet clear perpendicular depth, which is equivalent to the piling of the Monument of London seven or eight times upon itself. In one mining tour amongst the collieries of the north of England, the writer of this article descended twelve shafts, the *aggregate* depth of which was no less than *eleven thousand seven hundred and eighty feet*. One of these was the Monkwearmouth shaft first named. The mode of descent was (at that time) by a large iron tub and wire-woven pit-rope. The lapse of time in descent was rather more than four minutes.

Some foreign metallic mines have been carried to great depths. The Eselschacht Mine at Kuttenberg in Bohemia, now inaccessible, was deeper than any other mine, being no less than 3778 feet below the surface. That depth was only 150 feet less than the height of Vesuvius, and it was eight times as great as the height of the pyramid of Cheops or the cathedral of Strasburg. Mines on high ground may be very deep relatively to the surface, but not to the sea-level. The mine of Valenciana, near Guanaxuato in Mexico, is 1686 feet deep from the surface, but 5960 feet above the level of the sea. For the same reason the rich mine of Joachimsthal in Bohemia, though 2120 feet deep from the surface, has not yet descended to the sea-level.

It is common to divide the shaft into two by a strong wooden partition running down the middle; and to sink several shafts when the mine is extensive. At the Carn Brea Mine, which extends superficially in length for a mile and a half, and in breadth for about three-quarters of a mile, there are from twenty to thirty shafts; and other mines have even more. Such shafts are often situated along the line of the lode, and they bear different names to distinguish them, as, perhaps, "Taylor's Shaft," "Dixon's Shaft," &c.

It very rarely happens that the lode is perpendicular, but its inclination as it descends is generally to the north. If the underlie is not great, the shaft may to a considerable distance follow the lode; but if it be great, the shaft descends, not in one continuous line, but, as it were, by a succession of steps. It will be sunk perpendicularly by several fathoms at a time, the lode meanwhile diverging from it to the northward; but at certain distances the sinkers pause, and horizontal courses are driven in the direction of the lode until it is again struck. Whenever

the lode is struck the shaft is sunk again, and the lode is again to be reached by a horizontal course as before. Thus, while the shaft is being sunk, the horizontal passages of the mine are being constructed.

Simplest operations. The adjoining figure is a vertical cross section of the shaft and lode, designed to show the course of operations in the simplest form. AB is the engine-shaft and CD is the lode. At every 10 fathoms of the sinking of the shaft a cross-cut *c* is driven to meet the lode CD. This process is repeated at every 10 fathoms until the shaft crosses the lode at 80 fathqms, where the direction of the cross-cuts *c*, *c* is changed from right to left to meet the lode, while the shaft descends perpendicularly as before. This simplest form of procedure may be varied to answer to the varied conditions and requirements of the lode.

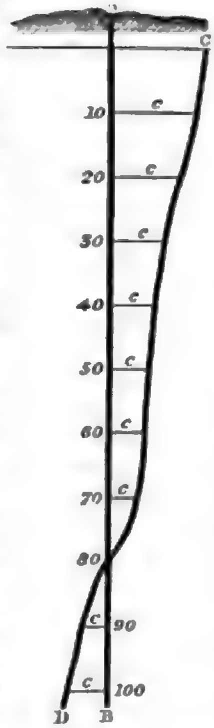


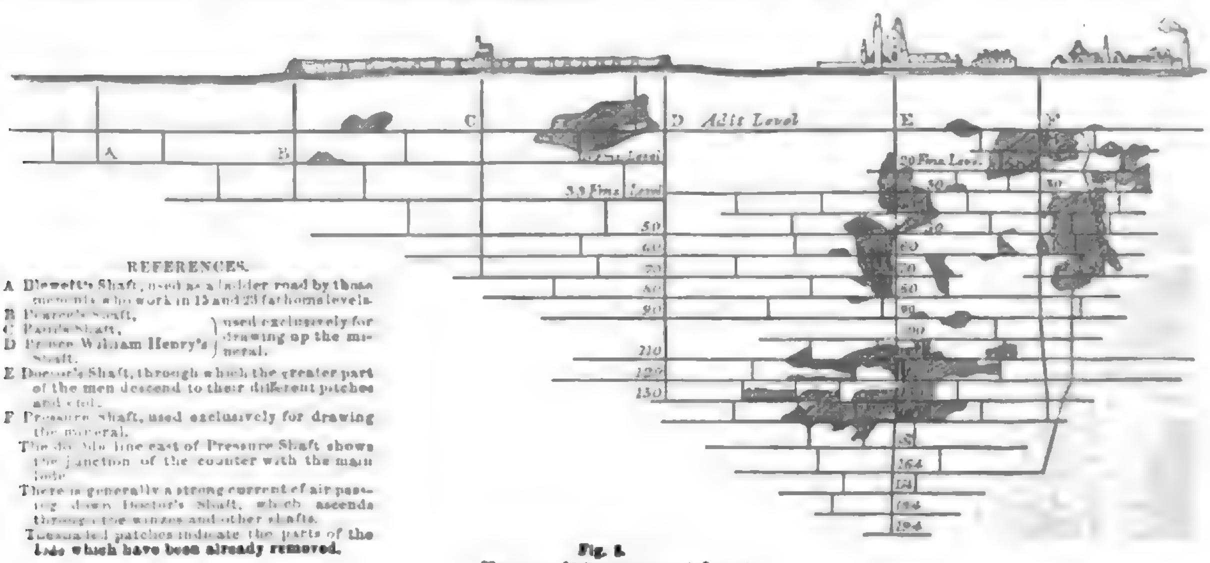
Fig. 2.

Levels. What we mean by the *levels* of a mine will be understood by fig. 3. The levels are parallel courses which diverge on either side from the shaft, and follow horizontally the course of the lode. These courses are usually in Cornwall 10 fathoms, or 60 feet, apart. After the shaft is sunk 10 fathoms, the first level will be run; or, to speak in common language, a horizontal passage will be cut from either side of the shaft, following the direction of the lode. The dimensions of this passage are generally from 5 to 6 feet in height and about 3 feet wide. It is seldom made wider, unless the lode is very rich, and never much narrower, as this width is necessary to the working of the lode. But there is no limit to the length of the level, except the *sett* or bounds of the mine. Where the course of the lode is irregular, as it generally is, the levels will not be directly over and under each other, but may vary considerably according to the course of the lode, which necessarily governs the mining excavations.

Miner's tools. The miner's tools consist of his pick and "gad" or wedge, and shovel, together with a series of blasting or shooting tools, such as sledge or mallet, borer, claying-box, needle or nail, scraper, tamping-bar; added to which are powder-horn, tin cartridges, and safety-fuse. When blasting by gunpowder was introduced, great danger arose from premature explosions. The powder was placed at the bottom of the hole in the stone, when bored to a sufficient depth; the needle was then inserted, and the hole filled up with sand or clay, and rammed in perfectly tight. The needle being then withdrawn, and a rush inserted and ignited, the miner scrambled to a place of safety. But the iron needle, when struck with the mallet, would often give out a spark and explode the whole; a copper needle was therefore substituted for it about 30 years ago, which itself has been generally superseded by the invention of the safety-fuse, consisting of a small hemp cylinder well saturated with tar and filled with powder.

Winzes. Besides horizontal galleries, what are termed *winzes*, or short shafts (see fig. 3) extending from one level to another, answer the purpose of making trial of the vein in the intermediate space between two levels, and by dividing the great masses into rectangular portions, these may be examined all round; so that the miner has the means of judging with tolerable certainty of the nature and value of the ores contained in each *pitch*, and can extract the produce in the most expeditious and economical manner, attacking these portions from as many points at once as may be convenient. By this arrangement, no necessity arises for breaking down the unproductive masses which are often found to intervene, even where the vein is richest and the ore most continuous. The vein having been properly laid open, the ore may be worked away round such unproductive masses, and these, when left standing, will form supports to the work on each side of the vein. Thus, for working out the ores, a system of winzes is quite as necessary as a system of levels; and as the levels are driven horizontally at vertical distances of 10 fathoms, so the winzes are sunk vertically at intervals of 20 or 30 fathoms, their position being so regulated as to prove the richest and most promising portions of the veins, and to avoid the harder and more unproductive portions.

Pitches. Suppose that a continuous body of ore is met with in one of the upper levels, and that winzes had been regularly carried down to the level below it, then similar operations will be required in the upper, and winzes will be sunk from it to the next lower level in the same manner as before; but they will generally be situated about midway between the former winzes, so that each may expose the ground under the middle of the rectangle formed by the upper winzes and the levels between which they are placed; and



REFERENCES.

A Blewett's Shaft, used as a ladder road by those men who work in 15 and 23 fathoms levels.
B Pearce's Shaft, } used exclusively for drawing up the mineral.
C Paul's Shaft,
D Prince William Henry's Shaft.
E Doctor's Shaft, through which the greater part of the men descend to their different patches and [illegible].
F Pressure Shaft, used exclusively for drawing the mineral.
The double line east of Pressure Shaft shows the junction of the counter with the main lode.
There is generally a strong current of air passing down Doctor's Shaft, which ascends through the winzes and other shafts.
The shaded patches indicate the parts of the lode which have been already removed.

Fig. 3.
[Scale of 90 Fathoms to 1 Inch.]

in this way the vein will be effectually exposed with the smallest number of excavations. A reference to fig. 3 will make this apparent. The tendency of this plan is to divide the vein into solid rectangular compartments of dimensions varying in different systems. When finally subdivided into portions of about 10 fathoms in height and 16 in length, they form convenient pitches for the Cornish miners. These pitches are "set" or let out to the workmen by auction, as afterwards described. In course of time the result of the operation we have described will be a large mine, as illustrated in fig. 3, which represents a vertical section of North Roskear, on the main lode. The references attached to this plate will explain particulars, and briefly illustrate the entire working of the mine. It will be seen that from a main shaft such as E, at vertical descents of 10 fathoms, long and ever extending horizontal galleries (levels) run right and left. These are numbered in the section successively, according to their distances in descent from the adit-level. By this numbering the exact place in the mine of any level can be indicated; and the workmen speak of their place in the 30 or 70 fathom or other level. All the horizontal strong black lines in the plate represent the levels; the long perpendicular lines the shafts, variously named; and the short perpendicular lines the winzes.

Stoping.

To illustrate the mode of working out the rectangular pitches, the irregular procedure according to the character of the vein, and the progress of the excavations, a distinct view of one portion of a Cornish mine is displayed in fig. 4. The different shadings will also show what parts

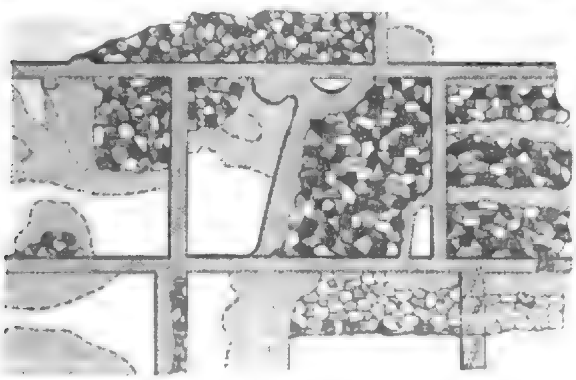


Fig. 4.

of the lode have been extracted, and what are in process of extraction. The "ground" or metalliferous mass is removed by what is technically called "stoping." To stope is to excavate horizontally, or "to beat away the backs." The word *stope* is evidently a corruption of *step*; and, in fact, the ore was taken away in steps. The French miners use the term *gradins* as synonymous with our word stopes. By the old miners the mass was invariably removed by the process of "under-hand stoping,"—the quickest, but the worst manner of getting the ore. The present method, or that adopted in the best mines, is termed "over-hand stoping." By this it is necessary, after having discovered ore, to sink shafts and drive levels before ore is attempted to be raised. No ore is raised before the ground is "laid open," and levels are excavated under the ore. Then stoping may be commenced over a level; the "deads" or rubbish may be piled up over the level, on a timber frame or "stull" (one only of which is necessary for each level by this plan, instead of several by the old plan); and the whole course of mining may be conducted so as to produce fair and average returns.

Ventilation.

A current of air, commonly sufficient for ventilation, passes through the mine by descending the main shafts, coursing through the levels, and ascending by the winzes. But when the mine is far extended in the course of many years, the miners do not find adequate fresh air; and the increase of temperature, which is always proportionate to the increase of depth, to the number of workmen present, and to the more confined and remote position of the recesses, is so considerable, that a decidedly injurious result is occasioned to the health of the miners. An analysis of sixteen samples of air taken from four mines in Cornwall, at an average depth of 214 fathoms, and at an average distance of 28 fathoms from any shaft or winze, gave a mean per-centage of 17·067 oxygen, 82·848 nitrogen, and 0·085 carbonic acid gas, instead of the normal proportions of 79 per cent. of nitrogen and 21 per cent. of oxygen. The mean temperature of the Cornish mines is generally higher than that of coal mines; and at a depth of 250 fathoms there is a difference of upwards of 10°. In many of the deeper parts of the Cornish mines the temperature approaches 100°; so that the miners have to plunge into water several times during their relays of painfully laborious work. The miners' health is thus injured; and the timber used to prop up the passages rapidly decays. These evil effects might apparently be avoided by the adoption of the Newcastle system of ventilation in coal mines, for which system the arrangement of Cornish mines offers peculiar facilities. (See a paper by H. Mackworth, Esq., in p. 28 of *Twenty-first Report of the Cornwall Polytechnic Society*, 1853.) The temperature of the deepest level in the Tresavean Mine was recently reported to the writer as 90° and upwards; and some of the water gushing into the deep level of the United Mines has been, says Mr Fox, from 106° to 108°.

Methods of raising minerals.

Minerals were originally raised to the surface by the common windlass, and afterwards by a *horse-whim*. A water-wheel was next applied; and on the introduction of Newcomen's engine, the water expended was sometimes pumped up again by it. A water-wheel with double buckets succeeded, in order to reverse the motion, and alternately raise and lower the rope. This was improved by Smeaton, who retained the single buckets, but made the rope-roll to throw out of gear and reverse. A step further was to apply Watt's engine directly to the rope-roll by means of a crank. The Cornish bucket that contains the ore and stuff is called a *kibble*. An experienced mining engineer has known as much as L.2 paid for drawing the same quantity of ore to the surface by horses as is now done by steam-power for one shilling. In raising ores the miners generally work upwards from the *back* or upper part of one level towards the bottom of another, and the excavations are so arranged that the ore may readily fall down to the level below them. The modes of bringing the ore, when dislodged, to the surface are various in different districts and countries. The most primitive and most disadvantageous method is, when ore is carried on the backs of the men or lads to the surface. Even women were employed at this degrading labour in Scotch coal mines before the investigations of the Mining Commissioners in 1840. An act of Parliament now excludes females from underground work. Very little ore is now carried on the backs of human beings in Britain.

The conveyance of ores along the level is effected by hurdles or barrows in some places, and by waggons in more advanced districts. The passage is facilitated by laying down wooden or iron rails, and thus forming subterranean railways.

Inclined planes.

In situations favourable to inclined planes, they are most convenient for the transport of ores to the surface. At Wheal Friendship Mine in Devonshire there were two inclined planes, distinguished as the *old* and the *new*, both beginning near the same point on the surface. The old was about 500 yards in length, and the perpendicular depth from the surface at the lower end was 600 feet, the angle formed with the horizon being about 20 degrees; but another plane is now in use, which is 650 yards in length, and attains to a perpendicular depth of about

Mines and Mining.

1025 feet below its mouth, or 1100 below the surface. The inclination which it forms with the horizon varies from 30 to 45 degrees—an angle which exceeds that of the inclination of the steepest mountain in this and probably in any other country; consequently no carriage could be propelled up so steep an ascent without the power of machinery. A single track of edge-rails is carried along the plane from top to bottom; and a wrought-iron waggon, loaded with ore, is propelled by the force of a large overshot water-wheel, 40 feet in diameter and 5½ feet in breast, which is turned by a considerable stream of water, conducted with another stream several miles through a *leat* or artificial channel to work this and other machinery belonging to the mines. The two streams constantly furnish 5000 gallons of water per minute.

A popular illustration of this inclined plane might be drawn from St Paul's in London. The height of St Paul's Cathedral, to the top of the ball and cross, is 340 feet. Supposing, therefore, that two buildings of equal altitude were placed on it, we should have an elevation of 1020 feet, answering nearly to the perpendicular *depth* of the foot of the inclined plane below its mouth, which was before stated as 1025 feet. If from this immense elevation we conceive two ropes or imaginary lines, about 4 feet apart, to be extended through the air, following the line of Ludgate Hill, and reaching the ground at the eastern end of Fleet Street, a distance of above 500 yards, the length and slope of the inclined plane will be nearly correctly realized.

Underground economy.

The underground work of a well-managed mine will be of two kinds—(1.) Work for discovery or development; and (2.) Work for extraction of ores. We might distinguish these two kinds of work as *dead* and *live* work; the *dead* being that which proceeds in the dead rock, and the *live* that which is concerned in extracting the ores. The only fair and permanently successful plan of managing the interior work of a mine is to economize the supply of existing ores, so as in some measure to equalize it, and not to take out all the ore which could be immediately obtained. Masses should be left here and there only to be extracted as the general prospects of the mine may require. These should form a sort of reserve fund of ore, to which recourse may be had when less is raised from newly-discovered parts than the average. The ores thus reserved in various parts are expressively termed in Cornwall the *eyes* of the mine. They who take all the ore they can get out of a mine, without making proper reserves, are said to *pick out the eyes of the mine.* By picking out the eyes and sending them to market, a fictitious value has sometimes been imparted to shares,—a process analogous to that of some companies who have paid dividends out of capital. In all accounts of well-directed mines the reserves of ores are alluded to. Heavy expenses in works of discovery can only be profitably sustained by mining establishments of magnitude, which, by sending up a fair general amount of ores, can afford to appropriate a certain portion of the profit for discovery. The Fowey Consols Mine, Cornwall, has long been known as a good example of this management; and expenses have been there incurred for discovery which would have been ruinous if the mine had been divided into three or four separate adventures. The extraction of an extensive mine is very considerable, though by no means so large in mere quantity as that of an extensive northern coal-pit. At the Consolidated Mines, Cornwall, in good times, the daily extraction was about 200 tons, a large proportion of which was raised from a depth of from 200 to 300 fathoms (1200 to 1800 feet).

The extent as to space to which mines are worked depends upon their age, prosperity, and hardness or softness of rock. Success has more to do with the extent than mere age. When the success of discovery has been great, excavation has proceeded rapidly; and conversely. When that very prosperous recent mine, the Devon Great Consols, had been at work only five years, it was found (in 1850) that there were 5853 fathoms, or nearly 7 miles, of excavations, vertical and horizontal.

Accumulated waters.

One of the most formidable obstacles met with in the progress of mining is that of accumulated waters. Water is the arch-enemy of coal-mining in the north of England, and of copper-mining in the south-west. The copious springs tapped in sinking shafts near Newcastle have been the surprise of all who have encountered them. In that district they are termed *feeders*. In the sinkings at the Great Hetton Colliery, Durham, three principal springs or feeders were met with, of which the first issued 2000 gallons of water per minute, the second 1000 gallons, and the third 1600 gallons per minute. In sinking Hebburn Colliery, Newcastle, it was necessary to contend with feeders pouring out 3000 gallons per minute. At Haswell, Durham, an error in endeavouring to sink through a bed of quicksand occasioned an outlay of L.60,000, and yet the attempt was abandoned for another spot not far off, where the quicksand was avoided. The feeders of water in the quicksand supplied the enormous quantity of 26,700 tons of water per diem, probably the greatest amount known, unless we except the Dalton or Dawdon sinking for the South Hetton Company, Durham, where similar feeders were encountered, and where 1300 horse-power in steam-engines was necessary to pump out the water only, sometimes at the rate of 10,000 gallons per minute. In that locality the cylinder of the engines is 84 inches in diameter. They are condensing and double engines, and amongst the largest and most powerful ever erected. In the Cornish mines, although situated in hard rocks, we find vast accumulations of water. They do not issue from feeders in sand, like those just described; nevertheless, the infiltration of the rain and surface water, together with subterranean streams and pools, would soon inundate a mine and put a stop to the work, were not adequate means employed to drain the mine. In some of these mines a great increase of water almost immediately succeeds the commencement of the heavy autumnal rains; in others, on the contrary, this increase, though equally certain, does not take place until after an interval of several months. The necessary inference is, that the increase is owing to the rain and surface waters which, being absorbed, sooner or later find their way into the deeper parts of the mine.

Drainage.

Wherever in mining the workings are driven below the natural means of drainage, or below the level of the plain, recourse must be had to mechanical means to remove the water. The quantity of percolating water is diminished as much as possible by planking, walling, or caulking up with the greatest possible care those pits and excavations which traverse the water-levels; and the lower workings are so arranged that all the waters may unite in wells (*sumps*) situated at the bottom of shafts or inclined galleries, whence they may be pumped up to the surface or to the level of the *adit*[1] or gallery of efflux. In most mines simple sucking pumps are used, as they are less subject to give way, and are more easy of repair. As many of these are placed over each other as there are lengths of 10 yards in the shaft, below the point where the waters have a natural run. These means for draining are set in motion by that mechanical power which happens to be the least expensive in the

[1] The word *adit* is variously used in mining. It sometimes signifies a level taken up at the foot of a hill, and either driven on the lode or to intersect it, for the purpose of draining the mine at that level. It is also occasionally used in bringing out the ores. The *top adit* is that first driven; the *deep adit* is that lowest driven; the *air-adit*, that driven for ventilation. Sometimes the words *level, drift, adit, gallery,* and *sough,* are used synonymously.

locality. In the greater part of England, and in most of the coal mines of France and Silesia, this motion is communicated by steam-engines. In the principal metallic mines of France, in almost the whole of Germany and Hungary, and in some parts of England and Wales, hydraulic machines perform the work. In other places machines moved by horses, oxen, and even human beings, are used.

If it be merely necessary to lift the waters to the level of the adit or gallery of efflux, advantage may be taken of the waters of the upper parts of the mine, or even of the waters turned in from the surface, to establish water-pressure machines, or overshot water-wheels, for pumping up the lower waters. This plan is successfully adopted in several mines in Hungary, Bohemia, Germany, Brittany, Derbyshire, and Cornwall.

Great adits. There are many galleries or adits for drainage of several leagues in length, and sometimes they are so contrived as to discharge the waters of several mines,—as in the environs of Freiberg in Germany. The great drainage-gallery of the mine of Clausthal in the Harz is 11,377 yards, or 6½ miles long, and passes upwards of 300 yards below the church of Clausthal. Its excavation lasted from the year 1777 till 1800, and it cost about L.66,000.

The greatest British work of this kind is what is called the Great Cornish Adit, which extends through the large mining district of Gwennap in Cornwall. It commences in the valley above Carnon, and receives the branch adits of fifty mines in the parish of Gwennap, forming excavations and ramifications which have an aggregate extent of between 30 and 40 miles, and which in some places are 400 feet below the surface of the ground. The longest branch is from Cardrew Mine, and is 5½ miles in length. This great adit drains a tract of about 5550 acres in area, and discharges nearly 1500 cubic feet of water per minute. Rather less than one-third of this stream is collected at the adit-level, whilst the remainder is pumped up from a mean depth of about 190 fathoms. The temperature varies between 60°·5 and 68°, and is on an average more than 12° above the mean of the climate. It opens into the sea at Restronget Creek, and empties its waters into Falmouth Harbour.

Under "*Lead Mines*" we shall notice the Nent Force Level in the north of England, which drains the numerous mines of Alston Moor.

Steam-engines. The steam-engine, applied to pumping, has been the great helper of deep mining, whether in coal or metallic districts. Without it many first-class collieries could not have been won, and many metallic mines must have been long since abandoned.[1] It is now almost a denizen of all lands; it exerts its mighty energies on the frowning cliffs near the Land's End, fumes in the narrow valleys, and it is planted on the high table-lands of Mexico. The first steam-engine in Cornwall was erected at Huel Vor, a tin mine in Breage, and was at work between 1710 and 1714. This was known as the old atmospheric engine, which continued in use long after Watt took out his patent; but the superiority of Watt's engine became so apparent, that it gradually advanced in fame and use. In 1778 the improved engines of Newcomen were giving place to Watt's engines. Watt required, as his remuneration, one-third of the saving of coal effected by his engines as compared with the old. To ascertain this saving a *counter* was invented, which, being attached to the main beam, marked the number of its vibrations, and thus the work done and the saving of coals effected were readily calculated. Cornwall being without natural fuel, coal is enhanced in cost by its freight from other parts; hence the Cornish engineers have been ever studious of extracting as much as possible of the heating power from coal. The result of their efforts is, they have extracted more heating power out of a bushel of coals than other engineers.

Engine duty. The saving of coals by three of Watt's engines at Chacewater mine exceeded L.7200 per annum; and although the patent-right no longer exists, the same mode of calculating the work by counters is still in use, and what is termed the *duty* of an engine is estimated by the number of pounds weight (always expressed in millions) lifted one foot high by the consumption of one bushel of coals. In 1812 Captain Joel Lean suggested the plan of publishing the estimated duty of the Cornish engines, ascertained by a counter placed on every engine. This plan gave a great stimulus to improvement. The counter is furnished with a Bramah lock, the key of which is retained by the reporter, who, by monthly inspection of the engines, and the orders for quantities of coals consumed, ascertains the consumption of fuel and the duty performed. The "duty-papers" are then made public, and include not only pumping-engines but also drawing-engines, and those used for the *stamps* which pulverize the ores. The whole particulars being arranged, the duty of any engine may be found on inspection, and for any reported year. If, for example, we wish to find the duty of the celebrated Taylor's engine (cylinder 85 inches diameter) at the Consolidated Mines, for the half year ending June 1837, we inspect the returns, and see it registered as 63,020,000 lb. lifted one foot high by the consumption of one bushel of coals. The duty of Borlase's engine at Huel Vor Mine (cylinder 80 inches), was, for the same period, 74,073,000 lb. lifted one foot high Another example for the same time, was the duty of an engine of 70 inches cylinder at North Roskear Mine, namely, 79,535,000 lb.

It appears from a tabular view drawn up in 1838 that, since the establishment of duty-papers, the work performed by the ordinary engines has been more than doubled in twenty-four years, and the duty performed by the best engines during that period has been more than trebled. Taking the two extremes of that table, in 1813 the average duty of the best engine was 26,400,000 lb. lifted, while in 1837 it was 87,212,000 lb. lifted. This is a wonderful advance from the early supposed average duty of less than 17,000,000 lb. lifted. It must, however, be borne in mind that there is a wide difference between the common and the best engines.

The subjoined table presents the average duty of Cornish engines for four years:—

Years.	Number reported.	Average duty.	Average duty of the best engines.
1839	74	48,880,000	82,292,681
1840	58	49,730,000	81,809,036
1841	51	50,920,000	92,231,622
1842	45	51,620,000	99,262,657

Large engines. The highest duty recorded is that of Taylor's engine,

[1] Watt, writing to Boulton in 1783, gives some interesting particulars of Cornish mines at that time. He says—"Poldice has sunk a very great sum, and is not now gaining nor saving. It has cost L.35,000 to fit up a drain, Wheal Virgin, in this working, and it costs above L.10,000 a-year to drain the water, after all that can be done for them. Pool adventurers have sunk near L.14,000, and have no great prospect of recovering any part of it. At Dolcoath, it is said, they use L.500 of timber per month; and a new kibble-rope of above a ton weight is worn out in a fortnight. It takes full fifteen minutes to draw a kibble of ore there, which weighs only about 3 cwt. On the average, about two-thirds of the stuff drawn is barren stones. It cost three years' work, and I believe as many thousand pounds, to sink a new shaft in this mine. Every fathom of an engine-shaft that is sunk under the engine costs from L.50 to L.100. If we had not furnished more effectual means of drawing the water, I believe almost all the deep mines had been abandoned before now." (*Letter* from Watt, dated May 18, 1783, to Boulton.)

Mines and Mining.

United Mines—being 110,000,000 lb. lifted. The average duty of the *best* engines has been, during a recent year, as high as 100,000,000 lb. lifted. The total force of steam-engines now at work is estimated as 5510 horse-power. The number of engines at work is reported as 82. The average duty in 1843 was 55,230,000 lb. lifted; in 1853 it was only 48,000,000 lb. lifted; refuse coal being largely used.

The annexed are the largest engines now in use in that district:—

United Mines and Consolidated, Poldice	90-inch and 85-inch cylinders, 90-inch cylinder.
Huel Prosper and Huel Darlington.... Godolphin, United Hills, Huel Tor..... Fowey Consols, Duffield, and East Huel Crofty	80-inch cylinders.

The great 90-inch engine at the Consolidated Mines cost at the foundry L.2000, and the pit-work cost L.2000 more. The expense of putting it up was L.4000: so that no less than L.8000 was expended in its cost and completion with the pit-work. In twenty-four hours it consumed about 180 bushels of coals, delivered at one shilling per bushel. It lifted sixty-four gallons of water per stroke, and can work twelve strokes in a minute.

The great increase of duty above noted arises principally from three causes:—1. A reduction of pit-work resistances, if not balanced by an increase of water delivery. 2. A reduction of engine resistances, conjointly with an increase of power from a given quantity of steam, by using high-pressure steam (of forty or fifty lbs. to the square inch) expansively. 3. An increase of water evaporated in the boiler per bushel of coal consumed, by carefully preventing the radiation of the heat from the boiler, cylinder, &c.

The greatest quantity of water discharged from any of the Cornish mines in 1837 was from the Consolidated and United Mines in the months of February and March, when there were discharged from the Consolidated Mines 1657·18 imperial gallons of water, and from the United Mines 1634·49 imperial gallons, in each case every minute. Such was the estimate of parties connected with the mine, although it has been considered too high. Sir C. Lemon ascertained that the whole quantity of water pumped up by sixty Cornish engines in 1837, reached the enormous amount of nearly thirty-seven millions of tons. A single mine, Huel Abraham, yields the vast quantity of 43,500 hogsheads of water in twenty-four hours, pumped up from a depth of 1441 feet. In reply to inquiries, we are informed that the average quantity of water raised by Devonian and Cornish engines is about 9000 imperial gallons per minute.

The engines for draining are erected near to the shaft in which the pumps are fixed, which is called the engine-shaft. One end of the beam hangs over the centre of the shaft, and is attached to the pump-rod, which is raised at each stroke of the engine, afterwards sinking with its own weight, which is always counterbalanced by a *balance-bob;* so that the whole power of the engine is exerted in raising the column of water in the pumps. An engraving of the pumps used in metallic and coal-mining is to be found in Plate CLXXVI., illustrating the article COLLIERY, in this work.

A large and substantial building generally houses the engine, having galleries affording convenient access to every part of the machinery. The centre of the beam is supported by the front wall of this house, and a low building attached to it contains the boilers, which in Cornwall, together with the steam-pipe and cylinder, are carefully cased and covered up with some non-conducting substances.

Cost of materials.

A very large expenditure is necessary for the materials consumed, both in the engineering and mining departments of the Cornish and Devonian mines. Of this the expenditure for one year (1837) will be a sufficient example:—

							Total values.
Coals............	56,860	tons at L.0	17	0	per ton,		L.48,331
Timber	14,036	loads at 2	12	0	per load,		36,545
Gunpowder ...	300	tons at 44	0	0	per ton,		13,200
Candles	1,344,000 lbs.						35,000

The roofs and sides of mining galleries must frequently be supported by timbering. In a gallery it may be sufficient to support the roof by means of joists placed across, and bearing at their two ends upon the rock; or the roof and two walls may be upheld by means of an upper joist resting on two lateral upright posts. From these simplest forms various adaptations, up to the most complex timberings, may be employed. An ingenious system of cross-bars is used in the Hartz for supporting the wall of a lode during excavation.

Considerable timbering is often necessary in shafts. Coal-mine shafts are often lined with timber in the north of England. Woodwork for shafts sometimes consists of rectangular framing, and sometimes of circular. In the Newcastle district coal-pit shafts are frequently *tubbed* to a considerable depth; and, when the feeders of water have been copious, iron tubbing is employed. Plank tubbing, when well executed, will sustain a pressure of 100 lbs. to the square inch, and endure for many years, when the water is fresh; but if salt, it corrodes the iron nails, spikes, &c. Solid wood tubbing, neither requiring planks nor spikes of iron, when solidly and smoothly fitted, is convenient, is very durable, and will often sustain a pressure of twenty atmospheres. But iron tubbing is now most frequently used in coal-mine shafts where copious water issues from sands. This, though costly, is very durable, and was applied in a colliery in Durham where all hopes of success seemed unfounded. It will sustain an enormous pressure.

The total quantity of timber in use for mining purposes in Cornwall would require no less than 140 square miles of forest of Norwegian pine, averaging a growth of 120 years. Taking a very speculative year (1836) as our example, the consumption of timber for mines was estimated at 36,200 loads, or 144,800 trees. The cost of timber imported in the same year was L.176,000; the drawback in the duties of which amounted to nearly L.82,000. The cost of timber for the Devon and Cornish mines in that year amounted to L.94,138. In the year 1837 the loads were 14,056, and the cost L.36,545.

Descent and ascent.

The descent and ascent of most metallic mines in Cornwall is made by ladders, of about 25 feet long and with steps from 10 to 12 inches apart. Successive ladders are placed slopingly, and at the foot of one ladder is a platform named a *sollar*, with an opening leading to the next ladder beneath, which is generally placed parallel with the one above. The fatigue of descending to great depths by successive ladders, and especially of returning after the day's work, and ascending these ladders, is very great. We may compute that one-third of a miner's whole physical strength is expended in going to, and more in returning from his work. In the year 1833 an accident suggested a new method to one of the Hartz miners, who availed himself of the reciprocating motion given to the pump-rods in the shaft. A portion of 100 fathoms was divided into 22 minor portions, and on each of these an iron step was fixed at intervals of four feet, while hand-holds were placed at convenient distances. A reciprocating motion of 4 feet being given to each rod, the miner stepped from one rod to the parallel one on the other when it arrived at his standing place. As one rod is always ascending while the other is descending, the miner can thereby ascend or descend at pleasure by stepping from one rod to the other. It is evident, for illustration, that if two rods A and B (fig. 5) be alternately descending and ascending by the communication of a reciprocating motion to them, then the steps

a, *b*, *c*, and *d*, fixed on A, will, in every motion of, say four feet, be even with the steps *g*, *h*, *i*, *k*, &c., fixed on B. If A descend and B ascend, then one movement will bring *a* level with *g*, and *b* with *h*, &c., so that a man beginning with *a* can step over to *g* when on the same level, and then he will be borne down, upon the next movement of B downwards, to *b*; from *b* in like manner to *h*; and so on successively until he arrives at the lowest step. In ascending he has only to reverse this action, and he will in due time reach the surface without fatigue. In the Fowey Consols Mine a *man-machine* of this kind extends to a depth of 1680 feet. It is improved by stationary platforms, the rod carrying down 12 feet at a movement. Other improvements may be adopted; and these man-machines are remarkable economists of labour, life, strength, and money. To descend 1700 feet requires only twenty-five minutes.

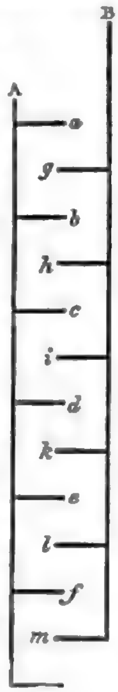


Fig. 5.

This machine is one of the most signal alleviations of the miner's toil which has ever been invented or applied. It ought to be generally adopted, as there is no objection on the ground of expense. In Cornwall the loss of time weekly sustained by workmen in descending and ascending ladders is estimated at three shillings, and the loss by man-machines at ninepence. They are now in very general use in the mines of France, Belgium, and Germany; and it has been shown that the saving, even in money, by the use of these machines, is considerable. Thus, in a mine where 250 men descend and ascend a shaft of 150 fathoms, the cost per annum is comparatively as follows:—

Ascent and descent by ladders		L.3150	0	0
...	... by man-machines	639	0	0

An engineer has shown how 10,000 miners might, by adopting these machines, save no less than L.39,000 per annum in the value of time alone. (For fuller details, see *Cornwall: its Mines and Miners*, &c., p. 155-161.)

System of labour.

It remains to explain the peculiar system by which mining labour is conducted in Cornwall. The two great classes of work-people consist of the surface men and the underground men,—the latter being about three to one as compared in number with the former, and being again divided into two strongly-defined classes, called provincially "tutwork men" or "tutmen," and "tributers." Tutmen are simply excavators, paid at a fixed rate per fathom. Their undertaking is to bring to the surface so much material, whether ore or mere "stuff," at the agreed price. Such men are necessarily the first labourers in a mine, as they sink the shafts and drive the levels. They form a party, or *gang*, consisting of several persons, and each party is divided into three gangs, each gang working eight hours at a time, the whole number thus taking their turns in the twenty-four hours. The price at which they are set to work is the only subject of dispute. The work is given out by the officers of the mine at a price per fathom, which the tutmen are to bid for. They bid with a real or supposed knowledge of the nature of the ground, and the party offering to take it at the lowest price secures the work. To fulfil their task they require the use of machinery to raise the excavated matter to the surface, and they are allowed to use the machinery on the ground at a certain rate of charge, to be deducted from their earnings. Other deductions are made for candles, powder, safety-fuze, smiths' costs, &c. In a case before us six tutmen took a contract for a month, and, after all deductions, each man earned L.2. 16s.

The "tributers" do not work for fixed wages of so much per fathom, but become, by a peculiar arrangement, partners of the mine as regards the portions or "pitches" which they respectively undertake. We have already explained that the *pitches* are the rectangular portions into which the part of the mine containing the lode is divided, as shown also in the illustrations. The method of arranging the excavation of these is as follows:—A mine has its regular "setting day," on which the captain of the underground work meets the tributers at a fixed time and place. A mining auction now takes its course,the captain acting as auctioneer and partly as appraiser. Particular pitches are named and put up by the captain. The tributers who form the bidders have, it is presumed, studied the character and metallic prospects of each pitch, and their knowledge and skill is now brought into exercise and competition. They are now about to agree to get the ores in the pitch in question, to break them, to raise them to the surface, and pay for the whole process of dressing them (if so required) and bringing them into fit condition for the smelter. It is evidently the object of the captain to set each pitch at the *lowest* price, so that his aim is the reverse of that of an ordinary auctioneer; and as the captain represents the proprietors, his interest is to secure the extraction of the ore at the smallest payment. The tributer will bid in proportion to his idea of the richness or the poverty of the pitch put up; if rich in metal, his labour will of course be less than if poor, and his reward greater. Quality and quantity of metal will regulate his offer. For example, he may offer to work the pitch put up, if rich in ore, at five shillings in the pound, that is to say, five shillings deducted from every pound's worth of ore raised to the surface, such being his *tribute*; and hence the name of tributer. If the pitch seem poor in ore, he may not take it under thirteen shillings in the pound; and the prices offered vary from one to thirteen shillings in the pound. The whole setting is generally arranged without much difficulty or difference. The pitches are set in this manner for two months at a time.

When the tributer proceeds to work in the manner previously described, he discovers the value of his bargain. If he finds the pitch much poorer than he expected, two months will terminate his bad bargain, if much richer, two months will terminate the bad bargain of the captain. If the tributer find his pitch to turn out extremely poor, he may throw up his agreement at the end of one month, or previously by paying a fine of twenty shillings. The preference is given to men best known and longest established in the mine. There are great and mutual advantages in this plan of conducting the raising of ores; and although the tributers are often disposed to complain, yet it may be doubted if any other equally beneficial and equitable mode of carrying on the work could be devised.

To show the operation of this system, we shall give an example occurring in actual work. The ore raised by a certain party of tributers sold for L.182, 2s. 2d.; and as the tribute was 7s. 6d. in the pound, the share for the tributers was L.68, 5s. 9d. From this sum the following deductions were made by the "adventurers" or owners of the mine:—For 108 lb. of candles, L.3, 12s.; for 195 lb. of powder, L.6, 10s.; for safety-fuse, L.1, 9s.; for hilts, 1s. 9d.; cams, 2s. 6d.; saws, 6s.; locks, 1s. 6d.; smith's work L.3, 19s. 6d.; drawing, L.3, 0s. 11d.; cost of dressing, L.6, 10s. 8d.; use of grinder, 8s. 10d.; sampling and weighing, 17s. 6s.; "subsist," or money drawn on account, L.36, 18s.; total, L.63, 18s. 2d. Thus the actual costs amounted to about L.27, or 40 per cent. on the tribute; and the men had drawn so largely beforehand that they had only to receive L.4, 7s. 7d.

The earnings of tributers vary so greatly, from the nature of their work and from the system, that no average can be deduced. It was, however, found in 1837 at the Fowey Consols Copper Mine, that the average monthly wages of

340 tributers were L.3, 7s. 1d. each, while the monthly average of 358 tutmen was L.2, 19s. 2d. each.

The remainder of this article will treat of the position, produce, statistics, and mines of the more important and useful metals, under each metal separately. (For additional information respecting gold and silver, not strictly belonging to mines and mining, see the article PRECIOUS METALS.)

GOLD.

Gold is less the subject of mining, strictly so called, than almost any other metal, as it is chiefly distributed in auriferous detritus. Some considerable portion is found in combination with iron pyrites and other metals, as silver, tellurium, and mercury. From silver it is obtained by a process termed quartation. Dr Percy has detected minute quantities of gold in almost all lead ores, and is disposed to believe that gold may have been thrown down by deposition from an aqueous medium; while Humboldt suggests that the formation of gold has some closer relations to, or dependence upon, the atmosphere, than lead, copper, or iron.

Great mistakes have been made, and may be repeated, concerning gold in veinstones. For example, about twenty-seven years ago lumps and specimens of gold were brought from North Carolina to London to induce the formation of a gold company. Fortunately a competent mining surveyor was sent out, who found numerous filaments and traces of gold in the pyrites and on the surfaces of the rocks, but he soon satisfied himself that "the veinstones had no body of ore downwards," and thus prevented a ruinous expenditure. Lodes or veins of copper, argentiferous lead, iron, &c., have been found in numerous instances to become more and more productive as they have been followed downwards; while, on the contrary, gold has invariably (hitherto) proved to be much attenuated in its descent, and in most instances to disappear at considerable depths. The auriferous quartz "reefs" in Australia run down sometimes from the surface between sandstone, slate, &c., but always seem to run out at a depth of generally less than 100 feet. This downward attenuation of gold veins in rocks is an opinion held decidedly by Sir R. I. Murchison (see the new edition of his *Silurian System*, the chapter on gold) and some other geologists. Reports from Mr Selwyn, government geologist, New South Wales, and from Mr J. S. Wilson (who has passed three years as a gold miner in the Sierra Nevada of California, and has communicated a memoir to the Geological Society of London), decisively confirm the above-stated opinions and facts concerning the downward impoverishment of quartz veins containing gold, and demonstrate that the richest produce is essentially derived from loose superficial debris piled up on mountain sides or slopes, or in ravines, and at various considerable altitudes above the sea.

It will be found upon examination, that in nearly all the gold countries the chief supply has been derived from the alluvial deposits, and but a small proportion from veins and rocks; and few deep mines have succeeded. Brazil indeed presents some examples of successful subterraneous gold mines; and in two establishments at the famous Minas Geraes the veinstones have proved highly remunerative, though the ore is seldom long continuous; but the loose rubbish of Brazil has afforded its chief supplies of the precious metal. Nearly all the gold in Chile is procured from sands, detritus, conglomerates, and loose debris. In Peru and Bolivia the ancient drift or diluvium has afforded most gold; and in Columbia the great mass of gold has for many years been derived from diggings and washings in similar deposits. The celebrated mines of Beresor in the Urals have, however, shafts 105 feet deep, and galleries in which the gold lies in soft decomposing gneiss, studded with bright veins of quartz and quantities of silvery talc. Brown spots of crumbling iron pyrites are strewed through it; but the large crystals of brown ironstone are only met with where the quartz is deposited in narrow and tortuous streaks and veins. It is from both sides of the hard white lines that the entire iron ore is collected containing the gold, partly dispersed in fine plates, and partly accumulated in lines and filaments like wire. The ore is followed in every direction.

Sources of gold and silver to the ancients.

With reference to the precise locality of the most ancient sources, termed Ophir (Supara of Ptolemy), nothing definite is known. The people living near the sources of the Indus obtained, according to Herodotus, a large quantity of gold from the eastern border of the Great Bactriana, and the desert steppes of Cobi. Much was obtained by washing sands, and more by digging. Herodotus again tells us that "in the north there is a prodigious quantity of gold; but how it is produced I am not able to tell you certainly." Pallas, in his *Travels*, describes the remains of these mines. Mines were also visited by Lepechin and Gmelin on the south-eastern borders of the Ural Mountains, which were in all probability the work of a nomadic people like the Scythians. This gold region still continues to yield treasures to industry. The extent of the works shows that the ancient workmen must have been very numerous; whilst an inspection proves that only the first rudiments of the science of mining could have been known. With very imperfect instruments (some of which remain) they must have worked very long and very patiently. They seem to have scraped out the gold with fangs of the boars, and collected it in leather bags or pockets. Some of the pits are 20 fathoms deep, shaped like a bell, and are about 7 feet in diameter. The passages and props are well excavated and arranged, but the former are extremely low. The natural pillars left to support the roofs are still effectual for that purpose in some parts, and in these are still found small portions of copper ore containing particles of gold. Human bones, probably of the workers, are found in the ruins of other pillars. Only the richest ores were worked, and some of them must have been smelted in the mines, for in the rubbish melted copper and smelting implements have been found. The operations of crushing and washing the ores were performed in the rivulets; and the smelting, whether in the mines or at the surface, was performed in small furnaces, of which Gmelin observed nearly a thousand in the eastern parts of Siberia. These were made of red bricks, and in them pieces of melted copper two and three pounds in weight have been found.

Nubia and Ethiopia.

From the mines of Nubia and Ethiopia it is evident that much gold was produced. These mines, like those of the Uralian chain, produced a copper yielding gold, which the Africans knew how to separate. Belzoni discovered that a very extensive tract had been worked in the Sahara Mountains. The Pharaohs derived their wealth from these sources at the expense of much human suffering and loss of life. Mr Jacob concludes, from a close examination of the subject, that not less than L.6,000,000 sterling of the precious metals must have been *annually* produced from these mines, and that a large proportion of this must have been gold. This source of gold may have become very productive.

Thrace and Thessaly.

There were gold mines in Thrace and in the island of Thasus. Thessaly produced ores which were rich in gold, and Epirus rich silver ores, and there were rich silver mines in Attica; and from all these sources the Athenians drew their wealth. (See Boeckh's "Dissertation on the Silver Mines of Laurion," in his *Public Economy of Athens*.) They extended from coast to coast, in a line of about 7 English miles, from Anaphlystus to Thoricus. The ores extracted contained silver and lead, with zinc, and probably copper, but no available gold. These mines were worked by means of shafts and adits, and whole masses were removed, so that the supports alone were left standing. The state was the sole

proprietor of them, but they were never worked at the public expense. They were always granted to private individuals in fee-farm, and these leases were transferred from one person to another by inheritance, sale, and other kinds of legal conveyance. When Themistocles proposed to the Athenians to apply the funds obtained from the mines to the building of ships, instead of dividing them as before amongst the people, the annual receipts appear to have amounted to 30 or 40 talents.

Sources to the Romans.

The Romans, who monopolized as much of the mining produce of the world as they could, found the principal sources in Upper Italy, in the province of Aosta, in the Noric Alps, and in Illyria. From this district gold was abundantly obtained at one period, partly in large grains on the surface, and partly in mines, so pure that an eighth part only was lost in the process of smelting and refining. Its great quantity caused a decrease of one-third in the price through all Italy, and induced the proprietors to employ fewer workmen in order to raise the value. The people named the Tarbelli, at the foot of the Pyrenees, also worked the soil extensively for gold. Amongst the most productive mines in particular belonging to the Roman republic, we may name the rich gold mines near Aquileia, those of Ictimuli near Vercelli, in which 25,000 men were constantly employed (Pliny, *Hist. Nat.*, xxxiii. 4), and the silver mines in Spain, in the neighbourhood of Carthago Nova, which yielded every day 25,000 drachmas to the Roman Ærarium (Polyb. xxxiv. 9). We are informed by Pliny that the Emperor Vespasian obtained annually from Galicia, Asturias, and Lusitania, L.60,000 of gold; while the silver was found in such quantities in Spain, that Hannibal extracted from a mine worked by him near Cartagena daily a produce exceeding L.300 of our money. Cato delivered into the treasury 25,000 lb. of silver in bars (L.120,000 in our money), besides 400 lb. of gold, all of which he had accumulated in Spain. Helvetius, who was only governor of Andalusia, delivered 37,000 lb. of silver in coin, and 40,000 lb. of silver in bars. Strabo also informs us that neither gold, silver, copper, nor iron, were found in such quantities and excellence in any part of the known world as in Turdetania (Strabo, *Geograph.*, p. 194). The Hungarian gold mines do not appear to have been worked before the eighth century, and the mines of Sweden and Norway not until a later period. In our own country, to the conquest of which the Romans were incited by the reported wealth of the inhabitants in gold and other metals, we do not find many evidences of ancient mines of the precious metals. Cimboline, prince of the Trinobantes (which included Essex), is stated to have coined gold money instead of rings. It is curious that Henry IV., by his letters-mandamus, commands Walter Fitz-Walter, upon information of a concealed mine in Essex, to apprehend all such persons as he in his judgment thinks fit, that do conceal the said mine, and to bring them before the king and his council, there to receive what shall be thought fit to be ordered.

The Welsh Triads celebrate princes as being possessors of golden cars, and in all probability this induced the Romans to penetrate into the principality. It has been recently found that the Romans worked the Gogofau or Ogafau Mine for gold, which is near Pamsant in Caermarthenshire. A Roman station is indicated by the remains of pottery and ornaments found on the spot; and several gold ornaments, and a very beautifully-wrought gold necklace, probably manufactured in the locality, have been discovered.

Geological and geographical distribution of gold.

It is very remarkable, as has been observed by Sir R. I. Murchison, that the countries which were successively to give laws and civilization to the ancient world—viz., Lower Egypt, Greece proper, Italy, &c.—should all alike have been destitute of procurable gold from their own soils, arising from the geological cause that those countries contain no mineralized old rocks. It were a curious geological problem to ascertain why the older strata, when mineralized, are pre-eminently auriferous, and the secondary and tertiary strata, when altered and mineralized, are not so. Italy, south of of the Po, contains scarcely any stratum older than secondary limestone, and is totally destitute of gold, a part of Calabria being the only exception. In proceeding, however, to Sardinia and Corsica, where silurian and crystalline rocks are found, there we observe that gold mines have been worked in the olden ages.

Adolph Erman, in his *Reise um die Erde*, and *Geographische Verbreitung des Goldes*, Berlin, 1848, gives some valuable information on the geographical distribution of gold, and has appended a gold map of the world to the latter of the above-named works, in which he marks seventy-seven tracts in which gold has been worked, or is known still to exist, and shows, in contradiction to the old-received opinion, how greatly it predominates in the northern hemisphere.

With reference to its geological position, gold is found in the primary group of rocks, including the transition strata of earlier writers, which, as they contain the oldest organic remains, have been technically denominated palæozoic. This series constitutes the dorsal spine of the great mountain chains of both the old and the new world. There are, however, vast regions, amounting perhaps to three-fourths of all known lands, where no such rocks appear. Experience has shown that it is only in the primary group of rocks, as above defined (including certain associated igneous rocks), that gold has been found in quantities sufficient to pay for working. All the veinstones or rock masses from which much gold has been derived, whether by natural catastrophes or by human endeavour, belong to the primary and transition group (or what are now called the azoic and palæozoic rocks), and especially to those portions which have been modified by the eruption of matter in a state of fusion, or at a very elevated temperature. It is thought that the gold-producing rocks are not confined to particular geographical zones, as formerly supposed, but they are found protruding more or less in meridional bands in all countries where the primary series is visible.

In the Urals.

In the Ural district, at Ekaterinburg, and north and south of it, gold was discovered in the beginning of the present century, and being traced to its parent source, small underground mining drifts were sunk on the quartz veins in the schistose and granitic rocks, which gave a scanty revenue. Gold was, however, subsequently discovered in lumps, grains, and scales in the gravel and sand on the sides of the brooks in the same district; and trials soon convinced the miners that it was far more profitable to wash the gravel and shingle, than to follow laboriously the quartzose veins containing threads of gold in the solid rock. The result has been the establishment of diggings and washings at different points between Petropaulosk in the north and tracts south of Minsk, which have afforded for many years yields of gold worth from L.500,000 to L.700,000. All these localities of auriferous gravel, shingle, and sand, are in the vicinity of those spots where Silurian and Devonian sandstones and schists have been penetrated and altered by the eruptive rocks before named. The gold, when traced to its original matrix, is found to occur chiefly in veins of quartz in the form of lumps, threads, and flakes. These veins rise, geologically speaking, from beneath; for they are seen to cut through all the strata or beds of which the hills were originally composed.

Theory of deposition.

In considering the original derivation and formation of auriferous, alluvial, or diluvial deposits, the following theory appears most applicable:—When the primæval breakers, waves, and currents acted on the rocks containing gold, whether it were disseminated through the mass of the rock, or confined to the quartz veins traversing it, fragments of the auriferous rock would be detached equally with other pieces. Such fragments, either slightly water-worn or alto-

gether broken and ground down, would afterwards be found in the drift clays, sands, and gravels, and would, in all probability, be much richer in gold than the actual gold-bearing rocks themselves. A current of water having sufficient force to bear along sand or pebbles of quartz, or any other rock of perhaps $2\frac{1}{2}$ specific gravity, might not be able to move associated fragments of gold, which metal has a specific gravity of 18 or 19. Moving water, therefore, has formerly effected upon the auriferous rocks that which the miner would now effect, namely, broken them up into fragments, swept away the lighter particles, and left the gold behind.

Rivers are great natural *cradles*, sweeping off all the lighter and finer particles at once, the heavier ones either remaining against any natural impediments, or being left where the current slackened in force or velocity. There are reasons why the auriferous drift may be richer in gold than the mass of the rock from which it is derived; and there are other reasons also why the auriferous drift of a country first deposited after the first formation of the gold, should be richer than any subsequent one.

The Gold districts of Australia.

These wonderful and recently-discovered auriferous countries have created the greatest excitement, and given rise to extravagant anticipations, as well as to much personal disappointment in the failure of foolish expectations. In the numerous publications of visitors to these regions, we find but little scientific information, nor are we yet able to form precise ideas as to all the geological conditions of these repositories.

At present the search for gold, at least in Australia, is chiefly confined to the alluvial beds. Of these, we learn from one geological visitor that at the Ballarat diggings, in the gold-fields of Victoria, the alluvial deposits may be thus divided:—

I. *Older than Basalt.*	A. Before the eruption of basalt and the bearing beds (*charriages*) of basalt boulders.
II. *Newer than Basalt.*	B. Contemporaneous with *charriage* of basalt boulders.
	C. Newer beds covering the basalt boulders, but older than the formation of the existing valleys.

The source of the gold appears to be an indefinite succession of clay-slate, and of argillaceo-arenaceo-micaceous slates, seemingly interstratified, as regards their strike, with quartz veins of all sizes, which form the matrix of the gold. The basalt hems in the gold district on the east and west as an iron framework.

A report of a select committee of the Victorian Legislative Council has just been published, in which a very favourable estimate of the richness of the Victorian gold-field is given. Mr Brache, said to be a reliable authority, estimates the auriferous lands of the colony to be 20,000 square miles, including 20,000 square miles of quartz reefs. He computes that there are about 20,650,000,000 tons of quartz, which would take 100,000 miners about 300 years to work up. The alluvial lands are further estimated at 20,444,000,000 cubic yards, and if worked up by 100,000 miners at the rate of 90,000,000 cubic yards per annum, they would occupy 2240 years. The grand total of the auriferous wealth of that colony is estimated at L.26,783,000,000 sterling. The aggregate receipts for the five years from both districts amounted to L.41,830,696, of which L.7,032,141 came from New South Wales and L.34,830,696 from Victoria. It appears that all of this vast amount, except about two millions, was brought direct to this country. The Australian produce of gold for 1856 has been estimated at 120 tons in weight and L.13,000,000 in value.

Mr Wyld says, that the whole range of the Australian Alps, 200 miles long, is supposed to afford sites for gold-diggings. Sooner or later the working of alluvial gold soils will cease to be highly gainful. The question will then be decided whether quartz-crushing for gold can be sufficiently remunerative. Many companies for this object have been projected, and nearly all have failed. There are many, however, who still think highly of quartz-crushing. A geological problem also still to be decided is the continuance of the veins or strings of gold beyond a moderate depth.

Mines and Mining.

Califo

Respecting the ultimate production of Californian gold, it has been thought that the metal is too richly sprinkled to promise any very long continuance of an abundant yield; for it is almost a law among miners, that ore too highly condensed in any given locality of lodes or veins is, in the long run, much less profitable than when broadly and widely diffused throughout a mass of rock. Hence other regions whose gold is disseminated through mountain masses may afford a supply for ages to come, long after the rich gravel troughs of California shall have been exhausted. Much, however, may possibly be derived from Upper California. There is a remarkable geographical feature connected with the mineral phenomena of California noticed by Murchison. All the great quantities of gold have been derived from some twelve or fourteen localities in that portion of the western flank of the Sierra Nevada which assumes a north-westerly direction from that parallel to the meridian it had before followed between 37° 30′ and 30° N. Lat. By reference to the map of Fremont, it will be seen that the centre of this westward deflection is directly opposite to where the extremity of an east and west ridge, which traverses the great saliferous basin, impinges on the Sierra Nevada, and is associated with the protuberance which *alone* has proved to be so eminently auriferous in all the long chain of mountains ranging from the eternal snows of Russian America to Mexico, Peru, and Chile. It is possible that the intersection of ridges may account for a great local development of metal, just as in mining practice at home and abroad it is found that the richest branches are often detected where lodes traverse each other.

United States.

From an American state paper just published, we extract the following interesting particulars:—The gold and silver coinage of the United States, from 1793 to 1856, amounted to 549,341,514 dollars. In 1844, before the gold mines of California were discovered, the total of gold and silver in the United States was estimated at 100,000,000 dollars. The imports and receipts of bullion at the mint from American mines, after deducting the exports up to the 30th of September 1856, have added at least 150,000,000 dollars to the amount of gold and silver in the country, without taking into consideration the amount brought in by emigrants and returning travellers, or the amount carried out by travellers and merchants, not entered at custom-house, or the amount used in the manufactures or employed in the arts. In the fiscal year 1856–7 our country received from America imports of gold to the value of 33,000,000 dollars.

The *gold region*, so called, of the United States is a metalliferous belt extending in a south-west direction through the states of Virginia, North and South Carolina, and Georgia. Its length is about 600 miles, and it has a mean breadth, from its southern to its northern edge, of about 80 miles. In every part of this extensive line native gold is met with in alluvial deposits, and in various streams where the contiguous rocky strata abound in quartzose veins more or less auriferous. In Georgia the richest mineral belt is in the talcose slate and granite formations, alternating with hornblende-slate, gneiss, and chlorite-slate. Parallel belts are found also near Augusta, but they cease with the termination of the primitive region. The most productive researches have been made in the branch streams or stream mines, and in the beds of rivers, rivulets, and ravines. A moderate amount of gold has been derived from the metamorphic rocks of the Lower Silurian range in Lower Canada; and very recently intelligence has arrived of larger auriferous deposits in Canada.

Russia.

The greatest increase of precious metals, except from Australia and California, has been from the mines of Russia. Sir R. I. Murchison considered the present production of gold from Russia to be nearly equal to L.3,000,000 sterling per annum. The quantity of gold raised in that country during the five years succeeding 1847 was equal to about 296,932 lb. troy.

Gold in Britain.

While our islands contain nearly every geological deposit from the oldest to the latest,—the older occupying all our mountainous tracts of the west,—it is only in some six or seven localities that gold has ever been largely found. British gold was not probably very abundant at any period, although the Druids may have found enough in the superficial gravel of certain limited tracts to serve for the manufacture of their beautiful "torques," armlets, and other ornaments. There may have been surface accumulations in Britain and Ireland (as in Bohemia, &c.), now totally exhausted. Some little gold, associated with the tin in the old and crystalline rocks of Cornwall and Devon, had long attracted the ancients; and so late as the reign of Edward III. we are told that the mines of North Devon furnished enough specie (possibly silver) to enable that warlike prince to embark in one of his campaigns; and even at this day pieces of gold, some as large as a pigeon's egg, are occasionally found at Combe Martin. In Cornwall a very small portion of gold is associated with the alluvial tin. In South Wales the Romans opened lofty galleries in the Silurian rocks for the extraction of small quantities of gold mixed with the pyrites. No British locality has afforded so much gold as the lead hills of Dumfriesshire, where, in the reign of James V., 300 miners were very profitably employed, and earned 4d. per diem,—in those days considerable wages. When the gold became scarcer the wages fell to 2d., and the works failed, like those of Bohemia and other exhausted tracts. It is said that some L.20,000 have been expended in this locality to obtain L.5000 worth of gold.[1] In the Wicklow Mountains in Ireland there are rocks which might be expected to be auriferous. Two or three golden streams descend from the granitic mountain Croghan Kinshela, and traverse the quartz veins in slate, and from these all the fragments of the precious metal have been derived, and minute portions are still sometimes found by the peasants. Formerly the government carried on the gold works, but the gains were infinitely exceeded by the expenditure.

In North Wales that part of Merionethshire which contains auriferous rocks lies between Dolgelly and the Moelwyn and Manod range, north of Festiniog. The gold at Cwm Eisen was discovered in 1843, and that mine alone has been worked, although bold assertions were made as to the gold to be obtained in that district. It has never been worked with a steady profit, as far as we can learn. The gold is found in a branching lode containing lead. Its principal branch runs north-easterly, and is mostly composed of exceedingly hard quartz. The neighbouring rocks are much disturbed and altered, and numerous little bosses of greenstone are intruded among its beds. At Dol-y-frwynog gold has been found in unusual quantities, and the lode there is the most promising. It runs W.N.W. and E.S.E., in low ground, and is principally composed of a white saccharoid quartz irregularly traversed by numerous loose joints. It was first opened for copper, but gold was found in several flakes and grains irregularly disseminated through the quartz,—sometimes visible to the naked eye. Discoveries of gold have been made in the hills north of the Dolgelly and Barmouth Road.

We have instituted some particular inquiries on the present state of the Welsh gold speculations, and learn that the Dol-y-frwynog Mine, 6 miles from Dolgelly, is the principal, or has been such, it having stopped. At this spot the adventurers had erected a steam-engine of, we believe, 70 horse-power, with grinding-pans about 10 feet in diameter, and four balls to rotate in the pans of 3 feet in diameter, together with a number of amalgamators, furnaces, &c. To all these was added an expensive staff. What was the result of mining? At a depth of 9 fathoms they "cut" or met with the quartz lode. At 20 fathoms they found gold-bearing quartz, and this continued to a depth of from 30 to 40 fathoms. Then they drove east and west, and found that the gold greatly diminished and nearly disappeared. Now the mine has stopped, and the adventurers have little hope of further success. In fact, the presumption we have expressed is in this case again confirmed, viz., that gold veins in quartz diminish in richness in proportion to their depth from the surface. The result of the crushing of the quartz in the upper parts is interesting. On the 16th August 1854 they crushed 39 tons of auriferous quartz, and found gold at the rate of 5 ounces 9 pennyweights per ton of quartz. Afterwards they crushed 100 tons, and found gold at the rate of 5 ounces per ton; then successively gold at the rates of 8 ounces 9 pennyweights per ton, and 4 ounces 15 pennyweights per ton. These ratios might have paid well if continued, but the expenses for extracting small amounts per ton are vastly more than the profits. We have examined some of the rich specimens, and found the gold visibly disseminated through the mass of quartz.

Preparation of gold.

The processes by which gold is made ready for the metallurgist may be divided into three:—(1.) Washing; (2.) Trituration; (3.) Separation of the useful from the waste.

(1.) The *washing* is necessary to clear off the mud and dirt from the larger fragments, and to set free small particles of the precious mineral which are enveloped in clay. Various machines may be used to facilitate the operations, such as inclined cylindrical sieves, adopted in some of the Russian gold-washings, or annular sieves, or a conical sorting-drum.

(2.) *Trituration* is not so needful in gold as in other metals, for here nature has already been the great triturator. It may be necessary, however, in the case of auriferous quartz, to break down the masses either by hammers (*buckers*) or by crushers or grinders,—machines almost peculiar to this country, and to be seen in simpler forms at the lead mines in Cornwall and Wales, and in their more complicated forms in the northern lead mines. In instances where the portion of gold is very minute, *stamps* must be employed, in the form of a range of massive beams shod with heads of iron, and weighing each from 3 to 8 cwt.

(3.) *Separation* is effected by some of the very numerous contrivances which have been invented to facilitate the fall of the gold to the bottom when the whole mass is suspended in water; or, in another form, to cause the flow

[1] Those who are curious in the history of abortive gold-mining projects will find something to reward them in *The Discoverie and Historie of the Gold Mynes in Scotland*, by Stephen Atkinson: written in the year 1619, and printed for the Bannatyne Club, 1825. From this book one might infer that gold was a staple product of Scotland—that it had been extracted in great abundance—and that from time to time it afforded employment to a considerable mining population. Atkinson speaks of Crawford Moor and Friar Moor in Lanarkshire, and Wanlock Moor in Dumfriesshire, also of a small vein called Glengaber in Peeblesshire, as the chief auriferous districts. To this day, we believe, the shepherds occasionally find grains of gold in the channels of the streams which water these districts. In 1803 Professor Traill found specimens of gold in a vein of quartz near Wanlockhead mines, one of which he deposited in the museum of the Edinburgh University. King James VI. expended about L.3000 sterling (a large sum in his day) in searching for gold on Carnwath Moor, but he never obtained more than about three ounces, worth not quite L.12. At the conclusion of this unprofitable speculation, Atkinson strongly urged the king to renew the national hunt for the precious metal, promising thereby "to make his majesty the richest monarch in Europe; yea, in all the world."

Mines and Mining.

of a stream of water down an inclined plane, depositing the heavier particles first, and carrying the lighter away with it to the lower end of the plane. Amongst the former machines are *dolly-tubs* or *keeves*, and amongst the latter are *buddles*, *tables*, *trunking-boxes*, and *cradles*, which last are extensively used in California and Australia. Several processes are finally adopted to cleanse the gold from remaining impurities. (For the physical properties of gold as a metal, see the article GOLD.)

SILVER.

Forms in which silver occurs.

Silver occurs in many natural forms and combinations, which are enumerated in the works of mineralogists. Native silver is found crystallized in wedge-form octahedrons, in cubes, &c.; at other times in dendritic shapes, or in arborescences, resulting from minute crystals being implanted upon each other. Fine specimens may be seen in the British Museum. Thirty-four specimens of silver from Sweden were displayed in the Great Exhibition. It most commonly occurs in small grains, without determinable form, or in irregular masses of various sizes. It is soft in its native state, but harder than gold, and its specific gravity is about 10. The ancients were acquainted with silver from the earliest periods; and it is constantly mentioned in Homer, though in a manner indicative of its comparative scarcity. It was much more abundant in Asia than in Greece proper. The Greeks worked the rich mines of their own country and its islands, the chief being in Siphnos, Thessaly, and Attica.

The native metal is found more or less in almost all the true silver mines now worked. Very fine specimens of native silver have come from the mines of Kongsberg in Norway, and some of these, beautifully crystallized, were displayed in our Great Exhibition of 1851. One mass discovered in 1834 at these mines weighed no less than 840 lb., as reported. In the Great Exhibition appeared a mass of native silver from Chile weighing 154 lb. It was found in 1850 at a depth of 200 feet. Its dimensions and weight are not its only interesting characteristics, for it is formed of successive layers folded on each other, like some beds of the coal measures, or like piled cloth when seen in cloth mills or warehouses. A large specimen of gold and silver in one mass lies under a table in the Museum of Practical Geology in London. It weighs 300 lb., and was brought up from the mine of Madre de Dios, from a depth of 45 yards, on the back of a miner. It contains 12 ounces of gold per ton of ore, and 220 ounces of silver per ton of ore. At Kongsberg the native silver occurs in carbonate and fluate of lime; at Schlangenberg in Siberia in sulphate of barytes; at Allemont in a ferruginous clay.

Cornish silver.

In our own country some few Cornish mines have produced silver in small quantities of extraordinary richness. There native silver has only been found in clay-slate; and the richest silver mines were Herland and Huel Basset. The former yielded about L.8000 worth of ore, and the latter about L.3000. It has been said that about L.40,000 worth of silver came from a mine at Alva. Some specimens, in very small quantities, from Illogan parish, would yield at the rate of 2000 ounces per ton. The principal portion, however, of our silver is obtained from the "gossans" (ochreous iron ore) and the argentiferous leads.

The proportion of silver in the lead varies in different mines. In Cornwall it is supposed to be 35 ounces of silver to the ton of argentiferous lead. In Devonshire (the highest of all) it is supposed that 40 ounces can be extracted from the ton of lead in favourable instances; in Cardiganshire, &c., the proportion of silver is presumed to be 15 ounces; in the Isle of Man 20 ounces; in Durham, Westmoreland, and Northumberland, 12 ounces. In the year 1851 the total number of ounces of silver obtained from British lead was 674,458; and its value, at 5s. per ounce, was L.168,614. In 1852 the total quantity of British (including Irish) silver from lead was about 818,325 ounces, valued at L.205,080. In 1853 the estimated total quantity was 700,000 ounces, and the value L.192,500. In 1854 the estimated total yield of silver from British lead was 562,659 ounces. The Beer Alston Mines in Devonshire are the most remarkable for their richness, and two lodes have produced large quantities of argentiferous galena, often containing from 80 to 120 ounces of silver per ton of lead.

Desilverising process.

Silver is now separated from lead by Pattinson's process, which is one of the most important of recent metallurgical improvements. From more than 30,000 tons of the lead raised the silver is extracted by Pattinson's process, which would otherwise have been lost to the arts. Thus (at the rate of 5 to 8 ounces to the ton) not less than L.200,000 of silver are obtained annually. The result of this application has therefore been the actual saving of from L.60,000 to L.70,000 per annum to the country.

This desilverizing process is now employed in nearly all the lead-mining districts of Great Britain, and by its adoption the produce of silver has been increased to the amounts we have named, and nearly *doubled* within the last twenty years. Large quantities of lead, too, are annually brought to England for the purpose of being thus desilverized; and, in fact, it may be everywhere applied to alloys too poor in silver to be treated by cupellation, it being both simple and economical; nor does it occasion more than 2 per cent. of loss of lead. This process has within the last few years been very generally introduced into the provinces of Murcia and Almeria in Spain; and a large quantity of silver, not formerly extracted, is thus obtained from the slightly argentiferous lead ores of the Sierra de Gador and of Cartagena. The cost of refining lead previously to Pattinson's process was from 30s. to 60s. per ton.

Produce.

The total yield of silver annually from Europe and Asiatic Russia has been rated by Humboldt at 292,000 marcs, by others at 310,000; while at the beginning of the present century that of the Spanish colonies in America was 3,349,160 marcs, or nearly 12 times as much. The sum total is 3,704,160 marcs, which is nearly 1,900,000 lb. avoirdupois, *i.e.*, little less than 9000 tons.

Spain.

We have already spoken of the richness of Spain in silver, and its yield in ancient times. It is only within the last thirty years that Spain has again become a silver-producing country, several very rich mines of this metal having been discovered since the revival of mining in 1825. The celebrated mines of the Sierra Almagrera, in the province of Almeria, were discovered in 1839, and they have ever since poured a large amount of silver annually into circulation. In 1843 the mines of Hiendelencina, in the province of Guadalaxara, were discovered, and these have been very productive. The produce of the Almagrera mines in 1850 was 40,596 marcs of silver, and it has probably since then remained about the same; but this amount is a decline from the earlier productions, the lode having become poorer, and water having hindered full operations. The veins of these mines run nearly north and south, and traverse finely-grained clay-slates and micaceous slates. The great lode of the Jaroso Mine is of extraordinary size, being in some places 6 or 8 yards, and even more, in width. The ores are chiefly argentiferous galena, the chloride of silver occurring but rarely in a separate state. The lodes of Hiendelencina run nearly east and west, and seldom exceed 3 feet in width; and are properly silver lodes, as they produce the ores of silver in chlorides and sulphurets, but unmixed with any ores of lead.

Mexico.

Europeans have undertaken the working of deep, extensive, and abandoned Mexican mines, with a confidence of their own superiority in the art and means of working such mines. The four essential points in mining are capital,

Mines and Mining.

industry, economy, and skill. These were thought to be at the command of the English; but in practice several drawbacks and obstacles—as distance, suspected frauds, &c.—have overcome the English. The single advantage of the introduction of the steam-engine by the English, burdened by almost insuperable difficulties in conveying it to the spot, and the deficiency of proper fuel when there, is not sufficient to counterbalance the numerous disadvantages under which they labour. Hence the history of English mining adventure in Mexico has been a history of failures and disasters, with occasional partial successes.

The mines of New Spain, the central group of which comprise three mining districts, including an area of about 1700 square leagues, are probably the most abundantly supplied with the precious metals of any in the world. Of the three districts the most southern of the group, that of Guanaxuato, is as remarkable for gigantic human labours in the mountains as for its vast natural wealth. A group of porphyritic hills, partly arid and partly covered with the evergreen oak, and the strawberry tree, rises on the ridge of one of the mountains of the Cordilleras, from a part of the great central table-land of Mexico. The absolute heights of the summits of these mountains range from 9000 to 9500 feet above the sea-level; but as the neighbouring plain is nearly 6000 feet above the sea-level, they appear only as insignificant hills to the traveller accustomed to the lofty mountains of the Southern Continent. The celebrated vein of Guanaxuato, the *Veta Madre*, crosses the southern slope of this porphyritic range, and the outcrop of the vein runs from S.E. to N.W. The quantity of the precious metals annually obtained from this vein, on the average of a number of years, amounts to *two hundred and eighty-six thousand pounds troy weight of silver*, being nearly double the average of the more celebrated mines of Potosi. The mountain of Potosi, however, has furnished, since its discovery in 1545 to the beginning of the present century, at least as much silver as was worth 235 millions of pounds sterling, although at the present day the quantity extracted is comparatively small, and the proportion of metal only about 1 in 2500.

The vein called the *Veta Madre* of Guanaxuato has been worked for a length of upwards of 6 miles, although the silver has been extracted only on a line of about 1½ mile. Its direction is (says Humboldt) N. 52° W., and its inclination from the vertical 45°, or 48° to the S.W. As this great mass of ore seems to have the same direction and dip as the clay-slate, it has been doubted whether it could be properly called a *vein*; but it appears to be a true vein, and divides into branches varying very considerably and capriciously in thickness. There seems to be a certain moderate depth at which the greatest riches occur, and this Humboldt states to be between 6000 and 7000 feet above the sea-level.

At the commencement of the present century the mechanical contrivances employed to work these mines generally were extremely rude. The whole of the ore was conveyed to the surface by human labour, the native Indians carrying a weight of from 240 lb. to 380 lb., exposed to a temperature of from 70° to 80° Fahr., for a space of six hours, and during this time ascending and descending several thousand steps in pits having an inclination of 45°.

The *weight* of the pure silver afforded by the Mexican mines in 1846 was about 1,047,582 lb. troy, and the value L.3,457,020. The weight of silver yielded in 1850 was 1,631,313 lb. troy, and the value was L.5,383,333. The weight of the produce in 1854 was 1,750,000 lb. troy. By reference to the table of general metallic produce at the end of the present article, it will be seen how far above other silver districts Mexico still rises.

Mines of the Andes.

The silver mines of the Andes are frequently in ground so high that the profits are diminished by the difficulties and cost of carriage, and the expenses of living and labouring in a barren country, destitute of water and sufficient fuel, and exposed to severe cold and snow. At the silver mines of Copiapo in Chile not a drop of water is to be found in a circuit of 9 miles. These mines are said to extend (as to capability) over 150 square leagues. The celebrated mines of Potosi in Bolivia were discovered in 1545, and since their discovery upwards of 1300 millions of dollars have been coined from them. Their total produce in pounds sterling is estimated at the astonishing sum of L.250,000,000. They are situated in an insulated mountain about 18 miles in circumference, which rises to an immense height in the shape of a cone. Spaniards assert that there are 500 mines in Potosi; but these are only lots (*estecas*) portioned out to individuals, of which in 1826 there were not quite 100 at work. Cerro de Pasco in Peru is famous for its neighbouring rich silver mines. It is situated in 10° 48′ S. Lat., at the height of 13,673 feet above the level of the sea. The mines have yielded, before the revolution, 130,000 lb. troy of silver. They have been suspended in consequence of the revolution. The water, which always occurred at the depth of 400 feet, took full possession of the mines. The house of Abadia, by which they were chiefly carried on, has been ruined. The table of metallic produce given at the end shows the yield of silver for 1854 from Chile, Bolivia, and Peru.

The mode of working many of the Mexican and Peruvian mines is primitive and perilous,—the object being to extract as much ore as possible without consideration of the future. Thus, in the rich Cerro de Pasco many of the mines are worked in a careless and disorderly manner. The dangerous parts in the shafts are never walled up, and the excavations proceed without precautions for security. Hence accidents are of frequent occurrence, and every year many of the Indians lose their lives. In the now ruined mine of Matagente (a word meaning "kill people") 300 labourers were destroyed by the falling in of a shaft. Rotten blocks of wood and loose stones commonly serve for steps, and where these cannot be placed, the shaft, which generally runs nearly perpendicular, is descended by the help of rusty chains and ropes, whilst loose fragments of rubbish continually fall in from the mouldering walls.

A recent report from Colonel Lloyd, chargé d'affaires in Bolivia, communicated to the Geographical Society of London, shows to what an enormous extent silver may yet be extracted from Copiapo, and from other South American mines; and as veins of silver and argentiferous lead frequently expand largely in their downward course, immense amounts of ore may be extracted. It seems to be the opinion of Humboldt and some eminent men, that the produce of silver will largely increase in the future.

Notwithstanding the very large quantities of the precious metals obtained from the mining districts of South America, the ores are not, *on the average*, richer than those of Freiberg, of Hungary, or of Transylvania. It is not, therefore, as has been generally supposed, from the *intrinsic* value of the minerals, but rather from their great abundance, and the facility of extracting them, that these mines are to be distinguished from those of Europe. The mean wealth even of the richer veins is not greater than four ounces of silver to the cwt. of ore extracted, whilst many districts of Saxony have at fortunate periods yielded ten and even fifteen ounces, and have often averaged not much below three. We find the produce of most of the silver ores of Freiberg in Saxony to ascend from ⅜ths and ½ per cent. to various higher per-centages.

Saxony.

The mining district of Freiberg in Saxony abounds in veins of silver, or argentiferous lead. They traverse gneiss rocks, and are generally composed of quartz, lime, and fluor spar. The richest of the Saxon mines, that of Himmelfurst, is situated 2 miles S.E. of Freiberg, and the elevation

Mines and Mining.

of the surface above the level of the sea is 1346 feet; the depth of the mine is 1083 feet. There are five veins, and the principal one is from 1 foot 6 inches to 3 feet in width. The produce of metal is from ⅜ths to nearly ½ per cent. The total annual produce of ore was formerly 630 tons, yielding 6160 lb. troy of silver, valued at about L.18,000. In 1750 a mass of silver was dug out from a mine near Freiberg, weighing 168 lb.

Hungary.

Hungary contains some rich and extensive silver mines. Those of Schemnitz and Cremnitz have been long celebrated both for their riches and the immense extent of their operations. Some miles to the N.W. of Schemnitz is Koningsberg, another mining town. In the Royal Mine the vein runs between the metallic rock, which forms its *hanging* side, and the granite, which is its *hading* side. Transylvania has ruby-silver mines. The circle of Saaz in Bohemia abounds in various metallic ores, among which the ores of silver occasionally predominate. The veins at Catharinaberg traverse gneiss, and generally run in a north and south direction, and parallel to the mountains in which they are situated.

The Urals, &c.

In the Ural and Altai Mountains, especially in the district of Kolyvan, silver is as abundant as in any part of the Old Continent. Travellers mention silver mines also in Armenia, Anatolia, Thibet, China, Cochin-China, and Japan. From China a piece of native silver was brought to St Petersburg of such purity that some coin was struck from it without its passing through the crucible. A story is told with reference to the mine of Schneeberg in Saxony, that a rich vein of silver was discovered in 1478, and so rich a block of the native ore or metal was dug out, that Duke Albert of Saxony descended into the mine and used this block as a dining-table; and when it was smelted it produced no less than 44,000 lb. of silver.

Norway.

The silver mines of Kongsberg in Norway are celebrated, and have been already named. They lie about 52 miles from Christiania, the capital of Norway, and are about 1800 or 2000 feet above the level of the sea. They were first discovered by a peasant in 1624, and were immediately taken possession of by the crown. In 1833 the produce amounted to 29,390 lb. troy, being the greatest ever attained by these mines, and this afforded an overplus of L.44,000. During recent years the yield has been somewhat less; but the profits in the four years 1841 to 1844 inclusive were L.46,787.

Copper has been found in addition to the silver, and at different times an inconsiderable quantity of gold. The geological formation is gneiss, and the lode is in felspar. The Fahlbaand is a certain range of the strata from 10 to 60 fathoms broad, and when it leaves this, the vein does not bear silver; 100 lb. of this Fahlbaand never contain less than ⅛th oz. of silver. The veins become metalliferous as they cease to run parallel with the cleavage of the felspar in the gneiss. The dip of the strata to the east is from 50° to 80°. Among the mines at present worked, the principal is called the "Armens-Grube," so named from being originally assigned to the support of the poor. The entrance to the Armens-Grube is by a high and broad level about 2 English miles long, at the termination of which the shaft commences. There are several levels branching off at various distances from the surface. The descent to the bottom of this mine is by forty-two ladders, averaging 5 fathoms each. The richest pieces of silver have been extracted from this mine; and there are now in the Royal Museum at Copenhagen two specimens, one of 6 feet long, 2 feet broad, and 8 inches thick. Although some of the matrix is attached to this specimen, it is supposed to be nearly all silver. The other specimen, though smaller, is perfectly pure, and is about 18 inches high and 12 in length and breadth.

Little blasting takes place in the rock, but a curious burning method of excavation is employed. On Saturday at noon, when the workmen leave the mine, large quantities of wood are placed against the portion of the rock to be extracted. This being ignited, softens the rock, and on the following Monday the workman commences his labours. In very stubborn rocks gunpowder is used. The excavations are large, and the ventilation is good. Small bundles of wood are ignited instead of candles. Lodging-houses for the miners are near the mines, and they remain there the whole week absent from their families. They are searched previous to their return home. Their pay is equal to about 10d. per day; and they are supplied with provisions at a cheap rate. On the road to the mines we pass the roasting-house, washing-house, and stamps for pounding the ores, all of which are guarded by armed men. About 700 labourers are employed in the mines and at the stamps. The smelting-works are situated in the town, and the smelting takes place twice a year, occupying two months at each period. The fuel consumed is 500 cases of charcoal and 800 fathoms of wood.

Sweden.

The number of silver mines in Sweden has diminished like some of the other mines of that country. In 1767 only three were reckoned under exploration. The Sahla or Sahlberg Mine is now the only one of importance. It is situated in Westmannia, about 23 leagues N.W. of Stockholm, and is very ancient. At present it yields only from 4000 to 5000 marcs of silver per annum. Highly argentiferous lead is its principal product. It is explored to a depth of more than 200 yards. The soundness of the rock has allowed of large excavations and galleries, and in the interior there are winding-machines and carriages drawn by horses for the transport of the ores.

PLATINA.

Platina is a most useful but scarce mineral in large quantities. Its refractory and unalterable nature, even when exposed to intense heat, and its resistance to action by salts and acids, fit it in a very peculiar manner for chemical purposes, and accordingly crucibles and caldrons, sometimes of very large size, are made of it. Its polish and freedom from rust and tarnish, its slight dilatability, and the regularity of its expansion for equal increments of heat, render it valuable for pendulums, &c. Medals were struck of it; and in Russia it was introduced as a current coin, but it having been found in greater quantities in Siberia, its value for coinage was lowered. From 1831 to 1833 the Russian mines produced 14,000 lb. weight of platinum. The Russian mines are all in the Ural Mountains, and the ore is disseminated in an argillaceous sand of a greenish-gray colour, resulting from the disintegration of the surrounding rocks, and constitutes from 1 to 3 parts in 4000 of the sand. Occasionally it has been found in lumps which contain 70 per cent. of platina and 3 to 5 of iridium. One locality contains small flattened grains with 88 per cent. of this valuable metal. It has only been known in Europe since 1748, and was at first brought into the market under the name of *white gold*. The whole produce of the Urals is sent to St Petersburg.

In the Urals.

At Choco, &c.

In the New Continent it is found chiefly in three districts, and principally at Choco, in the neighbourhood of Barbacoas, and generally on the coasts of the South Sea, or on the western slopes of the Cordilleras of the Andes, between 2° and 6° of N. latitude. The gold washings furnish platina, the former being separated by hand-picking and also by amalgamation. Platina grains are found in Brazil, but always in the alluvial lands that contain gold, particularly in those of Mato-Grosso. Grains are also found in Hayti or St Domingo, and the sand containing them is quartzose and ferruginous.

A remarkable specimen was found in the Ural in 1827, not far from the Demidoff Mines, which weighed 9½ lb.

avoirdupois; and at about the same time another was met with weighing 27 lb. These exceed any mass found in South America. Von Demidoff has also sent several other large masses to St Petersburg, weighing from 10 to 20 lb. From the discovery in 1835 to 1840, about 53,336 lb. were obtained from the Demidoff deposits. (Dickson in *Featherstonhaugh's Journal*, No. 3, Sept. 1831.) In 1847 the production had fallen to about 18 lb., representing, at the old price, a value of L.352.

The rarity of this valuable metal will render the following notices of its occurrence interesting. In 1847 platina was discovered in the Chapeau Mountain, and in the valley of the Drac, Upper Alps. It was found in a gray copper ore in the transition limestone. This metal has also been found in the alluvium of Columbia and Brazil, in the diorite rock of the high mountains of Columbia, and the serpentine rocks of the Ural. It has also been discovered in Saxony, on the right bank of the River Beus, in the territory of Presles, in a gray carbonate of copper. The quantities were too inconsiderable to justify exportation. In March 1848 it was found at Cavalles in the Mountain of Rousse, in gneiss and talcose schist, and also connected with a green carbonate of copper. The existence of platina in the silver of commerce has been recently certified by a money assayer at Munich, who has likewise obtained more than 500 grains of platina from the slag of the Bavarian coin.

MERCURY OR QUICKSILVER.

This metal is distinguished by its fluidity at common temperatures, its density (= 13·6), its silver-blue lustre, and extreme mobility. Native quicksilver occurs in most of the mines of the other mercurial ores, in the form of small drops attached to the rocks, or lodged in the crevices of other ores. Argental mercury, or native silver amalgam, has been found in Hungary, in a canton of Tyrol, in Sweden, Siberia, &c., but only in moderate quantities. Cinnabar, or sulphuret of mercury, is the most abundant and important of the ores, and by sublimation yields the metallic mercury. Vermilion is pure cinnabar, being a compound of mercury and sulphur in nearly the same proportions. The finest crystals come from China and Almaden in Spain, and produce (Klaproth says) 85 per cent. of mercury.

Pliny has recorded two interesting facts—(1.) That the Greeks imported red cinnabar from Almaden 700 years B.C.; and, (2.) That Rome in his time received annually 700,000 lb. from the same mines. They have been worked from time immemorial, and even Theophrastus (300 B.C.) speaks of the cinnabar of Spain.

The mines of Almaden.

These mines are the most celebrated for this mineral in the world. The veins extend all the way from the town of Chillan to Almanedejos. Since 1827 they have produced 22,000 cwt. of mercury every year, with a corps of 700 miners and 200 smelters. The veins are so wonderfully rich, that though they have been worked pretty constantly during so many centuries, the mines have hardly exceeded the depth of 330 yards, or something less than a 1000 feet. The lode actually under exploration is from 14 to 16 yards thick, and at the crossing of the veins it becomes thicker still. The whole ore is extracted. It yields in their smelting-works only 10 per cent. upon an average; but there can be no doubt, from the analysis of the ores that nearly one-half of the quicksilver is lost and dispersed in the air, to the great injury of the workmen's health. A certain barbarous apparatus employed in its sublimation, has remained without any material change for the better since the days of the Moorish dominion in Spain. The ores are treated in thirteen double furnaces.

The hill in which the mines are situated is chiefly composed of sandstone, and on its summit rises a crest of naked rocks streaked with cinnabar; indications which unquestionably led to the discovery of the mineral wealth concealed beneath. The whole of the country abounds with ferruginous ores, and in the mines themselves portions of mineral are sometimes found in which iron, quicksilver, and sulphur are blended together. The direction of the hill is from N.E. to S.W., and its height is about 125 feet. Two veins, from 2 to 14 feet wide, varying in richness, cross it in a vertical manner. These veins meet near the most convex part of the hill, when they expand into a bed nearly 100 feet wide, constituting the prodigious mass of ore known as "the Rosary" (*El Rosario*), the discovery of which was deemed miraculous. A belt of hard stone, from 3 to 4 feet wide, extends across the hill from N. to S., intersecting the veins. Beyond this the line of quicksilver does not pass.

These two veins are the only ones worked at Almaden, and they have already been excavated to such a depth that the drainage has become the heaviest item of expense. Should steam be applied, this charge would be considerably reduced. Thrice during the political contests was Almaden taken by the Carlists, and the last time they partly destroyed the machinery.

The labouring department has been carried on by convicts, each of whom costs the government 2s. a day; whereas peasants would perform double the work at less cost. The quantity of ground bored for shafts, and formed into caverns or resting-places, has not been precisely ascertained, but it is known to be immense. Scenes of the most terrific kind have sometimes occurred within these gloomy recesses. Soon after the junction of the two veins, owing to the confined state of the air, the gaseous exhalations have caught fire, when numbers of the miners have perished. Of this calamity the natives speak in most painful terms. Additional shafts diminish the risk of its recurrence. Remarkable cases of heart-rending misery and oppression have likewise occurred in these abodes of wretchedness. The surrounding scenery is exquisitely picturesque, and sometimes even majestic. The mineral wealth of this interesting hill was not scientifically explored till towards the middle of last century. In 1752 Mr William Bowles, an Englishman and naturalist, was commissioned to make excursions into the interior to survey mines, &c. His first trip was to Almaden, of which he gave some account in a work printed at Madrid in 1775. From the period of his visit the works were conducted on a better principle, but owing to old defects, the mines were inundated a few years afterwards.

About 2 leagues from Almaden another quicksilver mine was discovered in 1755, and commenced working in 1780. In the province of Valencia two quicksilver mines were discovered towards the middle of last century. The "Little Almaden," as it may be called, has produced in some years 1,217,160 lb. avoir., but its average is 304,290 lb.

The mines of Idria.

The quicksilver mines of Idria (a town of Illyria, near Adelsberg, in the Austrian dominions), situated in an Alpine valley, are the next largest to those of Almaden. They employ upwards of 600 persons, and produce annually from 3200 to 3500 cwts. of quicksilver, according to one account; but it said that the Austrian government, in order to uphold the price of the metal, has restricted the produce to 150 tons. The workings have been carried to the depth of 280 yards. The memorable fire of 1803 was most disastrous to these mines, and it was only extinguished by drowning all the underground workings. The mercury sublimed in this catastrophe occasioned diseases and nervous tremblings to more than 900 persons in the vicinity. The bituminous sulphuret of mercury appears to be the base of these great explorations. It is of a dark, liver-red hue, of a slaty texture, with straight or twisted plates, and exists in large quantities in the bituminous schists. The produce of these mines has been very large, and it is said that in 56 months, from 1809 to 1813, they yielded 1,419,425

lb. of mercury, 270,029 lb. of vermilion, and 76,225 lb. of lump cinnabar; besides 6400 lb. of calomel, 2867 lb. of red precipitate, and 2450 lb. of corrosive sublimate.

These mines were discovered in the year 1497. The mountain in which they were first excavated has been exhausted, and the operations are now carried on in an opposite mountain, whence it is said a supply of mercury to almost any extent might be obtained, but the produce is mostly retained for the amalgamation of the Austrian gold and silver ores. A traveller who visited the place states that, having descended by 727 steps, reaching to a depth of 120 fathoms, he arrived at the region where the cinnabar is principally procured. The mining operations are carried on chiefly by galleries, the friable nature of the rock seldom admitting of large chambers. The cinnabar lies in beds from 2 to 6 inches in thickness, and is of a variety of colours from dark to light-red; the native quicksilver being sometimes mixed with it, and sometimes occurring in the intervening strata of earth or stone. The strata yielding the quicksilver do not appear to have any precise direction, and occupy about one-third or one-half of the entire mass of the rock. Proceeding a short distance, the visitor arrived at the galleries where the cinnabar is less common, and where quicksilver is the chief object of search. Here it occurs sometimes imbedded in a friable rock, sometimes in a kind of earth resembling talcose slate, but principally in the former—generally in particles too minute to be discerned by the naked eye. Often when the rock is broken, small globules present themselves, varying up to the size of a common pin's head. They are not distributed at random through the mass, but the matrix in which they occur forms strata usually about one or two inches in thickness.

Descending still lower into the richest part of the mine, the matrix consists almost entirely of talcose earth, and the globules of quicksilver are so large, that when it is broken they roll out and fall to the bottom of the gallery. The labourers, being unable from the state of the atmosphere to work longer, are relieved every four hours in this part, but in other parts they work eight hours. The total number employed was 360, divided into three companies, and their pay was only the usual pay of day-labourers in Germany, viz., from 15 to 17 kreutzers per diem (6d. to 7d.) Several appeared to be suffering from the effects of the mercury.

The masses containing the metal are carried to the washing-rooms, which are situated a few hundred yards from the mines. If the ore is of the earthy kind, it is broken up and laid upon large sieves, by means of which the loose or native quicksilver is separated from the earth. It is then put into little shallow boxes open at both ends, and a little inclined. A gentle stream of water being made to pass over it, and a rake being used, the earthy matter is carried off. Several of these boxes are employed in succession, and by the time the residuum reaches the last of them, it resembles a heavy gray powder, and is sufficiently pure to be carried to the vapour furnace. The stony fragments require only a slight washing to cleanse them from the outward earthy impurities. The furnace is half a mile lower down the valley, and consists of a circular walled building about 40 feet diameter and 60 feet high. The ores being there roasted, the vapour resulting from this operation passes into condensers, where the little drops of mercury collect, and are conducted into a porphyry vessel placed to receive them.

California. Cinnabar has recently been discovered and mined in California, where it occurs in a quartzose vein in clay-slate. The veins are vertical, but the slates themselves lean considerably eastward. Great importance is attached to this discovery by the Californian miners.

Reduction of ores. The ordinary method of reducing the ores of quicksilver is by distillation. In some places the richer ores are burnt separately; but it is more common, and thought more economical, to mix the richer with the poorer ores, and expose the whole mass together to the action of heat in closed retorts, which also contain a certain proportion of limestone. The retorts filled with the mixture of ore and limestone are ranged, to the number of twenty or upwards, in recesses of a furnace, and heat being applied, each retort is made to communicate with a vessel of water, in which the vapours of the mercury are condensed.

Imports. The imports of mercury into this county, chiefly from Almaden, are about 2,200,000 lb. annually, of which little more than an eighth is retained for home consumption. The remainder is exported principally to South America and Mexico, the United States, and the East Indies; while smaller shipments are made to Russia, Belgium, and other countries.

COPPER.

(On copper as a metal, see the article COPPER.) Some of the principal localities for copper may be noticed before we treat of the mines of this metal in our own country.

Australia. The copper ores from Australia are strictly analogous to those from the Ural. They occur in nodules disseminated in a slightly coherent sandstone, or ochrey clay, and the surface of the nodules is studded over with crystals, the interstices between which are filled with clay or sand. Some of the nodules are of large size; one of them from Burra-Burra measuring 2½ feet by 2 feet superficial, with a thickness of 6 inches. The principal mass in this specimen consists of oxide of copper, with the green and blue carbonates of the same metal forming an external coating; but the three minerals are not superimposed in zones, the red oxide, although principally in the centre, sending out shoots in every direction. A little native copper occurs with the oxide. The Burra-Burra mines have yielded 56,428 tons of ore, averaging 40 per cent. of copper, between the time of their first opening in 1845 to the end of 1850, at which date more than 1000 workmen were employed. For some time these mines have been reported to be unworked, owing to inundations or desertion of miners to the gold diggings; but they are now said to be at work again, and highly productive. Many of the shares are held by British capitalists. The mine was commenced 5th September 1845, and the following are its returns of ore for the first five years:—

	Tons.	Cwt.	
September 30, 1846............	6,359	10	Total produce in five
" 1847............	10,794	17	years, 56,428 tons
" 1848............	12,791	11	3 cwts. of copper
" 1849............	7,789	16	ore; value of same
" 1850............	18,692	9	L.738,108.

The ores yielded from 30 to 70 per cent. of copper.

No copper mines have ever yielded such rates of profit as the Burra-Burra. At a meeting held in April 1850, it was stated that the amount of paid-up capital was only L.12,320, on which dividends had been paid, from June 1847 to March 1850, amounting to L.172,480, equalling a total profit of 1400 per cent. upon the capital. In several of the dividends, in particular, the profit was at the rate of 200 per cent. upon the capital, and in none less than 50 per cent. The balance-sheet showed an undivided profit of L.99,779, thus making the total profits since the commencement L.272,259. In five years the shareholders had received net dividends amounting to nineteen times the money they advanced.

United States. The most productive deposits of copper in the United States are those lying upon the shores of Lake Superior. The discovery of these was made many years ago, but the first scientific researches commenced only in 1842 by a geological surveyor attached to the government of the state of Michigan, and have been continued by Mr Jackson, who has made a detailed study of the district.

Mines and Mining.

There the native copper exists in two distinct deposits, one towards the northern extremity of the state of Michigan, at Keweenaw Point, which forms a projecting headland towards the middle of the shore of Lake Superior; and the other in Isle Royale, situated in the lake, about 50 miles N. of Keweenaw Point. This island, which ranges S.E. and N.W., lies exactly parallel to Cape Keweenaw, and to the strike of the beds of which it is composed. It presents also a geological construction identical with that of the shores of the lake. The two deposits occur in the same formation, and under circumstances precisely similar. Mr Jackson's geological map shows that the Michigan shore of the lake consists of granite, trappean rock, and red sandstone belonging to the Lower Silurian series. The sandstone and trap form parallel bands running due N.E. and S.W.

Native copper and silver are found at Cape Keweenaw and Isle Royale only in the trap formation; all the important veins forming together a narrow zone in the amygdaloid. When a vein of copper penetrates the trap, it at once thins out, and only affords a scanty film not worth working. The sandstone and conglomerate form also another limit of the metalliferous band, and when the veins do not terminate at the contact of the sandstone, the part extending into this rock is filled with calc-spar instead of copper; hence it results that the thickness of the amygdaloid band intervening between the trap itself and the sandstone becomes the limit of the cupriferous veins, which are of the most solid metallic form. The depth of the veins is unknown. It is uncertain if they extend below the sandstone. At Keweenaw Point the cupriferous zone may be about 120 miles in length; and in Isle Royale it ranges through the whole extent of the island, which is about 45 miles long. The richer portions are unequally distributed. Mr Jackson (*Geological and Mineralogical Reports*, by Charles Jackson, November 1849) has made numerous researches for several years, and states the direction of the veins, of which he has explored more than a hundred. In Copper Fall Mine they take a direction from N. 25° W. to N. 30° W., and S. 25° to 30° E.; almost at right angles to the line of separation of the trap and sandstone; and the dip is here 70° W. These veins are 18 inches wide, of which metallic copper occupies a fourth part. Mr Jackson had seen a mass 20 feet long, 9 feet wide, and from 4 to 6 inches thick, taken from these mines; the mass weighed about 10 tons.

The Cliffe Mine, the deepest and most extensive, commenced in 1848. It has repaid its original capital four times over. The lode is regular and continuous, and improves to 500 feet in depth. The produce of other mines for one year had been nearly 43 tons (95,994 lb.) of ore, containing 70 per cent. of metal, or about 30 tons of copper in all. The annual produce of Lake Superior mines has been 3000 tons. Among the masses of copper are mentioned four, the respective weights of which were 7018 lb., 7484 lb., 7678 lb., and 14,000 lb. One very extraordinary lump of copper was found on these shores which was estimated to weigh about 80 tons, and measured 50 feet in length, 6 in depth, and averaged 6 inches in thickness.

Siberia. In Siberia there are two principal copper mines, situated in the Ural Mountains. From one of these, in the central part of the chain, have come those magnificent specimens of malachite which have often excited wonder. Two large polished doors of Russian malachite, and several minor masses, were displayed in the Great Exhibition of London in 1851, and a splendid malachite vase presented to the Queen is kept in Windsor Castle.

Sweden. One of the most celebrated and productive copper mines is that of Fahlun in Sweden. It is said to have been explored before the Christian era. In its greatest prosperity it yielded about 5000 tons of copper per annum; it now furnishes about one-seventh of that quantity, and about 70,000 lb. of lead, 50 oz. of silver, and 3 or 4 oz. of gold. The mining district occupies a space of 9 leagues in length by 2¼ in breadth, and is surrounded by a reddish granite, succeeded by a micaceous rock. The principal mass, which is of enormous dimensions, consists of iron and copper pyrites, lying in a vertical position from N.W. to S.E. along the valley in which it is deposited. Here there is an immense opening or gulph of 840 feet in length, 720 in breadth, and 240 feet in depth, which was produced in the year 1687 by the falling in of a mass, in consequence of the unskilful manner of mining. The mass of ore lies in the form of an inverted cone, and the excavation has been carried to a depth of more than 200 fathoms. Latterly the operations have been carried on upon a more limited scale. In this mine Gustavus Vasa, when driven from his throne, worked for the means of subsistence. In the mine of Garpenberg, 18 leagues from Fahlun, there are fourteen veins in a vertical position, and all parallel to one another.

Cornwall. Cornwall—where before 1712 the yellow copper ore was thrown aside—now furnishes nine-tenths of the copper of our own country. Altogether it is found in larger or smaller quantities in nine counties of England. The number of copper mines in England is about 220; in Wales, 12; in Ireland, 15; in all 247. In this number are included several mines producing small quantities, and about 50 are excluded which do not produce any ore. The following tables will show the advance of Cornish copper mining:—

Produce of Cornish Copper Mines from the Year 1745 *to* 1800, *in Decennial Periods.*

Years.	Tons of ore.	Average price per ton.			Amount realized.
		L.	s.	d.	L.
From 1745 to 1755...	98,790	7	8	0	731,457
„ 1755 to 1765...	169,699	7	6	6	1,243,045
„ 1765 to 1775...	264,273	6	14	6	1,778,337
„ 1775 to 1785 ..	304,133	6	3	0	1,827,106
„ 1785 to 1795...	Not known.	—			—
„ 1795 to 1800...	249,834	8	9	6	2,177,724

The next table exhibits the annual produce and sales of copper ores for eight recent years, with the quantity of copper yielded by the ores:—

Years.	Ores.	Copper yielded.				Value.		
	Tons.	Tons.	cwt.	qrs.	lb.	L.	s.	d.
1848	147,701	12,241	19	2	5	720,090	17	0
1849	146,326	11,683	13	0	22	763,614	19	0
1850	155,025	12,253	10	2	21	840,410	16	0
1851	150,380	11,807	8	2	[illegible]	782,947	8	6
1852	165,593	11,776	17	2	24	975,975	14	0
1853	181,944	11,913	12	0	12	1,165,167	3	6
1854	184,858	11,979	4	2	21	1,192,696	12	6
1855	195,193	11,578	11	0	23	1,263,739	6	0

The quantities of copper ore bought by private contract by the great copper-smelting firms could not be included in the above table. The amount of sales at Swansea, in this form, in the year 1853, were 24,633 tons ore, which yielded 5875 tons 2 qrs. 11 lb. of copper. This quantity was bought by about ten firms or companies. The subjoined table displays the total quantities of copper smelted in this county for the last three years, the quantities bought in Cornwall, at Swansea, and by private contract, being distinguished:—

Year.	Cornwall.		Swansea.		Private Contract.			Total.	
	Tons.	cwt.	Tons.	cwt.	Tons.	cwt.	qrs.	Tons.	cwt.
1853	11,913	12	4,539	9	5,875	0	2	22,348	8
1854	11,964	12	4,726	19	5,426	3	0	22,117	14
1855	12,578	11	5,926	1	7,440	12	0	25,945	4

Mines and Mining.

It will thus be seen that the production of copper during 1855 in this country shows a large increase.

The mode of mining for copper ores has already been treated of above under "*Practice of Mining.*" We have only therefore to add in this place, that the greatest enterprise has been shown in Cornwall, both in copper and tin mining. Some of the Cornish copper mines are remarkable, and chiefly that named Botallack, established at the western extremity of the great copper and tin lodes, conjoined with lead, which run eastward through Cornwall. This mine was formerly worked only for tin, and was nearly abandoned in 1841, when, however, copper was found. In 1853 it yielded 1001 tons of copper ore, or 93 tons 8 cwt. of copper, and 147 tons 9 cwt. of black tin. The value of the copper was L.9248, and that of the tin L.8656.

At this and two other small mines in the vicinity, the hardihood of the miners has tempted them to follow the ore upwards, so close to the sea, that small openings were thought to have been made, and a covering of wood and cement was applied. A detailed account of the processes for dressing copper and tin ores will be found in *Cornwall; its Mines and Miners*, pp. 203, &c. In a table in p. 232 of that book, we observe that the average produce of the Cornish copper ores for eight years was from $7\frac{1}{4}$ to $8\frac{3}{8}$ per cent. of metal to the ores.[1]

The first process in dressing copper ores, so as to fit them for the smelter, is to throw aside the *deads* or rubbish, and this is cleverly performed by girls of seven or eight years of age, for 3d. or 4d. a-day. The largest fragments of ore are then *cobbed*, or broken into smaller pieces, by women. After being again picked, they are given to the "maidens" (as girls of sixteen or seventeen are named), who *buck* the ore with a *bucking-iron* or flat hammer, by which they bruise the pieces to a size not exceeding the top of the finger. The ores are now given to boys, who *jig* them, or shake them in a sieve under water, by which means the ore or heavy part keeps at the bottom, whilst the *spar* or refuse is scraped from the top. That portion which passes through the sieve is also stirred about in water, the lighter parts being thrown on the surface; and the ores thus dressed being put into large heaps of about 100 tons each, are then made ready for the market. The copper ores of Cornwall are all shipped for Wales, and mostly for Swansea, to be smelted there, it being cheaper and better to carry the ores to the coals than the coals to the ores. (For the methods of smelting, see COPPER SMELTING.)

Details of a mining establishment.

The most productive copper mines now in Cornwall are the Devon Great Consols, Carn Brea, Consolidated, United Fowey Consols, Par Consols. Some particulars of a more general nature respecting one of these, viz., the Consolidated Mines, will illustrate the extensive business of so great a concern:—

Consolidated Mines in 1836.

		Values.		
Quantities of ore raised	Copper, 18,498½ tons..	L.143,039	12	5
	Tin..........................	2,533	0	10
	Arsenic....................	144	7	10
		L.145,717	1	11
Lord's dues for rent for same..........................		6,071	10	6
Value of ore, deducting dues..........................		L.139,645	10	7
Total expenses for the year..........................		102,007	12	1
Total profit on the mines..........................		L.37,637	18	6

Details of Expenses (some of the principal items).

Agents' salaries..........................	L.3,343	19	0
Tutwork bargains..........................	26,177	3	8
Materials..........................	15,008	6	4
Engine or water cost (with rent of water, L.405, 13s.)	15,415	7	4
Expenses on ores..........................	7,803	8	7
Tribute, subsist, and balances..........................	25,030	17	0

Number of Persons Employed.

Agents..........................	28
Tutwork men (working by task for a fixed price)..........................	441
Tributers (working for an agreed proportion of the ore raised)	392
Surface men..........................	335
Boys underground..........................	109
Boys at surface..........................	327
Females..........................	755
Total..........................	2387

Rate of Wages to Work-people.

	Per Month.				Per Month.		
Tutwork men..........	L.3	11	6	Girls from 14 to 17...	L.0	15	0
Tributers..........	4	5	0	Girls from 12 to 14...	0	12	0
Surface labourers......	2	6	0	Girls from 9 to 12.....	0	8	0
Women and girls above 17..........	0	18	0	Boys above 12..........	0	13	0
				Boys under 12..........	0	9	0

The usual rate of wages should be estimated lower, as there was a great demand for miners in 1836.

TIN.

Cornwall and Devon afford all the tin yielded in the United Kingdom. Its foreign repositories are Bohemia and Saxony in Europe, and Malacca and Banca in Asia. One of the richest known deposits of tin is in the province of Tenasserim, on the east side of the Gulf of Martaban, in the Malayan Peninsula. There the richest layer of tin lies in a stratum of sand and gravel 8 or 10 feet thick, in which masses of oxide of tin are often found of the size of a pigeon's egg. The ores are also found in large caves near the surface; and although actively mined for many centuries, there is still easy access to unexhausted portions. The mines in the island of Junkseylon sometimes yield 800 tons per annum. The mines in the island of Banca, to the east of Sumatra, discovered in 1710, are said to have furnished in some years nearly 3500 tons of tin. It is found in the alluvial tracts through every part of the island, but rarely more than 25 feet below the surface. Great deposits of tin occur in the Siberian mining district of Nertshinsk, near the desert of the Great Gobi, and near Oruro in Bolivia. The Peruvian and other foreign tin contains large admixtures of tungstates of iron and lime, which depreciate its value; but an eminent metallurgist has discovered and patented a process by which the separation of these can be easily effected.

Saxony.

The tin mine of Altenberg in Saxony is remarkable for an interlaced mass of ramifying veins, termed a *stockwerke*, in a primitive porphyry (superposed upon gneiss), through which the ore is disseminated in minute particles. This mine has been wrought since the year 1458. In the year 1620 it was worked by twenty-one independent companies in a most irregular manner, so that it was damaged by a dreadful fall of the roofs to a depth of 170 fathoms. This mine yielded, some years ago, annually 400,000 quintals of tin ore, affording 1600 Leipsic quintals of tin, this amount being four-fifths of the whole furnished by the district of Altenberg.

Cornwall.

A somewhat similar deposit of tin occurs in the soft

[1] The following are the sales of copper ores in Cornwall for the three quarters of 1856:—

Quarters ending	Tons.	Produce.	Amount.			Average Price per Ton.			Product in Fine Copper.	
			L.	s.	d.	L.	s.	d.	Tons	cwt.
Mar. 31, 1856	53,934	6·202	317,337	17	6	5	17	8	3358	9
June 30, "	54,273	6·311	308,633	18	0	5	13	8	3427	13
Sept. 30, "	49,636	6·976	299,273	16	0	6	0	7	3455	18

decomposed granite of Carclaze Tin Mine, near St Austell, Cornwall. This singular mine has been wrought for nearly 400 years, and is the only one entirely open to the day. It consists of a large excavation of a mile in circuit. Its exact dimensions are 250 fathoms in length, 100 fathoms in breadth, and 22 in depth. The excavation occupies 5 statute acres, the solid contents are 63,000 cubic fathoms, and more than a million tons have been removed. There are no shafts or other usual appurtenances of a deep mine. The ground is almost wholly composed of decomposed granite, through which runs a numerous assemblage of schorl and quartz lodes in the usual direction. These contain the tin minutely disseminated. The ore is separated from the stone by repeated washings in little streams, conducted to and moving various water-wheels arranged in the bottom, and along the sides of the excavation.

In Cornwall the number of tin mines is about 130, and some are included in this number which produce copper as well as tin. Tin was probably obtained in this county at an earlier period than any other metal. Mr Carne has given a table of the Cornish produce of tin from 1750 to 1837; and Mr Hunt has formed a table of the produce of British tin from 1800 to 1855; thus affording records of tin mines of a more authentic kind than we possess of other metals. We are thus enabled to trace the course of the produce of this metal, of which a few specimens may be quoted:—

Produce of British Tin Mines from 1800 to 1855.

Year.	Tons.	Year.	Tons.	Year.	Tons.
1800	2522	1820	2990	1848	6613
1805	2785	1825	4358	1849	6952
1810	2036	1830	4444	1850	6729
1815	2941	1835	4228	1855	6000

It will be observed that the produce of tin has been steadily progressing, notwithstanding the precarious nature of the search for it, and the various fluctuations of mining.

The following are some of the principal Cornish mines, with their produce in 1855:—

Name of Mine.		Quantities of Black Tin.				Value.		
		Tons	cwt.	qrs.	lb.	L.	s.	d.
Penzance District.	Balleswidden	252	8	3	27	18,086	18	7
	Providence Mines	270	11	3	0	17,895	0	0
	Huel Owles	217	2	7	0	15,744	19	6
Helstone District.	Great Huel Vor United	229	19	2	21	12,668	0	1
	Porkellis United	167	8	3	10	9,961	0	9
	Great Work	149	2	0	2	8,946	0	0
Redruth and Camborne District.	Dolcoath	389	9	0	16	23,367	0	0
	Polberro	264	13	2	27	16,940	4	9
	Lewis Mine	104	0	0	0	6,670	0	0
St Austell.	Great Polgooth	235	17	3	9	15,465	3	6
	Boscundle	99	17	0	0	5,991	0	0
Liskeard.	Drake Walls	264	17	0	8	17,748	19	3

Mr Carne informs us, that the prices paid to the tinner in Cornwall between the years 1746 and 1788 varied from 60s. to 72s. the cwt. We find that from 1783, when the price was L.4, 1s. 7d. per cwt., it varied considerably, reaching in 1810, L.7, 9s. 8d. per cwt., and falling in 1825 to L.4, 16s. 6d. per cwt. The annexed table gives the annual value of the tin *ore* raised in England within the last three years, and of the tin:—

Years.	Tin Ore raised.			Average value per Ton.	Total value of Ore.	Estimated value of Tin per Ton.	Estimated value of Tin.
	Tons	cwt.	qr.	L.	L.	L. L.	L.
1853	8866	0	0	68	593,088	112 to 118	700,000
1854	8747	0	0	64	559,808	112 to 118	690,000
1855	8947	0	0	68	608,396	...	...

In 1855 the average prices of tin were—

English blocks	L.125 0 0
... bars	126 0 0
... refined	129 0 0

The existence of tin in Australia and Van Diemen's Land is known; and in the tin forwarded to this country from Victoria a considerable quantity of gold has been found. It mostly lies in grains in sand, and is analogous to our stream-tin.

Demand and supply.

In this country there has not been for a considerable period a discovery of any new locality of tin. The stream-works are by no means so productive as formerly, and the mines are being worked at a constantly increasing cost; yet the demand for tin in our white-metal manufactories is constantly increasing. The principal importations of tin to our country are from Singapore, Java, and the East Indies, and Holland. The total imports to us from Singapore during eleven recent years (from 1844 to 1854 inclusive) have amounted to 8303 tons of tin; from the East India Company's territories, during the same period, 2738 tons; and from Holland, for the same years, 4567 tons. In 1855 we imported 1612 tons of tin; and exported 1337 tons of British tin, also 280 tons of foreign tin.

Dressing ores.

It remains to speak of the processes for dressing tin ores. These commence with cleaning and sorting, and then proceed to washing and stamping, and finally to calcination in the "burning-house," and to smelting. The same great principle rules these processes that rules in dressing copper or lead ores, viz., the agitation of the mass reduced to fragments, so that the metal, by its much greater specific gravity, shall separate and sink down from the lighter earthy matter. The stamping is in the best mines performed by stamps or pestles of wood, carrying lifting-bars, and terminating in a lump of cast-iron called the head, and weighing 2½ or 3 cwt. A turning-shaft communicates motion to the stamps by cams, which are so arranged as to secure the falling of the second stamp while the first and third are uplifted. Each stamp gives 28 strokes per minute. With six batteries of six pestles each, at Poldice Mine 120 bags of ore are stamped in 12 hours, each bag containing 18 gallons of 282 cubic inches, measuring altogether 352 cubic feet and 864 cubic inches. At Boscean Tin Mine there is a 24-inch stamping-engine, to which are attached 48 heads of stamps, and there are 20 heads of stamps worked by water-power. At Botallack the tin stuff is returned by water-stamps of 24 heads. At Levant Tin Mine there is a 34-inch stamping-engine, working 64 heads of stamps. At Polberro Consols one large engine drives 120 heads at a time. By repeated pulverization, washing, and agitation, the ores may be obtained in a very fine state. As tin is often combined with wolfram, tungstate of iron, and other materials, which cannot, owing to their greater specific gravity, be so easily separated from the ores of tin as earthy matter, a new process has been invented by Mr Oxland, by which wolfram, &c., may be separated, and eventually the wolfram is saleable separately.

The ores of tin raised in Cornwall and Devon are always smelted within those counties, their transportation being prohibited. The market price of tin has lately risen considerably, and it still remains at a high figure; the mines of this metal are therefore more flourishing than usual. Tin ore is worth from L.56 to L.68 per ton. In its natural state, when dressed, the ore is called "black tin," to distinguish it from "white tin," which term is applied to tin in its smelted and refined state.

LEAD.

United States.

Before speaking more particularly of the lead deposits of our own country, we may briefly allude to those of other countries. One of the most remarkable lead deposits in the world is found in the western section of the United

States, particularly in Washington, Jefferson, and Madison counties, Missouri; and at Galena in the N.W. part of Illinois; in Iowa and the territory of Wisconsin. In this latter district the length of the lead deposit is 87 miles and its width 54, covering 80 townships, or 2880 square miles. In 1839 thirty million pounds of lead were smelted from this deposit; and during the eight subsequent years the smelted quantity varied from 72 millions to 54 millions of pounds. It is thought that it would readily yield annually 150 millions of pounds.

France. France possesses considerable deposits of lead, and some very old mines, although the development of these is not commensurate with their value. The most important are those of Poullaouen and Huelgöet in the department of Finisterre. These have been worked in two parallel veins, and have been known for upwards of three centuries. In 1816 they furnished 500 tons of lead. The mine of Pontgibaud is well known to English adventurers, and contains nine lodes or veins. It was worked as early as Poullaouen, although the last workings commenced in 1825. The ore is an argentiferous galena, of which 7800 tons have been extracted annually, which extraction yields 1077 tons in dressed ore, and 980 tons in "schlick." Vialas yields 81 tons of lead, 20 tons of litharge, and 12 cwt. of fine silver. The Pont Pean Mine is working upon a vein which is known for a run of 1¾ mile, and the works have reached a depth of 78 fathoms. Here they obtain about 244 tons of dressed ore, which is sold for about L.1400. The produce of the other lead mines is insignificant.

Germany, &c. Germany has also some valuable mines of lead, particularly in Saxony and in the Hartz. These are so rich in silver as to cause the lead to be almost overlooked. Hungary and Bohemia yield a good argentiferous lead. The mines of Bleiberg and Villach in Carinthia, where galena or sulphuret of lead is the prevailing ore, furnish the finest specimens of the molybdate of lead. At Tarnowitz in Silesia there is a remarkable deposition of lead ore, the beds in which it is distributed reposing in horizontal strata of compact limestone, which contains petrified shells. The lead ore is there deposited in veins, in rounded masses, and in small grains. The Ural Mountains in the Russian empire, so rich in other mineral productions, do not seem to contain lead; a chromate of lead is found in the gold mine of Beresov, where it is seen in a small vein of ferruginous quartz traversing a gneiss rock of a reddish colour.

Spain. Spain possesses numerous and valuable lead mines. The most important are those of Linares, which are situated to the east of Bailen, near the Sierra Morena. They have been long celebrated, and probably no known mineral field is naturally so rich in lead as this. The lead deposits, associated with much silver, and occasionally copper ores, occur in each of the local limestone districts. The expense and difficulty of conveying stores to the mines, and the ore to the market, are almost the only impediments to the prosperity of these mines, but they are sufficient to check it, excepting when lead bears a high price in the market. The lead ores of Spain are highly argentiferous, and of late years a considerable quantity of this ore has been imported by us from Spain. In the year 1851 we received 14,402 tons of lead. In 1854 the imports from Spain were 11,337 tons of lead.

Sweden. The lead of Sweden is highly argentiferous, and is worked chiefly with a view to the silver. In Daouria are numerous mines lying in a rich transition limestone which rests on primitive rocks, the lead being neglected in consideration of the silver. It is thought that the galena of the primitive formations contains more silver than that of the calcareous or carboniferous limestones.

Produce of British lead mines. It has often been supposed that England, so rich in regard to iron, copper, and tin, is comparatively poor in lead, or that her lead mines are of secondary importance; but this is so far from being correct, that it will be found that our own country supplies more lead than any other in the world. We do not speak of the amount contained, but of that raised. The following table will show the amount of lead ore raised, and lead smelted, in the United Kingdom during nine recent years; and the table subsequent to it being included, we shall have the quantities for the last ten years:—

Years.	Lead Ore.		Lead.	
	Tons.	cwt.	Tons.	cwt.
1845	78,267	0	52,695	0
1846	74,564	0	50,161	0
1847	83,747	0	55,703	0
1848	77,864	0	54,853	0
1849	86,773	0	58,703	0
1850	93,043	8	64,572	14
1851	101,964	12	65,110	11
1852	91,236	...	64,987	...
1853	85,121	8	61,021	2

The annexed table will still further exhibit the lead districts of the United Kingdom, with the produce of each in ore and metal, from returns for one year, viz., 1854, being the latest as yet made:—

Summary of Lead and Silver Produce of Great Britain and Ireland.

County.	Lead Ores.	Lead.	Silver.
	Tons.	Tons.	Ounces.
Cornwall	7,460	5,005	179,675
Devonshire	4,139	2,612	119,288
Cumberland	9,890	6,662	42,020
Durham and Northumberland	22,329	16,669	78,577
Westmoreland	383	289	80
Derbyshire	7,554	4,508	...
Shropshire	3,797	2,765	184
Yorkshire	9,244	6,476	...
Cardiganshire	7,034	4,948	33,418
Carmarthenshire	901	666	...
Denbighshire	1,824	1,363	1,455
Flintshire	7,027	5,408	28,588
Montgomeryshire	1,184	894	3,238
Merionethshire	98	63	...
Glamorganshire	62	45	352
IRELAND	3,069	2,210	18,096
SCOTLAND	1,753	1,279	5,426
ISLE OF MAN	2,800	2,137	52,262
	90,548	63,999	562,659

The number of mines is 322. They give employment to 14,499 male persons in England, to 5982 in Wales, and to 897 in Scotland; as well as to 371 females employed in works at the surface. The total is 21,749 persons. The price of pig lead in the London market in 1853 was L.23, 10s. per ton; in 1854 it was the same, and in 1855 it was L.24 per ton. It has been rising from 1844, when it was L.17, 5s. per ton.

When we examine the returns of the principal lead mines in each of the above districts, we find considerable differences in the yield of the several mines in different years. Thus, in 1850 the richest lead mine in Cornwall was East Huel Rose, then yielding 4206 tons of ore, equalling 2524 tons of lead; but in the returns of 1854 we observe the same mine yields only 1215 tons of ore, equalling 828 tons 5 cwt. of lead. On the other hand, we find South Tamar Consols Mine in Devonshire yielding in 1850 only 477 tons of ore, but in 1854 as much as 1469 tons 19 cwt. Another instance of this difference for the same two years is noticeable in the Brownley Hill Mine in Cumberland, which in 1850 produced 263 tons 4 cwt. of ore, while in 1854 it yielded no less than 1722 tons of ore. To take a

Mines and Mining.

mine in the north of England, Derwent produced in 1850 the amount of 1770 tons 1 cwt.; in 1854 only 1000 tons. The above-named mines are about the most productive in their respective districts for one or other of the two years named. The galena of the Beer-Alston mines in Devon has sometimes contained from 80 to 140 ounces of silver per ton of lead.

The lead ores[1] most interesting in the arts are:—1. Sulphuret (or bisulphuret) of lead (specific gravity from 7·4 to 7·6), or, as it is commonly called, *galena*, almost the only lead ore which occurs in sufficiently large masses to become the object of mining and metallurgy. It is found amongst the older rocks, as talc-schists and clay-slates, but is much more abundant among the transition rocks where it exists in interrupted beds, masses, and veins. The blackish transition limestone is that rock which of all others contains most galena in Normandy, the Hartz, and in Sweden. 2. Seleniuret of lead. 3. Native minium, or red lead. 4. Carbonate of lead, or white lead. 6. Vitreous lead, or sulphate of lead. 7. Green lead, or phosphate of lead. 8. Chromate of lead.

In our own country the lead of Cornwall and Devon is found in veins in *killas* or clay-slate. The galena of the Leadhills of Scotland occurs in a transition slate of a similar character. But in North Wales, as well as in Cumberland and the whole northern lead district, and in Derbyshire, the galena occurs in the carboniferous limestone which underlies the coal measures. Technically speaking, galena occurs in plutonic, metamorphic, and fossiliferous sedimentary deposits. A specimen of a lead vein from the Laxey Mines (Isle of Man) represents the total thickness of the lode, which amounts to nearly 23½ inches. The specimen is about 5 feet long by 30 inches wide. It consists of five solid layers or veins of galena separated by thin bands of sulphate of barytes. It was in the Great Exhibition, and was presented to the Museum of Practical Geology in London.

A magnificent lump of galena from the mines of Snailbatch or Snailbeach near Shrewsbury, is still more curious. It is composed of an assemblage of large cubes of galena measuring 3·15 inches a side, and of rhombohedral crystals of violet-coloured calc-spar 9½ inches long, the edges replaced by large facets. This specimen measured above 55 inches by 43½ inches, its thickness being 14 inches. (For the metallurgy, &c., of lead, see the article LEAD.)

The great lead-mining country of the north of England lies around the junctions of the counties of Northumberland, Cumberland, Westmoreland, Durham, and Yorkshire. It comprises Alston Moor, the mountain ridge of Cross Fell, the dales of Derwent, East and West Allendale, Weardale, and Teesdale. The three rivers—the Tyne, the Wear, and the Tees—take their rise from the bold and lofty hills in that locality.

Geological characters.

The coal beds so extensively worked at Newcastle-on-Tyne and in the Durham coal district gradually rise to the west, and one by one crop out, or basset, according to the undulations of the country. At length at about 20 miles W. of the German Ocean, the lowest of the beds crops out, and from beneath it gradually appear the limestone strata, which continue to rise nearly coincidently with the general rise of the country, until they reach the summit of Cross Fell (2901 feet). This general and very gradual inclination of the strata is a feature of the greatest importance in the practice of mining. In a thickness of about 2000 feet of the alternating beds of sandstone, clay, and limestone, which form the mining districts of Allendale, Alston, and Weardale, there is one single bed of limestone, named the "Great Limestone," the metallic veins in which have produced nearly, if not quite as much, lead ore as all the other strata put together. This stratum lies at a depth of about 850 feet below the summit of Kilhope Law. A little more than 2 miles eastward of this, at Allenheads, the top of the Great Limestone is 230 feet from the top of a shaft called Gin-Hill Shaft. Its thickness, which is tolerably uniform over several hundred square miles of country, is about 60 feet.

Kilhope Law is a hill rising 2200 feet above the level of the sea, on the boundary line of the counties of Northumberland and Durham, and is the highest point in Durham. About a quarter of a mile to the W. of Kilhope Law, the great limestone and all other associated beds are thrown down a depth of about 150 feet for a space of nearly 700 feet; and again, at the distance of nearly a mile from Allenheads, a vast dislocation takes place by which the Great Limestone is brought nearly to the surface, the amount of displacement being about 400 feet. By far the most extensive portions of the workings of the Allenheads Mines are situated in the Great Limestone. These mines being for the most part at depths from the surface varying from 200 to 600 feet, they are drained by ordinary water-wheels, and partly by the new hydraulic engines of Armstrong, four of which are now in use for draining and other mining purposes at the Allenheads mines. The most extensive mineral property in England, in the hands of a single individual, is in the mines of East and West Allendale and Weardale, belonging to Mr Wentworth Blackett Beaumont, M.P. The produce from these mines in 1854 was 12,220 tons of lead ore, or 9200 tons of lead, and 49,000 ounces of silver. The pigs of lead manufactured from the produce of these mines bear the well-known mark "W. B.," and weigh each 1½ cwt. The number of pigs commonly made in one year, if laid in a continuous line, would extend upwards of 70 miles. The produce of the Beaumont mines is about one-sixth of the total amount of lead raised in Britain, and about one-tenth of that of all Europe.

Mining districts.

This part of the country happens to be at once about the centre of our island, and by far the most elevated part; and is thickly peopled. Scattered over hills and dales, which present to the eye a succession of verdant fields and heathy moors, are to be found some thousands of inhabitants, nearly the whole of them being employed either in lead mines or in smelting mills, or indirectly deriving a livelihood from the lead-mining business. Allenheads forms a central position in the midst of these mines. The agent's house is 1400 feet above the level of the sea, and is said to be the highest house of its magnitude in Great Britain; not many even of the shepherds' cottages and other moorland habitations in England having a greater elevation.

The mining district of Alston Moor (situated at the south-eastern extremity of the county of Cumberland) comprises the whole of the parish of Alston; but by far the most extensive and productive mines are situated in the vale of the small river Trent, a tributary of the Lyne. In the vale of the Lyne, from Alston to Lynehead, are also numerous mines; and trials for mines and workings, which occasionally yield lead, are seen all over the parish. This mining district belongs principally to the commissioners of Greenwich Hospital, who let the mining ground on leases to various companies of adventurers, by whom the mines are wrought. The principal of these is the London Lead Company, producing about one-half of the ore raised in the manor.

One of the most celebrated of the Alston Moor mines, Hudgill Burn, was commenced by the Flow Edge Mining Company: a level driven 250 fathoms in the bed under the Great Limestone, and found only two weak veins. They sunk shafts and pursued other operations, discovering only

[1] Plumbago, graphite, or black lead, is one of the numerous forms in which carbon occurs, and is familiar to us in lead pencils. The celebrated Borrowdale mines, in Cumberland, supplied pieces which could be sliced and used in the natural state. It is not a lead ore.

another small vein, which they explored for 20 fathoms, and produced but a few trifling specimens of ore not worth washing and cleansing. Having lost L.2000, this company abandoned the undertaking, which then lay neglected for eight years. In 1812 some miners obtained leave to continue the search, and their success was so great that their discovery has proved a source of wealth to themselves, and has afforded employment to vast numbers of the labouring classes.

A work of great interest in this district is the Nent Force Level, which drains the numerous mines of Alston Moor. This is a stupendous aqueduct 9 feet broad, and in some places from 16 to 20 feet high. For more than 3 miles it passes under the course of the River Nent to Nentsbury engine shaft, and is navigated underground by long narrow boats. At the distance of a mile in the interior, daylight is seen at the mouth like a star, which continually enlarges as the passenger proceeds outwards, until he finds himself in open daylight.

Lead veins. The veins of lead are similar in their nature to the lodes of copper, tin, &c., in Cornwall, though the accompanying strata are different. A lead vein may be popularly described as a crack descending in a nearly vertical direction through the various beds, which have usually been separated not only a few inches or feet (forming the thickness of the vein, and subsequently filled with *vein-stone, rider*, and galena), but also by a vertical shift or dislocation, so that a vein may be between limestone on one side and sandstone on the other, or sandstone and clay may be opposite. One vein throws the strata down 25 fathoms (150 feet). The lead miner obtains all his treasures in those very dislocations which interrupt coal workings, and are by coal miners called *faults* and *troubles*.

Old miners have distinguished the lead veins by the names of *rake, pipe*, and *flat* veins. Rake veins are the most common in Cumberland, &c. They are generally narrower in the sandstone that covers the limestone than in the calcareous and siliceous beds. In the rich vein of Hudgill Burn the thickness is 17 feet in the Great Limestone, while it does not exceed 3 feet in the overlying sandstone. The influence exercised on metallic veins by the inclosing rock has been mentioned before, and is confirmed by wide observation in other countries, particularly in the veins of Kongsberg in Norway. Perhaps, however, the phenomena are nowhere more satisfactorily displayed than in the north of England. The mining districts consist of shales, grits, and limestones, traversed by east and west, and north and south veins, which variously dislocate the strata. In the course of these unequal dislocations, coupled with unequal thicknesses of strata, various oppositions of the argillaceous, arenaceous, and calcareous rocks take place. It is chiefly in the limestone that the veins are productive, although the fissures traverse a vast thickness of overlying strata, as shales, grits, and coal. In a series of limestones, gritstones, and shales, adjoining or forming the margin of a vein, it happens that when inclosed between *cheeks* or walls which are both argillaceous, the vein will be unproductive and generally *nipped* or reduced in width. With argillaceous beds on one side, and gritstone or limestone on the other, the same effects appear, but in an inferior degree., Gritstone opposing gritstone yields irregular results, according to the mass or quality of the gritstone; so that in several districts (as Allenheads, Grassington, &c.) much lead ore has been found in such situations. But when limestone is opposite to limestone the vein is almost always most productive. Of the stratum called the Great Limestone, and its metallic productiveness, we have already written. The *rake* vein is by some divided into two kinds, one of which, the *slip* vein, prevails most commonly in Alston Moor. *Pipe* veins are seldom of great length, but often have considerable width. They appear to be the result of a segregation of the metallic contents of a vein into portions inclined at various angles in different veins, but nearly parallel in the same vein. The *pipes* or *shoots* are usually very productive for a long course in a long vein. *Flat* veins seem to be expansions of the matter of the vein between the planes of the strata, and contain the same ore as the veins in their vicinity. When metalliferous, they are worked along with the adjacent rake vein, and are productive only to a certain distance from that vein, unless they become enriched by crossing a rake vein. The rake veins are the most productive of all in the north; and observations made in Derbyshire point to the conclusion that nearly the same conditions govern the lead veins in that county. An opinion prevails in the north that the greater number of lead veins are at right angles to the plane of stratification, and this opinion is not without foundation.

The numbers of males employed in lead mining in the northern counties of England are as follows:—In Durham, 2628; in Northumberland, 1070; in Cumberland, 1840; in Westmoreland, 317; in all, 5855.

Considerable numbers of young persons are employed at the surface works in dressing the ores. This process consists in—1. The sorting and cleansing of the ores; 2. The grinding; 3. The washing, properly so called. These operations are much alike in the English lead districts, but they are most perfect in the north.

The lead and argentiferous lead districts of South Wales lie chiefly along the shores of Cardigan Bay. The district containing the known argentiferous and lead ores stretches from about the centre of Carmarthenshire on the south, through Cardiganshire, and some distance into Montgomeryshire, on the north, and from about 5 to 20 miles from the sea towards the interior, or from W. to E. The most productive portion of the country as regards silver lies about 7 miles to the eastward of Aberystwith, perhaps the most beautiful of the Welsh watering-places. This contains the great mines Cwm Symlog, Goginan, Daren, Cwm Sebon, Bwlch Consols, &c. The district in which these mines are situated abounds in majestic scenery; the great mountainous region, commencing at Snowdon on the northward, passes southward through its centre, Plynlymmon being in the midst of the metalliferous deposits, and rising at 17 miles from the sea to the height of 3300 feet above its waters. The views on the rivers are amongst the most beautiful in the British Isles, and the well-known Devil's Bridge overspreads a cataract on one of the streams, and falls over a ledge of rocks from a height of 480 feet into the bed of the Rheidol. Welsh lead mines.

The present annual produce of these mines must not be taken as showing the produce in past years, for some of the mines formerly yielded immense profits. The lode in Esgair-y-Mwyn Mine is said to have been filled with lead for 30 feet wide, nearly solid; and although a royalty of L.3 per ton was paid to Earl Powis, it is not improbable that the mine has returned L.600,000 worth of ore. Of the other more profitable mines, it is estimated that Cwm Ystwith has yielded L.500,000, Grogwinion L.250,000, and Logylas L.200,000 worth of ore. In the main silver-lead districts of Cardiganshire, amongst the mines of which are Goginan, Bwlch Consols, Daren, &c., the total produce has been estimated to have been L.1,500,000 for lead, and L.1,000,000 sterling for silver. Yet the whole of these mines have been worked to but a comparatively shallow depth.

The group of mines adjacent to Talybout, 7 miles north of Aberystwith, includes Esgair-fraith, formerly called the "Welsh Potosi," and famous for having yielded immense masses of ore. The history connected with these mines is very remarkable, but we can only briefly notice it. The estimate of Mr Waller sounds extravagant to us at this day; but it is believed that he proposed to realize a profit of

L.75,000 a-year from these mines alone. It is reported that Sir Carberry Pryse (ancestor of the Gogerddan house) refused L.75,000 for a moiety of them. It may be presumed that the whole of the mines in this part have actually yielded not less than ores worth one million sterling. It is very curious, when we are made acquainted with such facts, to read this passage in Cicero's Letters (Epist. ad At.) written almost immediately after the disembarkation of Cæsar's troops on our island:—"One thing we are already certain of, that there is not a grain-weight of silver in that island, nor the least prospect of plunder, but from the slaves that may be brought away."

The metalliferous district of Cardiganshire and Montgomeryshire is formed exclusively of clay-slates and gritstones underlying the lowest beds in the Silurian system of Murchison. Large portions of this principal district are as yet not known to contain mineral veins; and the intermediate parts which are the most noted for their productiveness, are defined by certain limits intimately related to the lithological character of the rocks. The prevailing strike of the beds is from N. by E. and S. by W., to N.N.E. and S.S.W.; and in the same direction bands of various width may be traced in which a number of the most successful mines have been worked. There are several anomalous features in this district, if compared with other mining districts. The presence of ore cannot be directly ascribed to the proximity of granites or porphyries, since this is the only large portion of the slaty rocks of Wales in which not a vestige of any rock of igneous origin is met with. The various directions of the lodes gives no clue to the determination of their relative age.

The band known about two centuries ago as the "Welsh Potosi," from the enormous returns it yielded to Middleton (afterwards Sir Hugh Middleton), is at the present day distinguished by the mines of Goginan, Cwm Sebon, Cwm Symlog, Daren, &c. The slaty rock there assumes a paler tint, inclining to a bluish or greenish gray, and exhibiting on the whole a more massive bedding, in consequence of which it would appear that the mineral veins increase in width, expanding in some cases to upwards of 20 feet. This ore is generally argentiferous, sometimes to the amount of 38 oz. in the ton. Several facts have been observed with reference to the ore-bearing portions of the lodes, which are in perfect accordance with the experience of other districts. When the lodes approach each other under a small angle, the junction is nearly always marked by a larger deposit of ore. The lead veins of this part of Wales differ from those of Cornwall in one point, upon which all the miners are agreed,—viz., that when they pass from a harder to a softer rock, their mineral contents *decrease*. In Cornwall, however, we observe, that at the exceedingly productive mine of East Huel Rose, not only is the *killas* or clay-slate very soft, but the lode itself, including its saccharoid quartz, is in so disintegrated a condition that a blow with the pick will often cause it to run down like a quantity of sand or mud.

There are about 120 named lead lodes in Cardiganshire,—some worked, and others not. The most productive of those at present in work are, first, those named Pen-y-Gist South Lode, Logaulas, &c., forming the Lisburne Mines. From these the lead ore returns in 1845 were 2492 tons; in 1846, 1724 tons; in 1853, 2752 tons; in 1854, 2595 tons. 500 persons were employed there. Secondly, the next most productive mines are Goginan North and South Lodes,—the lead ore returns being 1768 tons in 1845, and 1627 tons in 1846. The number of persons then employed was 400. The above mines were very far more productive than the remainder in the county. In Montgomeryshire we find 38 named lodes, of which the principal are,—that named Llechwydd-ddu, a rich and regularly-worked vein; and Esgairgaled, which averages 15 feet wide, and has been productive in former times. Both these united yielded in 1845 586 tons of lead ore, and in 1846, 557 tons of lead ore; the number of persons employed being 200. In 1854 we find the most productive mine in this county to be Machynlleth, which, including Delife, yielded 637 tons of ore, affording 470 tons of lead.

Many considerations tend to encourage the development of the mineral resources of this district: the great number of lodes lying idle, or only in some cases tried to a small depth; the probability of the existence of many more, in consideration of the difficulty of discovering them from the surface; the facility of drainage; and the fact of the resumption of the two most profitable mines from very fortuitous circumstances,—the very profitable mines of Logaulas and Goginan. Logaulas had been erroneously worked, and the true lode was missed, until the present holders, after making an accurate survey, altered the drivings, and shortly discovered, not only the lode, but a rich *bunch* of ore, parallel to which their predecessors had been toiling for many a fathom through barren rock at the distance of only a few feet. The mine has ever since continued to yield several thousand pounds of profit yearly. Still more hopeless did the condition of Goginan appear to be when commenced; yet the mine has since produced upwards of 1500 tons of silver-lead ore yearly. The mode of working these veins is very similar to that adopted in our southern counties, and most of the mining captains are Cornishmen.

Derbyshire.

In Derbyshire the metalliferous limestone occupies a length of about 25 miles from north-west to south-east, with a very variable breadth, which, however, towards the south, amounts to 25 miles. Castleton to the north, Buxton to the north-west, and Matlock to the south-east, lie nearly upon its limits. This limestone district is surrounded nearly on all sides by the millstone grit which covers it, and which is in its turn covered by the coal strata. The nature of the rocks beneath the limestone is not well known. In Cumberland the metalliferous limestone includes a bed of igneous rock, called *trap* (from the Swedish word for stair) by mineralogists, but locally *whinsile*. Igneous rock is much more abundant in Derbyshire, where it is termed *toadstone* (probably from the German *todstein*, dead rock), and it is there thrice interposed between the beds of limestone. These two rocks of themselves constitute the whole mineral mass through a thickness of about 550 yards, measuring from the millstone grit; only in the upper portion—that is, near the millstone grit—there is a considerable thickness of argillaceous schists. The toadstone is of various thicknesses and colours, and is sometimes very porous, and presents the appearance of scoria or volcanic lava. It is the miner's dread, as it is thought to cut off the vein of ore. On Tideswell Moor, however, where toadstone intersected the vein that was worked in the incumbent limestone, it at once cut off the vein; but when the miners cut through the toadstone, they met with the limestone underneath, and the continuation of the lost vein. At Black Hillock Mine, where the vein was cut off by toadstone, they sank for 600 feet in its mass, and yet could not get through it; while at a distance on either side miners got through the toadstone in a few fathoms. It appears that though the vein may be retraced on the other side of the toadstone in the limestone again, yet it is generally very thin, and sometimes extremely poor.

The veins in this district are of three descriptions:—*1st*. The *pipe-vein*, which lies between two rocks of limestone extending regularly above and below. It consists of several lines or branches running nearly parallel to each other; and although they sometimes deviate from that course, they generally return after a short distance. The branches communicate with each other by means of slender threads or *leadings*. Sometimes the surrounding rock is penetrated by these transverse threads, and by pursuing the thin veins

Mines and Mining.

a new repository of metal may be discovered. 2*d*. *Rake veins* traversing the strata; and, 3*d*. *Flat veins*, forming beds along with the horizontal strata, and generally lying near the surface. A variety of the ore, termed by the miners *slickensides*, abounds in some parts, and forms the sides of cavities. Some fabulous tales of its explosive violence are narrated in the district. It presents a smooth surface with a bright metallic lustre. The blocks of lead bearing Latin inscriptions, which have been found here, have led some to think that the mines of this county were wrought in the time of the Romans.

General returns.

In the table of lead-ore returns for 1854 it will be seen that those of Flintshire are nearly equal to those of Cardiganshire. The most productive mines in Flintshire are those called Talargoch, which in 1854 yielded of lead ore 1910 tons; and these afforded 1490 tons of lead, from which was extracted 10,430 ounces of silver. The next richest mine is Maes-y-safn, yielding 1423 tons of ore, equalling 1117 tons of lead and 3071 ounces of silver.

The most important items of returns from other lead-mining districts for 1854 are as follows:—Derbyshire yielded 7554 tons of lead ore, affording 4508 tons 15 cwt. of lead. The largest mines in Yorkshire are Swaledale and Arkendale, yielding 4817 tons of ore, or 3276 tons of lead; Grassington is the second in yield. In Scotland the Wanlockhead Mines yielded 795 tons of ore, or 596 tons of lead. In Ireland the Newtownards Mine afforded 1379 tons of ore, and 1084 tons of lead; the Luganure Mines in Wicklow yielding 1095 tons of ore, and 710 tons of lead and 4970 ounces of silver. In the Isle of Man the principal mines, the Foxdale, yielded 1900 tons of ore, or 1449 tons of lead, the proportion of silver being 19,926 ounces.

IRON.

For information respecting iron, its localities, &c., see the article IRON.

MINES OF ZINC, ARSENIC, ANTIMONY, &c.

Zinc.

Our islands produce considerable quantities of zinc. There were obtained from the mines of Cornwall, Wales, Cumberland, and the Isle of Man, during the year 1855, not less than 5000 tons of zinc ore, in the form of sulphuret of zinc or *black-jack*, and calamine, a carbonate of zinc. The estimated value of this product was at least L.17,000. As the price for zinc is advancing, and as it is now selling at prices varying from L.2, 10s. to L.3 per ton, we may expect a new business for our zinc mines. The great supply of zinc for this country has hitherto been derived from the works of the Vieille Montagne Company. Our imports in the last five recent years have been as annexed:—

Years.	Zinc.	Oxide of Zinc.	
	Tons.	Tons.	Cwt.
1850	18,626	170	16
1851	22,986	495	9
1852	18,505	787	9
1853	23,418	342	8
1854	19,583	336	0

Calamine is very abundant in England, as in the Mendip Hills and parts of Somersetshire; at Holywell, Flintshire; at Castleton, Derbyshire, and in Cumberland. In 1854 the English zinc mines produced 4531 tons 3 cwt. of sulphuret of zinc, and 280 tons 11 cwt. of calamine. The value of the zinc smelted in England in 1854 was about L.16,500.

Arsenic.

Cornwall and Devonshire yield annually not less than 1500 tons of arsenic, a considerable proportion of which is employed to give the required whiteness to copper in our white-metal manufactures, and hardness to steel; and a large quantity is exported to Russia and other places, where it is used in dressing furs and skins.

Antimony, nickel, cobalt, &c.

We have also in our country antimony, nickel, cobalt, manganese, and some other metals, which are of use in the arts. Cornwall formerly supplied antimony to the type-founder, but now we import nearly all the antimony we use. Antimony is found at Rosenau in Hungary; in Saxony and the Harz; in Spain, Tuscany, France, Siberia, Mexico, and the Indian Archipelago. The St Austell Consols Mine sold two years ago about 150 tons of nickel and cobalt; and the mines of the Duke of Argyle in Scotland produced about 300 tons, averaging about 6 per cent. for nickel. All the nickel which our white-metal manufacture requires is supplied from Norway and Germany. Cobalt is of interest to us as being the basis of the blue colour in our earthenware, &c., and nickel as an essential ingredient in various metallic alloys, such as albata and German silver. The two metals are often associated in the same mass. A specimen of ore found near Keswick, Cumberland, contained from 2 to 3 per cent. of cobalt, but no nickel. The ores found in Cornwall include both nickel and cobalt; but as they seldom contain more than from 2 to 7 per cent. of available metallic matter, while the ores on the Continent frequently contain from 12 to 15 per cent., the process which may answer in the reduction of the richer ores may prove too costly in the poorer ones. The Swedish method has been tried with the Cornish ores, and failed.

Manganese.

This metal, used as a glaze or pigment by potters, &c., occurs native in the Hartz Mountains, in Piedmont, in the Mendip Hills, Somerset, and in the counties of Devon and Aberdeen. It has been recently found that a certain proportion of this metal, added to steel manufactured from British iron, produces a cast-steel nearly equal to that obtained from Swedish iron. Great quantities of the peroxide have been found near Tavistock in Devonshire and Launceston in Cornwall.

Sulphur from iron pyrites.

When sulphur was high-priced, considerable quantities were manufactured from our iron pyrites; but its present comparative cheapness has greatly reduced the demand for our own sulphur. Some, however, being still employed in our chemical works, it is produced from a few mines, chiefly from the Irish. Since 1839 the mines of Wicklow have sold, in fifteen years, 338,368 tons; the mines of Arklow, 606,972 tons; collectively, 945,340 tons. In the last year of the fifteen, viz., 1854, the quantities were,—Wicklow, 34,000 tons; Arklow, 90,000 tons; collectively, 124,000 tons. Cumberland and Westmoreland sold in that year 2400 tons. The Wicklow and Arklow mines, which produce the iron pyrites, all contain the same "sulphur course," which traverses them in a north-eastern and south-western direction. The iron pyrites consists, in 100 parts, of iron 46·67, sulphur 53·33.

Rock-salt is mined in some countries, and especially at Wielizka, near Cracow, in Poland (in the Cretaceous formation), where the excavations are of vast extent, and have been continued, it is said, from the year 1251, extending more than a league from east to west. The salt is of an iron-gray colour, in which are found rocks of a pure white. The annual product is reported to be about 2,000,000 cwt.

Salt.

The great beds of rock-salt in the New Red Sandstone of Cheshire, in our own country, are known to extend one mile and a half north-east and south-west, and to be upwards of three quarters of a mile wide. There are two beds lying one over another, and at Northwich at least 60 feet in thickness. The top of the lower bed is about 220 feet from the surface; and no bottom has been found. The salt is mostly of a reddish hue, and is so hard that blasting by gunpowder is often necessary for its extraction.

The brine springs do not fall within the description of mines. A remarkable deposit of rock-salt has recently been discovered on the Marquis of Downshire's property at Car-

rickfergus, about 8 miles from Belfast, Ireland. The discovery was made in searching for coal, and at a depth of about 550 feet from the surface. It is comprised in a series of strata lying contiguous to each other, and the aggregate thickness is about 100 feet. The quality is said to be superior to the Cheshire rock-salt. Hitherto no springs have been discovered. The low price of coals in Cheshire will always be in favour of the manufactures there. From all these sources the British and Irish production of salt in 1854 has been nearly as follows:—

	Tons.
From Cheshire about	850,000
„ Worcestershire about	100,000
	950,000
From vicinity of Belfast	15,000
Total	965,000

MANAGEMENT AND FINANCE OF MINES.

Many of the foreign mines are under the control and management of the respective governments. This is not the case with British mines, some of which belong to private individuals (as the lead mines of Mr Beaumont), some to institutions (as the Greenwich Hospital Lead Mines), and many to public and private companies.

When a company undertakes to work a mine, the lord of the land must be arranged with, and he grants a lease (*sett* is the mining term) upon certain terms, and demands a rent (royalty) either in ores or money. A ratio of one-fifteenth may represent the lord's average dues. Mines are worked by a greater or less number of adventurers or shareholders, either on what is termed the "cost-book system," or under joint-stock laws.

The cost-book system is very peculiar, and differs mainly from that of joint-stock companies in the control directly exercised by the whole body of the shareholders over the management of the concern. They appoint a *purser*, who acts as the financial servant of all, and renders an account to the shareholders at their frequent meetings. There are many advantages in this system; but legal questions and complications may arise which are difficult to decide. Many of its customs or usages are still *sub judice*. Coal mines alone are under government inspection, and that exclusively with reference to accidents, their causes, and preventives. The numbers of shareholders of which the associations for working mines consist are very various; but they are more than in ordinary trading partnerships, on account of the risks and expenses of mining. In the old adventures in Cornwall the number of shares in each mine was commonly either 64 or 128. It is now desired by many to increase the number of adventurers in these concerns. If the mine be a scrip concern, there are directors, &c. In Cornwall the mining agents are termed *captains;* and these are divided into "grass-captains" (at the surface), and "underground captains." The purser is the chief financial and managing officer. (*Cornwall; its Mines and Miners*, pp. 136, &c.)

The amount invested in British mining in 1852 was about five and a quarter millions, and these investments yielded dividends of L.1,409,060. Of these, mines representing L.2,345,624 produced something more or less; and mines representing L.1,476,666 produced nothing. Of the former class, mines representing L.498,196 produced dividends of L.253,057, or on the average 50 per cent. The amount of dividends paid on mining in the first nine months of 1856 may be thus classified:—

English mines	L.288,869
Irish „	17,970
Welsh „	15,485
Isle of Man	11,240
	L.333,564

From this statement an idea may be formed of the magnitude of business in British mining companies. There is a Mining Exchange in London.

Mining schools have long been established upon the continent of Europe. The most celebrated in Germany are those of Freiberg in Saxony, and Clausthal in the Hartz. Schemnitz in Hungary has a good mining academy, founded about 1760; France has its Mining School; and generally the foreign mining districts are well provided with scientific instruction. In England there has been a lamentable deficiency of mining schools. However, the Government School of Mines was opened in London on 6th November 1851, in connection with the Museum of Practical Geology. It is a well-provided institution, having able professors, a fine museum, many models, and a good library. A mining school has been established, after many difficulties, in Truro, Cornwall, and one smaller in Bristol.

Mining schools.

GENERAL VIEW OF THE MINERAL WEALTH AND PRODUCE OF THE PRINCIPAL COUNTRIES OF EUROPE.

Great Britain.

Great Britain is the most favoured country in the world for the development of mineral industry, as well as for its mineral possessions. Fuel, the indispensable agent in the treatment of metalliferous ores, and the most powerful element in the production of motive force, is distributed, though unequally, throughout the three countries of England, Scotland, and Ireland. The coal formation in these three divisions of the British Empire occupies rich and widely-spread basins, several of which (especially those of Newcastle-on-Tyne, Scotland, and Wales), being situated near to the sea, which surrounds the whole country, are enabled to export the coal to those places in which the metalliferous ores exist in abundance; but in some districts (as in Cornwall), the absence of fuel renders the work costly and difficult. The ores of iron, abundantly distributed in several of the coal basins, add greatly to their value. Each coal basin so situated has become the centre of a metal-working district, where numerous works produce iron at a price so comparatively moderate, that no nation has as yet been able to compete with us with any great success. The insular position of Great Britain allows the coal to be conveyed at a minimum cost wherever it is wanted, and is equally important in permitting iron or other metals to be shipped to any part of the world. Hence the importance of these particulars of situation, &c., is strongly shown when we state, that while England is thus enabled to supply her iron at a price which ejects all rivals from the market,—and while she exports annually upwards of 800,000 tons (her mean annual importation during the five years ending 1852 being 32,197 tons), and could supply the whole European continent,—yet the quality of her iron is considered by foreigners to be but middling, and it is not applicable to the purposes for which she imports the finer iron; while for the manufacture of steel she imports from Sweden and Russia. The manufacture of steel is very backward in Russia. Asia and European Turkey take more than two-fifths of the Russian exported iron, England and the United States nearly two-fifths, and other countries somewhat less than a fifth.

From time to time a few conjectural estimates have been formed of the value of the produce of the British mines. Dr Buckland, in his address to the Geological Society in 1840, remarked,—"The average value of the annual produce of the mines of the British Islands amounts to the enormous sum of L.20,000,000, of which about L.8,000,000 arise from iron, and L.9,000,000 from coal." Sir Henry de la Beche in 1851 stated, that "the raw mineral produce of Great Britain and Ireland is valued at L.24,000,000 per annum, or about four-ninths of that of all Europe, including these islands; the coal being estimated at the pit's mouth, the iron in the pig, and so on."

Mines and Mining.

The following is Mr Hunt's estimate of the annual value of our produce of metals and minerals for two recent years, taken from the Government Geological Survey:—

	Value of British Produce for 1853.	1854.
Iron (pig)	L.10,000,000	L.9,500,000
Copper	1,500,000	1,229,807
Lead	1,000,000	1,472,115
Tin	400,000	690,000
Silver	210,000	192,500
Zinc	10,000	16,500
Coal at pit's mouth	11,000,000	14,975,000
Other minerals, as Nickel, Arsenic, Sulphur	400,000	500,000
Total,	L.24,520,000	L.28,575,922

The number of persons employed in British mining is as follows:—

	Men and Women of all ages.
Coal	219,995
Iron	26,106
Copper	21,169
Tin	14,764
Lead	21,769
Zinc, &c.	174
Total	303,977

An analysis of this number affords the following particulars:—

Males under 20 years of age	86,647	
Do. 20 years old and upwards	208,520	
Total Males		295,167
Females under 20 years of age	4,994	
Do. 20 years old and upwards	3,816	
Total Females		8,810
Total Males and Females		303,977

Russia. According to the estimates of Tegoborski (*Commentaries on the Productive Forces of Russia*, by M. L. de Tegoborski, Privy Councillor, &c. of the Russian Empire, 8vo, London 1855, vol. i., p. 213), the latest and most reliable Russian authority, the principal products of the Russian mines of gold, silver, platina, iron, copper, lead, zinc, coal, and salt, together represent a value of L.5,460,000 sterling, of which more than 55 per cent. is gold alone. This estimate excludes the accessory products of the mines,—granite, malachite, gems and precious stones, &c., found in mountains of Siberia. With the addition of these secondary articles of the mines and quarries, the author carries the gross value of the whole productions of the Russian mineral kingdom to L.6,333,333 sterling.

Austria. In Austria, the whole products of mines, salt excepted, on an average of the years 1841–1844 inclusive, represented a value of 22,102,000 florins. Adding the gross value of salt, at 1 florin per quintal, the gross total product of the mines will be 27,602,000 florins, equal to L.2,750,000 sterling. Taking into account the progress of production during preceding years, the present total Austrian production is estimated at about L.3,166,666.

Prussia. In Prussia, according to statistical information published in the Berlin newspapers, the total produce of the mines amounted in 1848 to nearly L.5,000,000 sterling.

France. In France, according to M. Schnitzler's statistics, founded on official returns, the total produce of the mines represented in 1843 a value of L.16,640,000, and according to the progress of production assigned by this author, it may now be carried to about L.16,800,000 sterling; but in the French estimates the produce of quarries and peat bogs, to the amount of L.1,600,000, is included. It would appear, too, that M. Schnitzler's rates of valuation are much higher than those of Tegoborski.

Thus an approximative comparison may be instituted, from which it would follow that the produce of mines in Russia exceeds that of the mines of Austria in the proportion of 2 to 1; exceeds Prussia by more than a third; but attains only two-fifths of the mining produce of France, and is therefore, of course, greatly inferior to that of Great Britain.

An approximative attempt at exhibiting a complete view of the metallic produce of the world for 1854 has been made in the subjoined table by Mr Whitney, an American:—

Table of Metallic Produce for 1854.

Countries.	Gold.	Silver.	Mercury.	Tin.	Copper.	Zinc.	Lead.	Iron.
	Lb. Troy.	Lb. Troy.	Lb. Avoird.	Tons.	Tons.	Tons.	Tons.	Tons.
Russia	60,000	58,000	...	...	6,500	4,000	800	200,000
Sweden	2	3,500	...	...	1,500	40	200	150,000
Norway	...	17,000	...	...	500	...	...	5,000
Great Britain	100	70,000	...	7,000	14,500	1,000	61,000	3,000,000
Belgium	...	...	...	...	...	16,000	1,000	300,000
Prussia	...	30,000	...	...	1,500	33,000	8,000	150,000
Hartz	6	30,000	...	...	150	10	5,000	...
Saxony	...	60,000	...	100	50	...	2,000	7,000
Rest of Germany	...	3,000	...	...	...	...	1,000	100,000
Austria	5,700	90,000	500,000	50	3,300	1,500	7,000	225,000
Switzerland	...	...	...	...	...	...	...	15,000
France	...	5,000	...	...	...	...	1,500	600,000
Spain	42	125,000	2,500,000	10	500	...	30,000	40,000
Italy	...	...	...	...	250	...	500	...
Africa	4,000	...	...	...	500	...	...	...
East Indies and So. Asia	25,000	...	...	5,000	3,000	...	...	...
Australia, Oceania	150,000	8,000	...	...	3,500	...	...	...
Chile	1,000	250,000	...	...	14,000	...	...	...
Bolivia	1,200	130,000	...	...	...	...	...	...
Peru	1,900	30,000	200,000	1,500	...	...	...	...
Ecuador and N. Granada	15,000	130,000	...	...	1,500	...	...	...
Brazil	6,000	700	...	...	...	...	...	...
Mexico	10,000	1,750,000	...	...	...	...	...	...
Cuba	...	...	...	...	2,000	...	...	...
United States (includ. California)	200,000	22,000	1,000,000	...	3,500	5,000	15,000	1,000,000
Total	479,950	2,812,200	4,200,000	13,660	56,850	60,550	133,000	5,792,000

The following table of the values of the metallic produce of different countries, showing the ratio of their production as compared with that of the United States and that of Great Britain, has also been compiled by Mr Whitney:—

Countries.	Value of metals produced in pounds sterling.	Ratio of production to that of United States.	Ratio of production to that of Great Britain.	Countries.	Value of metals produced in pounds sterling.	Ratio of production to that of United States.	Ratio of production to that of Great Britain.
United States	L.16,630,625	1·00	5·6	Prussia	L.4,100,000	·121	1·10
Great Britain	20,035,375	1·205	1·	Belgium	1,953,125	·118	1·10
Australia	8,214,167	·494	5·12	Spain	1,670,087	·100	1·12
Mexico	6,350,000	·382	1·3	Sweden and Norway	1,137,687	·068	1·17
Russian Empire	5,258,333	·316	4 15	Saxony	303,125	·018	1·67
France	3,177,604	·191	1·6	Harz District	239,081	·014	[illegible]
Chili	2,738,333	·165	2·15	Italy	173,437	16	1·120
Rest of South America	3,370,000	·203	1·6	Switzerland	78,125	·005	1·240
Austrian Empire	355,958	·147	1·8				

With reference to Great Britain, mining operations are carried on to a greater or less extent in 21 English counties and the Isle of Man, in 12 Welsh counties, and in 17 counties in Scotland. Coal and iron, of some varieties, are found in greater or less proportions in nearly all the counties of England. In examining the counties in Wales and Scotland, we find a similar wide diffusion of coal and iron, and in Wales of lead. In Ireland we observe a wide diffusion of coal and lead, and argentiferous lead. Other minerals are far more rare. (J. R. L.)

MINES, Military. See Sapping and Mining.

MINGRELIA. See Caucasus.

MINHO (the ancient *Minius*), a river of Spain, rising in the N.E. part of the province of Galicia, about 30 miles N.E. of Santiago, and flowing southward till it reaches the borders of Portugal. It then takes a westerly direction, and forms the boundary between Galicia and Portugal to the sea, which it enters at Caminha, after a course of about 130 miles.

Minho, or *Entre Douro e Minho*, a province of Portugal. (See Entre Douro e Minho.)

MINIATURE PAINTING, a delicate kind of painting, consisting of little points or dots, usually done on ivory, vellum, or drawing-paper, with very thin, simple water-colours. Miniature painting is generally limited to portraits, which are for the most part executed on ivory, owing to the superior durability of that material and the peculiar brilliancy with which it bears out the colours. In composition, drawing, and finishing, the execution of miniatures is subject to the same laws as painting, although the process of miniature painting in water-colours is not at all similar to that employed in water-colour drawings generally. The outline, which must be extremely delicate, is traced upon the ivory with a silver-pointed pencil, and is afterwards drawn in with thin carmine. The colours, instead of being washed on or applied by successive tints laid over each other, are entirely dotted on the surface after what is called the dead colouring has been applied. In the dead colouring, which consists in laying on the colours in the smoothest manner, as painters do in oil, the shades are left less dark and the lights stronger than they ought to be; the finishing being performed by the process of dotting already referred to. The speediest method of dotting is the patching process, which consists of drawing delicate lines intersecting each other in all directions till the surface presents a regularly dotted appearance. The artist generally commences his shading with vermilion and carmine, using indigo afterwards for the bluish shade, and ochre and vermilion for the yellowish tints employed on those parts of the face which rise towards the light. The backgrounds, which, when very dark, are composed of bistre, umber, or Cologne earth, are formed by two coats, the first being of a light thin nature, and the last of a darker tint of the same colour. The most usual and appropriate dark grounds are of a greenish colour, consisting of a mixture of black, Dutch pink, and white. This ground is mostly preferred, owing to the rich appearance which it communicates to the carnation or naked parts of a picture. Landscapes and flowers are also occasionally done in miniature; but as the process requires great nicety and patience, it is scarcely fitted for any subject beyond the face and bust of a figure. It is accordingly very seldom used except for likenesses, which, besides being portable, are much admired for the rich softness and delicacy of the colouring.

MINNESOTA, a territory of the United States of North America, bounded on the N. by British America, E. by Lake Superior and the state of Wisconsin, from the latter of which it is separated chiefly by the St Croix River and the Mississippi, S. by the state of Iowa, and W. by Nebraska, from which it is separated by the Missouri and White Earth Rivers. It lies between Lat. 42. 30. and 49. N., and Long. 89. 30. and 103. 30. W., and is 630 miles in length from E. to W., by about 380 in breadth from N. to S.; area 141,839 square miles. Minnesota occupies the most elevated tract of country between the Gulf of Mexico and the Arctic Sea, and forms the watershed of three of the greatest basins of North America—the Missouri, Mississippi, the St Lawrence, and the Hudson's Bay. The sources of the Red River of the North, and of the Mississippi, are nearly in the centre of the territory, at an elevation of about 2000 feet above the Gulf of Mexico. The *Hauteurs de Terre*, or Highlands, are a range of heights which extend W. by S. about 300 miles, and form the dividing ridge between the Mississippi and Lake Superior. The region W. of the Mississippi has several plateaus or tablelands, which mark the limits of various river basins. The most remarkable of these are the *Coteau des Prairies*, or Prairie Heights, about 200 miles in length by from 15 to 40 in breadth, running through the middle of the southern part of Minnesota; and the *Coteau du Grand Bois*, or Wooded Heights, extending for more than 100 miles nearly parallel with the *Coteau des Prairies*, and mostly covered with an extensive forest of hard wood. A range of less altitude than the Coteau des Prairies, but continuing in the same direction, forms the watershed of the streams flowing into the Missouri on the W., and those flowing into the Red River on the E. The rest of the country generally alternates between sandhills and swamps, river bottoms and prairies.

One of the most distinguishing features of the territory is the great number of its lakes of every size, from 40 miles to less than 1 mile in extent. The largest of these lakes are the Lake of the Woods, Rainy Lake, Red, Minni-Wakan, Leech, and Spirit Lakes. These have generally clear pebbly bottoms, and are well stocked with fish. The rivers and streams of Minnesota are also very numerous. The

Mississippi takes its rise in Lake Itasca, which it leaves by a small rivulet only a few feet in width, and subsequently flows through a number of small lakes. Its length in this territory is about 800 miles, for 500 of which (200 below and 300 above St Anthony's Falls) it is navigable. The Red River, passing north, and ultimately falling into Hudson's Bay, is the outlet of numerous small lakes. It has a winding course of about 500 miles in Minnesota. The Rum and St Croix tributaries of the Mississippi drain the S.E. portion of the territory, the latter of the two forming the boundary between Minnesota and Wisconsin. The slope toward Lake Superior is drained by the St Louis River, and by a chain of small lakes forming the N.E. boundary. The great valley formed by the slopes of the Coteau des Prairies and the Coteau du Bois is drained by the St Peter's, which flows first S.E. and afterwards N.E., till it falls into the Mississippi, after a course of about 460 miles. It is navigable for steamers for about 60 miles, and for flat-bottomed boats for about 120. Its principal affluent is the Blue Earth or Mankato River. The Rivière à Jacques and the Sioux are the principal affluents of the Missouri from this territory. They have both an almost directly S. course, the former being about 600 and the latter about 350 miles long. The Missouri, which forms the western boundary of the territory, is navigable by steamboats throughout Minnesota.

The larger part of Minnesota, including the central and N.E. portions, appears to belong to the igneous and metamorphic formations. In the N. and S.E. districts there are extensive formations of Lower Silurian rocks; and in the valleys of the St Peter's and Mississippi magnesian limestone forms the basis of many of the bluffs. Extending from the centre eastward to Lake Superior is a narrow band of new red sandstone, and on the shores of the lake are alternations of metamorphic schists, slates, and sandstones, with volcanic grits and other bedded traps and porphyries, intersected by basaltic and greenstone dykes, with occasional deposits of red clay, marls, and drift. The Missouri through its whole course in Minnesota appears to flow through cretaceous rocks, which are bordered on the E. by tertiary formations. The mineral resources of the country are as yet little known. Iron and coal exist in the southern parts, but it is not supposed that either are very widely diffused. Copper and lead have also been found, the latter on the Waraju River, and the former in masses having the appearance of having been carried by the action of water. Salt is abundant in the N.W. The most remarkable mineral, however, is the red clay, from which the Indians manufactured pipes, and which is believed to be peculiar to the region of the Coteau des Prairies.

The winters of Minnesota, especially in its northern and western sections, are extremely severe; but owing to the great stillness of the air, the coldest weather in winter is endurable. At Pembina settlement, under the 49th parallel of latitude, the cold is frequently so intense as to freeze mercury. The mean temperature of the month of January 1847 was 12½° below zero, and the greatest cold 48° below zero. The hottest day in the month of July was 96°, showing a range of 144° between the greatest heat and the greatest cold. From the 17th of June to the 17th of July 1848 the mean temperature was 69°. The weather nearer the lake is milder, and of course the climate in the south yields to the influence of the latitude. The rivers are frozen over early in November, and generally remain close to the middle of April. On the whole the climate is dry; and while the early winters prove unfavourable to the ripening of Indian corn, the steady cold, and the dryness of the atmosphere, are favourable to wheat and other winter grains.

The soil varies greatly in different parts. In the valleys of the rivers it is mostly excellent, especially those of the St Peter's, and of the Mississippi and its tributaries in the S.E. of the territory. Above the Falls of St Anthony, with the exception of the river alluvions and some prairie land, the country is generally covered with drift, interspersed with marshes too wet for cultivation; but much of the elevated portion is often of tolerable fertility, though inferior to the calcareous land of the river bottoms, and not unfrequently covered with dwarf timber. The country on the Red River, however, is excellent, and equal in soil to the best bottom lands of Illinois, producing fine crops of grain, fruit, &c. Wild rice, berries of various kinds, plums, wild grapes, and the crab-apple, are indigenous. According to the census of 1850, there were only 5035 acres of land under cultivation, producing 1401 bushels of wheat, 125 of rye, 16,725 of Indian corn, 30,582 of oats, 10,002 of peas and beans, 21,145 of potatoes, 200 of sweet potatoes, 1216 of barley, 515 of buckwheat, 2019 tons of hay, 85 lb. of wool, 2950 lb. of maple sugar, 80 lb. of bees' wax and honey. Value of live stock, L.18,575; of market produce, L.31; and of slaughtered animals, L.570. Parts of Minnesota are densely covered with pine forests, though it cannot be said to be a well wooded country. According to Professor Owen, a belt of forest crosses the territory in Lat. 44. 30. On the Rum, St Croix, and Pine Rivers, there are extensive forests of pine. The ridges of the drift districts are usually covered with small pine, birch, maple, ash, elm, fir, and poplar. In the swamps between the ridges the tamarisk and cypress are found; while the river bottoms furnish a good growth of oak, ash, linden, elm, walnut, maple, &c. Wild animals abound. Vast herds of buffalo, elk, deer, antelope, and other game, roam over the western plains, and occasionally the grizzly bear is met with. The black bear, wolverine, otter, mink, musk-rat, wolf, and raccoon abound; and over the prairies grouse, pheasants, and partridges are plentiful. The golden and bald-headed eagle are occasionally met with, and many kinds of water-fowl are common.

Previous to the organization of the state of Wisconsin, all that part of Minnesota lying on the E. side of the Mississippi River had been included in the territory of Wisconsin; and all the portion W. of that river had been included in the territory of Iowa. By the act of Congress 3d March 1849, Minnesota was erected into a territory.

The government comprises a governor appointed by the president of the United States for four years, a Council of 9 members elected in districts for two years, and a House of Assembly of 18 members elected for one year. Members of either body must be resident in their districts, and every district is represented according to its population. The suffrage is vested in every white male inhabitant twenty-one years of age, and who has taken an oath to support the constitution. In 1850 Minnesota was divided into nine counties, and had a total population of 6077; of whom 3695 were white males, and 2343 white females; 21 free coloured males, and 18 free coloured females. In 1855 the population of the territory was estimated at 45,000 to 50,000, and the counties had increased to 29. St Paul, the capital, is situated on the left bank of the Mississippi, at the head of the steamboat navigation, 15 miles below the Falls of St Anthony. Pop. (1850), 1338; (1855), estimated at 5000 to 6000.

MINOR, in *Music*. See MUSIC, §§ *Intervals, Scales*.

MINORCA, or MENORCA, the second in size of the Balearic Islands, is situated between 39. 47. and 40. 4. 55. N. Lat., and 3. 48. and 4. 20. E. Long.; 27 miles E.N.E. of Majorca, 140 miles S.E. of Catalonia, the nearest European coast, and 180 miles N. of Bujia in Africa. Its surface is uneven,—flat in the S., and rising irregularly towards the centre, where the mountain named El Toro has an altitude of 5250 feet. Owing thus to want of shelter from mountains, the climate is not so equable as that of Majorca, and it is

exposed in autumn and winter to the violence of the N. winds. This want of shelter also, and the sterility of the soil, are the causes of the scarcity of trees and of the frequent failure of the crops. The surface is rocky, and the soil of very unequal quality; that of the mountains being light, fine, and fertile, and producing regular harvests without much labour or cultivation; while that of the plains is chalky, scanty, and alike unfit for pasture and the plough. Some of the valleys have a good alluvial soil; and where the hills have been terraced, they are cultivated to the summit. The wheat and barley raised in the island are sometimes sufficient for home consumption: rarely is there a surplus. Wine, oil, potatoes, legumes, hemp, and flax are produced in moderate quantities; fruit of all kinds, including melons, pomegranates, figs, and almonds, is abundant. Horned cattle, sheep, goats, &c., are reared, and the island abounds with small game. Stone of various kinds is plentiful; a soft stone, easily quarried, and acquiring hardness by exposure is used for building. In the district of Mercadal and in Mount Santa Agueda are found marbles and porphyry superior to those of Italy. Lead, copper, and iron are said to be abundant, but owing to the scarcity of wood, would not repay the expense of working. There are manufactures of the wool, hemp, and flax of the island; and formerly there was a good deal of boat-building, but, with the exception of agriculture, all branches of industry are in decay.

The coast is deeply indented, especially on the N., with numerous creeks and bays, that of Port Mahon, the capital, being the most considerable; after it come those of Addaya, Fornells, Ciudadela, and Nitja.

Port Mahon is situated on the E. coast, in 39. 52. N. Lat., 4. 20. E. Long., and occupies an eminence on the S. side, and 2 miles from the mouth, of a bay a league in extent. Its lofty position gives it a picturesque appearance, and contributes to its extreme salubrity. The city is of modern construction, and contains some fine public buildings, four churches, two ex-convents, two hospitals, a normal school, and one for higher instruction, with other private schools. The bay forms the finest and most capacious harbour in the Mediterranean, and one of the largest in the world, as a saying of Andrea Doria testifies,—

> "Junio, Julio, Agosto y puerto Mahon,
> Los mejores puertos del Mediterraneo son."

"June, July, August, and Port Mahon are the best harbours of the Mediterranean." On one side stand the fine large lazaretto and the marine arsenal; and on the largest island in the bay is the naval hospital, begun by the English in 1722 and finished in 1795. Of the fort of San Felipe, famous in the history of the island, and once deemed impregnable, no vestige remains since 1805. A road of 29 miles in length, S.E. to N.W., connects Port Mahon, by Alayor, Mercadal, and Ferrerias, with Ciudadela, the second city in the island; this road was constructed in 1713 by Brigadier Kane, to whose memory a marble monument was erected at the first milestone. The surrounding country produces abundant crops of wheat, some barley, excellent cheese, and honey; horned cattle are reared in considerable quantity, and there are fisheries. There are manufactures of tackle, soap, earthenware, &c.; these, together with the commerce, now confined to the coasting trade, are in a state of progressive decay. Pop. (1846) 13,280.

Minorca was taken possession of in 1287 by Alfonso, grandson of Jayme, the conqueror of the Balearic Isles, and continued under Spanish rule till 1708, when Port Mahon was taken by the English under General Stanhope, and the island secured to them by the peace of Utrecht. In 1756 it was invaded by a force of 12,000 French, who, after defeating Admiral Byng, captured Port Mahon. Restored to England in 1769 by the peace of Versailles, the island remained in our possession till 1782, when it was retaken by the Spaniards. Again taken by the English in 1798, it was finally ceded to Spain by the peace of Amiens in 1803.

The Menorquins, especially those of the district of Mahon, who have been under English influence, are an enterprising and industrious, grave, and religious people. The general decay of manufactures and commerce has caused of late years a large emigration, chiefly to the French colony of Algeria, where they prosper. In 1846 the population amounted to 31,443.

MINOS, a king and lawgiver of Crete, was the son of Lycastus, and is sometimes confounded with another Cretan monarch of the same name, who was the son of Jupiter and Europa, and one of the judges in the infernal regions. He married Pasiphaë, the daughter of Sol, and became by her the father of Catreus, Deucalion, Glaucus, Androgeus, Acalle, Xenodice, Ariadne, and Phædra. According to the prevailing legend, he aspired to the vacant throne of Crete on the death of King Asterius. To prove to the people that his claims were favoured by the gods, he asserted that he could obtain from Neptune whatever he might choose to ask. He prayed that the god might send forth a bull from the sea. His prayer was granted, and the crown in consequence was immediately yielded up to him. But since the bull was not sacrificed to Neptune, as Minos had vowed, the god in revenge infected Pasiphaë with a passion for the brute. The queen concealed herself in a wooden cow constructed for the purpose by Dædalus, and thus became the mother of the *Minotaur*. This monster, who had, according to some, the head of a man on the body of a bull, and according to others, the head of a bull on the body of a man, was imprisoned by the king in the famous labyrinth. Minos is said to have been the master of a powerful fleet. With this he wasted the Greek islands of the Ægean, and cleared the neighbouring seas of pirates. He also sailed to Athens, and in revenge for the supposed murder of his son Androgeus, forced the Athenians to send him annually seven youths and seven maidens as food for the Minotaur. His next expedition was made to Sicily in pursuit of Dædalus. There he is reported to have been deceitfully put to death by Cocalus the Sicilian king. The legislative code of Minos is said to have been framed with the advice of Jupiter, and to have been the model of the Spartan lawgiver Lycurgus.

MINSK, a government of Western Russia, between 51. 12. and 55. 50. N. Lat., and 25. 10. and 30. 45. E. Long. It is bounded N. by Witepsk, E. by Mohilev and Tchernigov, S. by Kiev and Volhynia, and W. by Grodno and Wilna. Area 34,467 square miles. The surface is for the most part very flat, except towards the N., where a low chain of hills separates the rivers which flow into the Black Sea from those which flow into the Baltic. The principal rivers of the government are the Düna and the Dnieper; the former constituting the frontier between it and Wilna, and the latter flowing between this government and that of Tchernigov. The principal rivers that join the Düna are the Desna and the Ulla; and the Dnieper receives in this government the Pripetz and the Beresina. Besides these, Minsk is also watered by the Niemen and its tributary the Vilia, both of which take their rise in the government. The northern parts of Minsk are covered with extensive forests, and the soil is there dry, and in many places sandy; but the southern regions are marshy, and the country is generally inundated in the spring time, so as to present the appearance of a large lake. Although the soil is generally poor and sterile, there are nevertheless some fertile tracts. Agriculture forms the chief employment of the inhabitants, and the produce is more than sufficient for the consumption of the inhabitants. Rye is

the sort of corn grown in the greatest quantity, but barley, oats, and wheat are also produced. Flax and hemp are grown in great abundance. The inhabitants are also employed in cutting timber in the forests, and conveying it down the rivers. Cattle and sheep are reared in large numbers, but they are generally of inferior breed, and the wool of the sheep is very coarse. The country abounds in deer, wolves, bears, wild boars, foxes, and other sorts of game; and the rivers are well stocked with fish, but the quantity got is not equal to the demand, so that large supplies are imported from other parts. The principal manufactures are weaving and distilling, but these are not carried on to any great extent. The trade also is far from extensive, and is chiefly in the hands of foreigners; the chief articles of exportation being timber, flax, hemp, corn, honey, cattle, &c. The inhabitants belong for the most part to the Greek Church, but there are also many Roman Catholics and some Protestants; and the towns and villages are principally occupied by Jews. Pop. (1850) 1,067,000.

Minsk, the capital of the above government, is situated on the Swistocz, a tributary of the Beresina, 154 miles E.N.E. of Grodno; Lat. 53. 40. N., Long. 27. 40. E. The town is irregularly built, with narrow and dirty streets; but it contains some good public buildings, among which are a cathedral, an abbey, and a theatre, besides several handsome palaces belonging to the nobility. It is the seat of the government of the province, and of a Greek archbishop and Roman Catholic bishop; and has manufactures of cloth, hats, and leather, as well as a considerable trade. Pop. (1851) 25,352.

MINSTREL, an ancient term applied equally to a singer and an instrumental performer, derived from the French *menestral*, and not used in this country before the Norman Conquest. Our old monkish historians, in speaking of this class, characterize them by the epithet *mimus*, *histrio*, *joculator*, or some other word which implies gesticulation. Hence it would seem that the minstrels, occasionally at least, set off their singing by mimicry or action, uniting the powers of melody, poetry, and dancing. According to Percy, "the minstrels were an order of men in the middle ages who subsisted by the arts of poetry and music, and sang to the harp verses composed by themselves or others." The Teutonic races generally, and especially the Danes, had been accustomed to hold men of this profession in the highest reverence. Their skill was considered as something divine, their persons were deemed sacred, their attendance was solicited by kings, and they were everywhere loaded with honours and rewards. In short, poets and their art were held in that rude admiration which is ever shown by an ignorant people towards such as greatly excel them in intellectual accomplishments. When the Saxons were converted to Christianity, in proportion as letters prevailed amongst them, this rude admiration began to subside, and poets were no longer a peculiar class or profession. The poet and the minstrel became two persons. Poetry was cultivated by men of letters indiscriminately, and many of the most popular rhymes were composed amidst the leisure and retirement of monasteries. But the minstrels continued to be a distinct order of men, and obtained their livelihood by singing verses to the harp at the houses of the great. There they were hospitably and respectfully received, and retained many of the honours conferred upon their predecessors, the bards and the scalds. Although some of them only recited the compositions of others, many of them still composed songs themselves, and all of them could probably invent a few stanzas upon occasion. There is no doubt that most of the old heroic ballads were produced by this order of men. Although some of the longer metrical romances might come from the pen of the monks or others, yet the shorter narratives were probably composed by the minstrels who sung them. From the striking variations which occur in different copies of these old pieces, it is evident that they made no scruple to alter one another's productions, and the reciter added or omitted whole stanzas, according to his own fancy or convenience.

That in the early ages this profession was held in great reverence amongst the northern tribes is curiously illustrated by incidents recorded of several Saxon and Danish princes (of whom the most noted are Alfred the Great among the Saxons, and Anlaff among the Danes), who assumed the disguise of gleemen, and chaunted to the harp, while they successfully explored the camp of the enemy.

From the Conquest downwards, through long ages in England, the profession of the minstrel was a popular and privileged one. There was no period, however, immediately subsequent to the Conquest, in which this entertaining class met with so much royal patronage as during the reign of Richard I. This brilliant Crusader, himself an adept in the minstrel's art, invited to his court, according to Hoveden, many minstrels and troubadours ("*cantores et joculatores*") from France, whom he loaded with honours and rewards, such as arms, clothes, horses, and money. And the well-known story of Richard's favourite minstrel, Blondell de Nesle, discovering his master by singing a French chanson under the walls of the German castle in which royalty lay imprisoned, if more popular than well authenticated, possesses at least the merit of recording symbolically the traditional devotion of the royal minstrel to his art. It appears from a passage in a letter of Hugh, Bishop of Coventry, that the superior officers of Richard's court had also learnt to patronize these "Jestours that tellen tales;" for William, Bishop of Coventry, chancellor to the king, brought over French minstrels, and loaded them with handsome presents, to sing the praise of *Cœur de Lion* in the public streets.

We occasionally find the *minstrels* and *jestours*, or reciters of *jestes* (gestes) or tales, named separately, as in a prologue of Nassyngton; but they for the most part belonged to the same class. The minstrels were also sometimes distinguished from the *harpers*. "In the year 1374," says Warton (*Hist. of Eng. Poet.*, vol. ii., p. 369), "six minstrels, accompanied with four harpers, on the anniversary of Alwyne the bishop, *performed* their *minstrelsies* at dinner in the hall of the convent of St Swithin at Winchester, and during supper sung the same *gest*, or tale, in the great arched chamber of the prior."

The instances of regard shown to minstrels during subsequent reigns are very abundant. Edward II. rewarded his minstrel William de Morle, known as "Roi de North," with certain houses in the vill of Pontefract, which had previously belonged to the degraded minstrel John de Boteler, called "Roi Brunard." We find from Rymer, in his *Fœdera*, that in 1415, when Henry V. was on his voyage to France, he was accompanied by eighteen minstrels, who were to receive twelve pence a day each. Indeed, the minstrels were often in those days more amply paid than the clergy. "In this age, as in more enlightened times," says Warton (vol. ii. 309), "the people loved better to be pleased than instructed. During many of the years of the reign of Henry VI., particularly in the year 1430, at the annual feast of the fraternity of the Holie Crosse at Abingdon, a town in Berkshire, twelve priests each received four pence for singing a dirge; and the same number of minstrels were rewarded each with two shillings and four pence, beside diet and horse meat. Some of these minstrels came only from Maydenhithe or Maidenhead, a town at no great distance in the same county. In the year 1441 eight priests were hired from Coventry to assist in celebrating a yearly obit in the church of the neighbouring priory of Maxtoke; as were six minstrels, called *mimi*, belonging to the family of Lord Clinton, who lived in the

adjoining castle of Maxtoke, to sing, harp, and play in the hall of the monastery, during the extraordinary refection allowed to the monks on that anniversary. Two shillings were given to the priests and four to the minstrels; and the latter are said to have supped in *camera picta*, or the painted chamber of the convent, with the sub-prior, on which occasion the chamberlain furnished eight massy tapers of wax."

So late as the reign of Henry VIII. these reciters of verses found free access into all companies; into the mansion of the noble as well as into the plebeian tavern. Yet they were gradually sinking into contempt and neglect, and were seldom called upon to furnish a specimen of their venerable art, except when some royal or other great personage condescended on some public occasion to smile benignantly upon the rude pastimes of their ancestors. It should not be forgotten, however, that the genuine minstrel was now seldom to be found in England; that, indeed, the name had become so far degraded as popularly to denote a mere musician. So singular a phenomenon had a veritable minstrel become in the reign of Queen Elizabeth, that when that august personage was entertained at Kenilworth Castle in 1575 by the performance of one of those ancient singers, his appearance and dress excited so much wonder among the spectators, that old Laneham felt called upon to transfer to his book the *Princely Pleasures of Kenilworth*, a provokingly minute description of the person, dress, and adornments of this extraordinary man of the harp. After describing this "squire minstrel of Middlesex," from his "fair kembed," "finely smoothed" head, to his feet, which were encased in "a pair of pumps; not new, indeed, yet cleanly blackt with soot, and shining like a shoeing horn," the author says,—"After three lowlie coursiez, he cleered his voice with a hem and a reach, and spat out withal, wiped his lips with the hollo of his hand, for fyling his napkin, temper'd a string or two with his wreast, and, after warbling on his harp for a prelude, came foorth with a sollem song, warranted for stoory oout of King Arthurz acts."

Towards the end of the sixteenth century this class of men had lost all credit, and were sunk so low in the public opinion, that in the thirty-ninth year of Elizabeth a statute was passed, by which "minstrels," wandering abroad, were included amongst "rogues, vagabonds, and sturdy beggars," and were adjudged to be punished as such.

(For valuable information respecting the minstrel's character and poetry, see Wright's *Biographia Literaria Britannica*, Anglo-Saxon Period, pp. 3-7; with illustrations from the early Anglo-Saxon poem of *Beowulph*.)

MINT. See Coinage.

MINUCIUS, Felix. See Felix.

MINUET, a very graceful kind of dance, consisting of a coupee, a high step, and a balance. It begins with a beat, and its motion is triple.

The invention of the minuet seems to be generally ascribed to the French, and particularly to the inhabitants of the province of Poitou. The word is said by Ménage and Furetière to be derived from the French *menue* or *menu*, small or little, and in strictness to signify a small space. The melody of this dance consists of two strains, which, from being repeated, are called *reprises*, each having eight or more bars, but never an odd number. The measure consists of three crotchets in a bar, and is thus marked $\frac{3}{4}$, though it is commonly performed in the time $\frac{3}{8}$. Walther speaks of a minuet in Lully's opera of *Roland*, each strain of which contains ten bars, the sectional number being 5; a circumstance which renders it very difficult to be danced. Modern instrumental composers have introduced into their symphonies and quartets, &c., minuets of a rapid movement and fanciful character, and which are followed by trios in a different style.

MIÖSEN, a lake of Norway, in the province of Christiania, and 36 miles N.E. of that town, has a length of 55 miles, and a breadth at the widest part of 12 miles. It is fed by the large river Lougen, which has a length of 130 miles, and falls into the lake at the village of Lillehammer. The surrounding scenery is very fine, the banks, which rise gradually from the surface of the water, being covered with forests and pastures. A steamer plies upon the lake; and a railway is projected from Christiania to its southern extremity. In 1755, at the time of the great earthquake at Lisbon, the waters of Lake Miösen were much agitated, rose suddenly to the height of 20 feet, and then as suddenly subsided.

MIRABAUD, Jean-Baptiste de, a French writer, was born at Paris in 1675. His intercourse with La Fontaine was the means of inducing him to abandon the military profession which he had adopted, and to devote himself to literature. To obtain greater facility for study, he entered the Congregation of the Oratory. His French translation of Tasso's *Gerusalemme Liberata*, in 2 vols. 12mo, Paris, 1724, first introduced him to notice. The French Academy recognised his merit by admitting him soon afterwards among their number, and by electing him in 1742 their perpetual secretary. He died in 1760. The other works of Mirabaud are a translation of Ariosto's *Orlando Furioso*, in 4 vols. 12mo, Paris, 1758; *Alphabet de la Fée Gracieuse* 12mo, Paris, 1734; *Opinions des Anciens sur les Juifs*, 12mo, 1769; *Le Monde, son Origine et son Antiquité*, 8vo, Amsterdam, 1751; and *Sentiments des Philosophes sur la Nature de l'Ame*, inserted in the collection entitled *Nouvelles Libertés de Penser*, 12mo, Amsterdam, 1743. The atheistical work of Baron d'Holbach, entitled *Système de la Nature*, was published under Mirabaud's name.

MIRABEAU, Gabriel Honoré de Riquetti, *Comte de*, was born at his father's chateau of Bignon, between Sens and Nemours, March 9, 1749. He seemed destined from his entrance into the world to excite perplexity and wonder. "Don't be afraid!" said the nurse, as she presented to his father a huge-headed infant already armed with a pair of grinders, one foot twisted, and tongue-tied. His calamities began early: at the age of three his remarkable face was seamed and disfigured by confluent small-pox, mismanaged through the impatient anxiety of his mother. "Your nephew," wrote the Marquis to his brother the Bailli, "is as ugly as the nephew of Satan." Still uglier in the eyes of the pedantic Friend of Men was the exuberant activity of the boy. At four years old he was incessantly burrowing among books and papers; all Paris talked of his precocity,—the "marmot" had all at once become waggish, very inquisitive, and very troublesome. The Marquis's bulletins regarding him varied with his humour. At one time he "promises to be a very fine subject," though "turbulent, yet mild and easily controlled;" he shows a "high heart under the jacket of a babe, a strange instinct of pride—noble nevertheless—the embryo of a dishevelled bully, that would swallow all creation before he is twelve years old;" possesses "an intelligence, a memory, and a capacity that strike, amaze, and terrify." At another time he is "a type quite unparalleled of baseness, absolute senselessness, and the quality of the dirty rough caterpillar, that will never uncrust itself;" he is "a nothing set off with trifles, who will throw dust in the eyes of gossips, but will never be but the fourth part of a man, if, perchance, he be anything;" "an almost ungovernable maniac, possessing all the vile qualities of the maternal stock;" and so on. The Marquis's feelings towards his too promising child would, in fact, notwithstanding his eccentricity, be quite inexplicable, did we not know what evil influence reigned at the family hearth. The Marchioness had retired, on the death of her father in 1757, to his estates in Limousin; during her absence a certain

Swiss lady, by name De Pailly, came to reside at Bignon, and the Marchioness returned no more. This bird of ill omen carried discord and misery into the peaceful house of Mirabeau, thenceforth divided against itself. Keeping in view, then, the influences amid which Mirabeau was trained, and the tyrannous pertinacity with which they were directed to his ruin, the wonder is, to find this excitable and headstrong being pass through it all so little injured; to see him still reverentially kissing the rod that had smitten so unjustly and so sorely; still nourishing in his wild and lacerated heart that "unutterable tenderness," that generosity, that love of virtue, which even "so much scoria" could not obscure.

At length it was evident that Gabriel had become too strong for his mild tutor M. Poisson, and he was put under the care of M. Sigrais, a retired officer, and friend of the family; but, to the annoyance of the Marquis, the new governor became quite "fascinated" by his pupil, and gave far too flattering an account of him. A severer discipline was ordained; and in June 1764 young Mirabeau, now fifteen years old, was placed with the Abbé Choquard, who kept a military school at Paris. The Abbé was instructed not to spare the rod; and a more grievous than bodily punishment was administered in his being entered under the fictitious name of Pierre Buffière. Choquard soon reported very favourably; his pupil studied passionately, and with prodigious success, classics, modern languages, mathematics (under Lagrange), drawing, music, &c. An unfortunate discovery checked this hopeful progress. The Marchioness had been "secretly sending money to that reprobate;" Gabriel was absolutely forbidden to correspond with any member of his family; and at the suggestion of the enemy, it was resolved to remove him. On the 19th July 1767 he was entered as a volunteer into the Berri regiment of cavalry, commanded by the Marquis of Lambert, a man notorious for severity. He was accompanied by a man named Grévin, an auxiliary of Madame de Pailly, duly authorized by the Marquis to "watch and denounce" M. Buffière. Despite this vile espionage and the extreme harshness of discipline, the fiery youth behaved so well as to extort some expressions of satisfaction even from his father. The sunshine was brief, however; nature took her way in spite of the *furca*. The Marquis, whose errors of judgment and heart were as remarkable as his genuine sagacity and kindness, seemed to think that pocket-money was a sinful luxury even for the heir of all the Mirabeaus. That the young soldier, then, contracted "a few debts" will not be surprising; that being inexperienced in gaming, to which he never was inclined, he lost 40 louis at play, will admit of palliation; that he, still farther, took leave to fall in love with a pretty maiden of Saintes, and even to win her heart, will not shock the most lofty moralist. Unhappily, however, the close conjunction of these discoveries was coupled with other aggravating facts:—the ugly young subaltern had outrivalled his colonel; stung by insults and oppression, he had fled to Paris to complain to his friend the Duke of Nivernois; when brought back to his regiment and confronted with his superiors and accusers, he had energetically defended himself;—all which, to the stern eye of the Friend of Men, afforded conclusive proof that his son was a "sink of vice," fit only to be securely hedged within four stone walls,—nay, perhaps to be more effectually got rid of under the burning heat and pestilential vapours of Surinam. On second thoughts, the anxious parent (who at this very time was intensely occupied in the establishment of public ovens for economical baking) decided on the less barbarous alternative, and the young Count was duly lodged in the fortress of the Isle of Rhé, there to soothe his chafed spirit with the wintry roar of the Bay of Biscay.

The bailli of Aulan, governor of the castle, had strict injunctions to allow his prisoner no manner of liberty; and the spy Grévin, whom the unsuspecting youth had begged as a favour to have with him, fulfilled his base office admirably. But in vain: not many days had passed before the "terrible gift of familiarity," the frank and fascinating warmth of the prisoner, had made a captive of his gaoler, who presently became his intercessor, and recommended his release. The French expedition to Corsica against the native patriots offered an eligible opening for a troublesome "monster:" Mirabeau received a second lieutenant's commission in the Legion of Lorraine under the brave Baron de Vioménil; and on the 16th April 1769 embarked for Corsica. During a year of active and harassing service he distinguished himself by his courage, ability, and industry, winning the esteem and confidence of his superiors and even some qualified approbation from the Friend of Men. On his return he was permitted to go and kiss his uncle's hand at Mirabeau: the honour of beholding the paternal countenance was as yet too much to grant. The Bailli was delighted with his nephew, and sounded his praises day after day. "I think I never encountered so much wit; it quite absorbed my poor brains—quite astounded me; he would cast the very devil into the shade. "Still better, this brilliant youth showed "a feeling heart," and the grave Abbé de Castagny was ready to cry when he exclaimed to him in a transport—"Alas, that my father would deign to know me; I know he thinks I have a bad heart, but let him only try me!" To these affecting relations the iron Marquis responds very cautiously; he is glad to hear them, but will take his own way; there is no necessity for throwing off restraint too soon with a fellow whose "head is a wind and fire mill;" he never approved of "fathers and sons being hail-fellow-well-met." From a distance he condescends to direct and mould the mind of the too aimless and romantic youth: there must be no more reveries, literary or military—no more voyagings in the planets; he must set himself steadily to the study of the paternal science; otherwise he will be a laughing-stock, and disgrace his father.

These repeated advices were unfortunately quite thrown away on *M. le Comte Ouragan*, who, so far from aspiring to the apostleship of political economy, could see nothing in the whole system but radical falsehood and barren pedantry. This blasphemous opinion was never hazarded in his father's presence, but easily found its way to his ears, with such result as may be imagined. The young Count had strong leanings towards a military life. "It is in battle only," he said, "that I am cool, calm, and lively without impetuosity. I then feel myself grow taller." The Friend of Men, however, was determined to throw cold water on his son's "smoke and military fire:" "does he think I have money to get him up battles like Harlequin and Scaramouch?" He must "become rural;" must be well crammed in the *Economics* and *Ephémérides*. Rural, accordingly, the young man did for a time become, active employment being for him a necessity of nature; and in surveys of the Mirabeau estate, and plans for all kinds of improvements, he found abundant occupation, working "like a galley slave." The Bailli was charmed by his nephew's energy and industry, and gently pressed his brother to relax a little. "You will find," he said, "as I do, that the furnace is hot,—very hot; but, my dear brother, let us bear in mind his age, and the brimstone peculiar to our blood. It is well that he should be within reach of being known; for, being perfectly open to reason, he listens to nothing else, and finds it a frightful task to submit to any other human restraints." At length the Friend of Men gave in; and received his son with what he called "tenderness." A course of lecturing followed, with the best effect; and shortly after the young Count was permitted to assume his proper title. A severe famine, attended by much misery and disorder, soon gave occasion for a display of his wonder-

ful power of dealing with men. He exerted himself from morning to night, found work and food for the people, and cheered them by his vivacious example, working with them and presiding at the head of the common table. His father had planned a court of rural arbitration for the settlement of the disputes which abounded in the district, but despaired of getting it established. Not so his son. By dint of energy and tact, frankness and persuasion, he "reconciled everybody," and set the new institution agoing with success. "In one word," said the Marquis, "*he is the demon of the impossible.*" As the reward of his good conduct, the Marquis allowed him, in the spring of 1771, to visit Paris. There, as elsewhere, the young Count took everybody by storm, astonishing even the old stagers of Versailles. In the summer he was sent back to Limousin, the "black lady" becoming jealous of the good understanding between father and son. Happily his mission prospered, and a still more difficult and even dangerous errand to the Mirabeau estate was crowned with like success.

His prospects, at their brightest, now began to be clouded. The Marquis, separated from his son, and restored to De Pailly influence, soon relapsed into his old mood, listening to all ill reports, and doing well, as he thought, to be eternally angry. The perpetuation of the name and honours of the Riquetti lineage was with him at all times a fixed idea, amounting to a kind of mania, and to get his fatiguing "wolf-cub" off his hands there seemed no better device than marriage. After some looking about in the market, it was decided that an alliance with the rich Marquis of Marignane was highly eligible. His only daughter, Marie Emilie de Covet, was eighteen years of age, small, plain-featured, and dark-complexioned; but she had fine eyes and hair, a gay and amiable though weak disposition, and "great expectations." Her the young Count consented to woo; but richer rivals were in the field. His overtures were rejected, and he at once drew off. Spurred on, however, by the taunts of his father, he again entered the lists, determined to carry all before him, and he succeeded. His matchless powers of persuasion conquered not only the young lady, but "all the female relations, both old and young;" and on the 22nd June 1772 she became his wife. The income assigned to the young pair was far short of the original bargain, and utterly inadequate to maintain their position in society. Mirabeau was already in debt, and the bridal arrangements had been made regardless of expense. No wonder, then, if the exchequer soon ran empty. Help from the Friend of Men being out of the question, Mirabeau appealed to his father-in-law, who offered to lend him 60,000 livres if his father approved. A peremptory refusal, backed by threats, was the reply; and Mirabeau, now driven into a corner, retired from Aix to his patrimonial castle. Here, however, his thoughtless magnificence of taste, and his passion for improvements, brought matters to a crisis. The Marquis, ever ready to believe the worst, adopted his infallible resource, a *lettre de cachet*, and Mirabeau was forced to retire, an interdicted exile, to the small neighbouring town of Manosque. In this banishment he lived more than a year, during the course of which his wife bore him a son. Here also, warm from the study of Tacitus and Rousseau, he gave the first vent, in an *Essay on Despotism*, to that fiery hatred of oppression which was the ruling impulse of his life. Though full of haste and imperfections, its merits are as conspicuous as its faults.

And now came the chivalrous offence which led to new and deeper woes. That reckless ride of 20 leagues, to save a foolish young chevalier from matrimonial shipwreck—that fatal meeting on the highway with the aristocratic bully who had insulted his sister and refused satisfaction—that incontinent hiding of the noble recreant on the spot—who has not sympathized with? The whipped Baron instituted criminal proceedings; sentence was delayed for two years; but a less tardy vengeance had been decreed by the inexorable Marquis; and on the 23d of August 1774 Mirabeau was caged in the gloomy fortress of If, perched on a barren rock near the entrance of the port of Marseilles. A friend had provided the means of escape, and urged him to fly, but he submitted obediently to the paternal mandate. The governor was instructed to use the utmost severity, and bar all communication with the world; and to add to the prisoner's sorrows, his wife, who had retired to her father's residence, declined to join him. They never met again. But no restrictions could prevail against that winning frankness and buoyancy which vanquished every heart of man or woman that ever came under their influence; and as usual the governor became his friend and intercessor. As usual, also, the prisoner was busy with his pen, and composed during this confinement the interesting sketch of the family history prefixed to his Memoirs.

In vain did his wife and family pray for his release, and the commandant Dallègre bear testimony to his irreproachable patience and resignation. The Friend of Men had his own plans; and on the 25th May 1775 the prisoner was removed (passive as before, though armed, and with but a single keeper) to a still drearier lodging, the castle of Joux, far up among the snow and clouds of the Jura Mountains. In this "owl's nest, enlivened by a few invalids," Mirabeau at first abandoned himself to solitary gloom. His keeper, the Count of St Mauris, was not a person to sweeten his solitude; but he permitted the prisoner occasionally to visit the neighbouring town of Pontarlier. Here Mirabeau was introduced to the only noble family in the place, that of the Marquis de Monnier. This wealthy and aged seigneur had, four years before, in revenge for the marriage of his daughter against his consent, taken to wife (or, properly speaking, bought) the daughter of M. de Ruffey, a Burgundian law dignitary. His years were seventy-one—hers eighteen; his character and habits were reserved and ungenial,—she was beautiful, ardent, and high-spirited. But home was dreary, and the choice lay between the old man and a convent. So early sacrificed to parental avarice and senile revenge, her gloomy life at length suddenly irradiated by the light of genius and kindred sensibility, the result was inevitable. For some time Mirabeau endeavoured to resist the fatal attraction that now drew him to Pontarlier. He avoided the society of Madame de Monnier, and wrote to his wife, passionately urging her to come and share his confinement and strengthen his resolve. In reply he received "a few cold lines," in which his gay little wife, otherwise occupied, gently insinuated that he had lost his senses. What wonder that the Riquetti flesh and blood took their way,—that the desolate prisoner continued to prefer the society of Pontarlier to that of his harsh-grained Cerberus at Joux? Meantime the jealous governor, himself a baffled suitor of Madame de Monnier, found a ready pretext for venting his spite on the prisoner, and Mirabeau learned that aggravated horrors were in store for him. His father, now in the thick of a law-suit with his wife, was "interested in continuing the confinement of the rascal, lest he should come and support his mother." Roused to desperation he escaped, January 16th 1776, into Switzerland, returning, however, in two days to Pontarlier, where he lived concealed. Madame de Monnier, subjected to the most humiliating bondage, at last broke loose and fled to her family at Dijon, Mirabeau following close behind. On the 24th March, she was sent back to Pontarlier, and immediately thereafter Mirabeau surrendered himself to the authorities. He lost no time in appealing to the benevolent Malesherbes. A commission was appointed to examine his case, and reported favourably; but meantime his father pressed for his removal

 to another fortress, and the minister, now on the eve of retirement, could only advise him to go abroad and enter foreign service. Nothing remained but flight; and having got back his parole, he set out for Verrières, thence to Geneva, and back to Lyons. Here he met his sister, Madame de Cabris, accompanied by her "friend" Brianson, a low and worthless adventurer. This foolish sister, for whose sake he had suffered so much, had no better advice to give than that he should escape with Sophie to a foreign country, she and Brianson lending their aid. Distracted, but not yet wholly lost to reason, he chose rather to hide himself for a season in Provence. Forced to fly, he went to Nice, and thence to Turin. Sophie meanwhile, goaded by daily persecution, overwhelmed him with passionate letters. The climax came at length: she tells him that her situation is too terrible to be borne; it must have an end—"Gabriel or death!" Such appeals were hard to resist. But the paternal vengeance was now on his trail; and for nearly two months he was hunted over hill and dale, over ford and ferry, through Nice and Turin, over the Great St Bernard, and down into the Valais. His route had been betrayed by his base companion Brianson, and on the 23d August, as he descended on Verrières, the enemy were only two days' march behind. But they were too late; that night Sophie, dressed in man's attire, crossed the garden wall by a ladder, and flew to Verrières.

On the 7th October they reached Amsterdam. Mirabeau, who had assumed the name of St Mathieu, was now left entirely to his own resources, and at once applied for employment to the booksellers. After waiting for three months, he was at last successful, so far at least as quantity was concerned; he was "overwhelmed with work." Among the books which he partially translated were Mrs Macauley's *History of England*, Watson's *Philip II.*, and some of Gesner's works. Of his original compositions the most important was his *Advice to the Hessians*, an eloquent pamphlet against the Hessian subsidy to Britain for putting down the American revolution. Rest in this quiet haven was not long permitted to the fugitives; their retreat became known in France, and the Marquis de Monnier offered to take back his wife. Mirabeau would listen to no such proposal, and the Marquis instituted a criminal action. On the 10th May 1777 the bailiwick of Pontarlier convicted Mirabeau of "forcible abduction and seduction" (*rapt et vol*), sentencing him to be beheaded (in effigy), with 40,000 livres of damages; while Sophie was condemned to life imprisonment in the Besançon house of correction, with forfeiture of marriage rights and dowry. The parents on both sides were not satisfied with a mere sentence; the police were again unleashed, and on the 14th May their old pursuer, Inspector Brugnières, descended on his prey. Sophie was carried off to a private penitentiary in Paris; Mirabeau to the donjon of Vincennes.

Now at length the unmanageable heir of the Riquettis was tightly fixed under the *furca*, no more to spring up and shoot his arms at his own wild will; straitly trained to a stone wall, he might bring forth the fruits of repentance at his leisure. The Marquis was now satisfied: his son was ruined; but he had brought an heir to the house of Mirabeau, and that was his "chief end" as man. That end having been attained, the future destiny of the criminal was fixed with icy determination. After the usual communion with his "conscience," he resolved on perpetual imprisonment. As to the opinion of the stupid world, what mattered it? He would, so long as health and spirits lasted, "please God, play the part of Rhadamanthus." Thus, then, the door of hope seemed absolutely shut. But hope and effort were never, save for one brief season of utter despair, abandoned by the prisoner. Shut up in a chamber ten feet square, environed in winter by "smoke and ice;" miserably clothed; tormented by failing eyesight, stone, gravel, and blood-spitting; visited only by a turnkey charged to silence; one hour a day for exercise; few books, and these bad; denied the solace of music or any other recreation,—this ruined man battled indomitably with fate, and laboured as industriously as any journeyman in Paris. The extraordinary interest which he inspired in all his keepers won him, even in this stronghold of despair, unwonted privileges. Through the kindness of Lenoir, head of the police, he was permitted to correspond with his mistress, on condition that all letters should pass under the eyes of his confidential assistant, Boucher, and afterwards remain in his keeping. For three and a half years the lovers interchanged their passionate sympathies, their tender reminiscences, their griefs and their hopes. The version of these letters given to the world in 1792, through the unscrupulous greed of Manuel, procureur of the commune, is, according to M. Montigny, neither complete nor faithful; but how far the reckless prurience of the editor may have tampered with the originals, it is neither possible nor important now to determine. Of Mirabeau's other compositions during his confinement, the most important by far was his *Lettres de Cachet and State Prisons*, a work of immense labour, directed with vehement zeal towards a very noble end. His *Espion Dévalisé*, his *Collection of Tales*, his translations of Tibullus, of Boccaccio, and of the *Basia* of Johannes Secundus, are little worth. Of the *Biblion Eroticon* and *Conversion*, judging by report, the less that is said the better. Besides all these, were an elaborate treatise on *Inoculation*, drawn up for the benefit of his own and Sophie's child; translations of Horace, Ovid, Catullus, Propertius, and Tasso's *Aminta*; a general grammar; dramas; treatises on Mythology, on Religious Houses, on Standing Armies, &c.,—all which have been lost. Assuredly, whether well or ill employed, the prisoner was not idle. The idea of escape, save by legitimate means, seems never to have crossed his mind; and he perseveringly pleaded his cause, though without effect. He had been fifteen months in prison when the death of his son, "the last hope of our race," fell like a thunderbolt on the Friend of Men, who began to think himself "an especial object of Heaven's wrath,"—he, who had sounded his "conscience" every day, and "never did, nor wished to do, injury to a human being." In vain, however, was this occasion used to excite relentment. To his brother's timid remonstrances he answers in this truly Rhadamanthine style,—"I have rendered justice in my capacity of natural and domestic judge, and I could see, unmoved by remorse, the mother in the pillory and the son on the gallows tree! I should nevertheless carry my head erect and my bosom bare." The good Bailli still persevered; and the gradual progress of the intercession, as revealed in their correspondence, is one of the most interesting parts of the adopted son's memoirs. His favourite daughter, Madame du Saillant, assiduously aided her uncle; and at length Rhadamanthus announced that, "for his own purpose, as well as ours, he should be liberated after trial." "Our purpose" was the perpetuation of the family: "If my grandson had lived, I should never have swerved from the word I gave to keep the father in prison." The happy day came at last; and on the 13th December 1780, after 42 months of durance, Mirabeau, with scarcely a rag to cover him, strode forth from his dungeon. At the hotel of his brother-in-law the grim portrait of the Marquis looked down on him from the wall; he burst into tears, uttering only the words, 'My poor father!' Here is his first meeting with that father after an interval of nine years:—"I found myself face to face with him one day as I left Desjobert's. His eye was piercing—his appearance strong and healthy. He cast down his eyes, drew to one side as far as he could, and I passed on."

Mirabeau's first work on regaining his liberty was the

 attempt to settle the long warfare of his parents; but the only result of his interference was an irrevocable alienation from his mother's love. She succeeded in her suit, and the report having spread that her defeat was to be the signal for the Marquis's reconciliation to his son, the old man determined to falsify it by receiving him at once. Boucher, the "good angel" of Vincennes, acted as mediator; and on the 20th May 1781, amid the tears of a friendly circle, the prodigal knelt at his father's feet. He spent the next eight months at Bignon, exerting himself to help and please his father, and so successfully, that the old man now found it necessary to defend himself and his prodigal from the mild sarcasms of the Bailli. "A son" he said, "cannot be amputated like an arm." Something told him, in spite of all outward appearances, that his son was "not more dangerous than a stuffed scarecrow; that the sternness with which he has contrived to invest his person, his reputation, and his mighty deeds, is nothing but smoke; and that at bottom there is no man in the kingdom less capable of committing a deliberate act of wickedness." During this period took place that last melancholy interview between Mirabeau and his long-lost Sophie. There had been jealousy and suspicion, now there were reproaches and recriminations; "the anger on both sides passed all reasonable bounds;" and so the lovers parted for ever.

And now Mirabeau girded himself to the great task of "replacing his head on his shoulders,"—getting the Pontarlier sentence reversed. The most able criminal lawyers pronounced the case frightfully complicated. His father and uncle, dismayed by the difficulties, scandal, and expense, proposed to solicit letters of abolition; in other words, to get the sentence quashed by a royal edict. But Mirabeau scorned a remedy which would absolve himself alone; and though Sophie generously urged him to yield, he was peremptory in his resolution to clear both or neither. "Since the days of the late Julius Cæsar," said the old man, "audacity and rashness have never existed in such strength." On the 2d February 1782 he left Bignon, accompanied by an able advocate named Desbirons, who soon, to his surprise and vexation, found his part in the business reduced to that of merely copying and examining documents for his client. Conciliation having been first attempted, with indifferent success, Mirabeau surrendered himself a prisoner at Joux, and a few days after obtained a provisional release. Against this the prosecutor appealed, and the prisoner was remanded. Mirabeau now opened his guns on the enemy, and continued firing till all France resounded with the "Case of the Count of Mirabeau." On the 5th March he appeared at the bar, and for ten hours was confronted with two of the principal witnesses, whom he succeeded in utterly demolishing, though "well crammed," and that touching things that had passed under their own eyes. The Marquis was in high dudgeon: he had "humiliated the witnesses, exasperated the judges, and insulted everybody." The Bailli took a calmer view of the whole business:—"Who, in that infamous Babylon, where everything scandalous in such an affair is soldered, cicatrized, and settled, is not, either by deed or will, guilty of all that is essentially blameable in the conduct of the *Infallible?* It is true that he has given it more *éclat;* but the groundwork of the thing is the same,—adultery, rape, and seduction, supposing him to be guilty of all three, though he is guilty only of one, form the history of almost all men; in his case there is only a noisy publicity in addition." Here was the secret of all the terrible ill-fame of the Count of Mirabeau,—he had dared to break through the trammels of fashionable decorum, doing openly and bravely what it was "proper" to hush and veil under the polite forms of a corrupt society; and that society, irritated and alarmed at the exposure, shuddered, not at the crime, but at the monstrous courage that justified it unabashedly in the face of day. Such a sin was, and ever has been, unpardonable.

Mirabeau's appeal for release was rejected; and three days after, he appealed the whole case to the Grand Chamber. His father sent his son-in-law, the Count du Saillant, to negotiate a compromise, but the undaunted prisoner would hear of none. He had reserved his heaviest artillery to the last, and now discharged his *Third Case* into the besieging camp. The prosecutor, Sombarde, who had throughout displayed the most indecent animosity, was within the prohibited degree of relationship to the accuser, and on this ground Mirabeau founded a most withering philippic. "If this," said he, with his sublime self-esteem, "be not eloquence unknown to these slavish times, I know not what that gift of heaven is, so seducing and so rare!" The enemy's fire was fairly silenced; and, after some delay and quarrelling, the matter was finally settled on the 14th August, Mirabeau getting his own terms, and satisfactorily proving his father's admission, that he was "in extreme cases very superior to a wise man." The Pontarlier sentence was reversed, the Marquis and Marchioness de Monnier separated, her dowry returned, and a conditional annuity of 12,000 francs a year settled on her. Having thus triumphantly replaced his head on his shoulders, the freed prisoner remained four days at Pontarlier, and exhibited himself in all public places for the benefit of his old friend Count St Mauris, or any other gentleman who might wish to speak with him, feeling, as he told his sister, "sadly in want of being run through the body."

The Friend of Men, while granting a qualified approbation to these proceedings, was as tough as ever on the subject of money; and in this melancholy predicament Mirabeau, having some MSS. to dispose of, retired for two or three months to Neufchâtel. Here, in spite of private woes, his public spirit found vent in a long and eloquent letter to the Count de Vergennes, showing the injuries inflicted on the Genevese republic by the intervention of France in favour of aristocracy. Meantime his sister pleaded for his return, and the Marquis requested the Bailli to receive him. He endeavoured to make the reception as ceremonious as possible, but quite failed; the cordiality of his nephew was too infectious, and the enthusiasm of the peasantry, "though he was in debt to some of them," passed all bounds. It was now time for Mirabeau to set about his second great task,—a reconciliation with his wife. The obstacles seemed insurmountable; she was passive in the hands of her exasperated father, and Mirabeau's letters were at first answered coldly, then with insults, and finally sent back unopened. The Bailli seconded his nephew's endeavours, while the Marquis held disdainfully aloof. He had no wish "to throw himself at the feet of that troop of play-actors[1] to beg for posterity;" it was time to stop that universal question, "Shall we never hear anything else but about that unruly race of the Mirabeaus?" All means of conciliation being exhausted, proceedings began in form, and on the 20th March 1783 the case came on for hearing at Aix. The court was crowded to excess; on the one side were the Marquis of Marignane, surrounded by a host of friends and advocates; on the other Mirabeau appeared with but three companions, and these three Englishmen, no Frenchman daring to stand by him. Two young advocates had lent him their assistance, but he pleaded his own cause. Restraining his usual vehemence as suited the line of defence, he spoke with great gentleness and moderation, with moving softness and dignity. Old Marignane at first sneered and tittered; as the speaker proceeded he bent his

[1] We are informed, on the Bailli's authority, that the Countess "acted plays and received the news of her husband's condemnation to death on a stage erected over the remains of her child."

head, and at last he wept, as did half the audience. The pleading closed amid a tumult of enthusiasm, and Mirabeau's demand for a provisional reunion was sustained; but this temporary triumph only heightened the bitterness and activity of the enemy. The case came for final hearing before the Grand Chamber of Aix. On three several days Mirabeau pleaded before intensely excited audiences. On the final day the sensation reached its climax. Despite police and barricades, all doors and lobbies were stormed, and the very roofs of the neighbouring houses swarmed with human beings eager to catch even the distant hum of the pleader's voice.[1] So far as the public was concerned the triumph was complete; but one-half of the judge were relatives of Marignane! In proof of his kindness to his spouse, Mirabeau had quoted a letter dated May 28, 1774, proving his forgiveness in the case of a grave *faux pas*. This point was eagerly caught at by the public prosecutor as a ground for nullifying the husband's claim to cohabitation, and on it the whole case was made to turn. On the 5th July the chamber decreed a separation of body and goods, a sentence which was received with hisses by the angry public. The popular sympathy was some consolation to the defeated husband, and in due time bore fruit; he had made himself "the idol of the whole country." He resolved to appeal to the Court of Cassation at Paris; but the indefatigable intrigues of the enemy, and his own recklessness, defeated his efforts. A new *Case*, issued by him at Lyons, was suppressed by the keeper of the seals, whom he vainly attempted to enlighten on the subject of civil liberty; an appeal to the king was equally fruitless. As a parting shot, he republished his *Case* in Belgium, appending a sarcastic account of his interview with the seal-keeper; and, foreseeing troubles, made sail for England, accompanied by his fair friend Madame de Nehra.

His fortunes were now at their lowest ebb, and for the next five years his life was one of perpetual strait and struggle, of wandering and embarrassment, of hand-to-mouth expedients and reckless improvidence, of incessant and vehement activity, of headlong controversy, and of evil reputation—but a life still of high endurance, of patriotic zeal, of unconquerable independence. In England he resided eight months, of which some record is preserved in a collection of letters written during that period. He was, of course, an acute, and, for a foreigner, an unusually fair observer of the national peculiarities. In his wrestlings with despotism he had often turned an eye of respect and longing towards Britain, and now he was able to see the practical working of that constitution which, in spite of defects and anomalies, seemed to him the best pattern for other nations to follow who had their own to rebuild. Among his most intimate friends were Romilly, Sir Gilbert Elliott (afterwards Lord Minto), and the Earl of Peterborough; and despite his formidable fame, he had access to "good society," in both senses of the term. As usual, he was full of great literary schemes; but the English publishers were not easily caught by flaming prospectuses. He wrote much, but published only ***Considerations on the Order of Cincinnatus***, a bulky volume, spun out from a thin pamphlet by an American, on a subject no longer interesting; and ***Doubts on the Freedom of the Scheldt***—a defence of the Dutch monopoly against the designs of the Emperor Joseph II. At the end of seven months he sent out Madame de Nehra from the ark to spy the aspect of things abroad, and soon after followed her, reaching Paris on the 1st April 1785.

He now meditated a retirement to Provence for the composition of some great undefined work of history, but the illness of his (so-called) adopted son detained him in Paris, and his thoughts soon turned into a new channel. Intimacy with the Genevese exile Clavière, and his compatriot the banker Panchaud, directed his attention to the subject of finance, into the mazes of which he plunged with characteristic energy. The stock-jobbing fury was at this time at a climax in France, and Mirabeau determined to attack the hydra. At three of its principal heads were his thrusts directed,—the Bank of Discount, the Bank of St Charles, and the Paris Water Company. Between the months of May and December he issued five large pamphlets on these topics. His Genevese friends supplied the raw material; the arguments, the eloquence, the vituperation, were all his own. A rapid fall in the shares showed that his blows had told; and the rage and hostility excited were as the rousing of a nest of hornets. The new minister at first countenanced him, but having got into deep waters, soon found it expedient to shake off his fiery ally; and two of Mirabeau's pamphlets, one of which M. Calonne had himself revised, were successively suppressed. The attack on the Water Company was answered by the witty author of ***Figaro*** with a delicately cutting irony, to which Mirabeau, now in Brussels, replied with a vehemence of invective redeemed only by the utmost magnificence of style.

At the close of 1785 he left Brussels with a vague design of visiting the north of Europe, but once beyond the Rhine he felt strongly drawn towards Berlin, where the great Frederick, now scant of breath, but as fresh in head and fiery in temper as ever, was nearing the end of his long life-march. The king had ceased to receive foreigners; but to the general surprise, and the special chagrin of all the French residents, he twice gave audience to the doubtful stranger, whom his sharp eye had already noted as one fit to speak in the gate with kings. Mirabeau's first work on arriving was a long and bitter letter to M. Calonne, justifying himself against the minister; but his friends in Paris, to whom he sent it for revision, wisely refrained from publication. He worked incessantly at Berlin, but published only a pamphlet on Cagliostro and Lavater, castigating the impudent quackery of the one and the more honest but fanatical reveries of the other. About this time, also, he composed one of his best productions, published in the following year,—an Essay on Moses Mendelssohn and the Jews, in which he advocates principles of toleration not yet carried out towards the ancient people. At the end of four months he returned to Paris, and in a few weeks he was on his way back, commissioned as a secret agent to the Prussian court. On the day after the great Frederick's death he addressed his successor in a long and eloquent letter, replete with very noble counsel, delivered with such dignified frankness as rarely finds way to royal ears. His correspondence, and the accumulation of materials for a great work on the Prussian monarchy, occupied him constantly during six months. Two causes moved him to return to Paris: he had grown weary of his underhand employment, and wished a more honourable and acknowledged position. He had received the tidings, too, of the convocation of the Notables, and was in hopes of being appointed their secretary, having been the first to suggest the measure. In this hope he was disappointed; and, unsheathing his pen, within three weeks he wrote and published his ***Denunciation of Stock-jobbing***. In this slashing pamphlet he commenced his assaults on Necker's financial measures, which he followed up with blow upon blow most perseveringly, most courageously, but also with most in-

[1] Here is the Marquis's version of the affair:—"My poor brother writes to me that his nephew spoke and pleaded from a quarter past 8 till 1 o'clock without spitting or blowing his nose. But I tell you that this posthumous Cicero is nothing more than an incorrigible clack-jaw and a fool." On the same severe authority we learn, that the opposite counsel, the celebrated Portalis, got such a dressing, that he was "borne fainting out of the Court," and kept his bed for days, a victory unparalleled in the annals of the long robe.

Mirabeau. temperate personality. The *Denunciation* had great success, and even the king acknowledged that Mirabeau had done the state good service. It was suppressed, nevertheless; and the denouncer received warning of a seventeenth *lettre de cachet* in readiness for him. He took refuge in Liège; and on the 24th May he set out towards Berlin for the purpose of completing his book. He remained three months at Brunswick with his friend and helper Major Mauvillon, encouraged in his labours by the Duke, through whom he obtained the King of Prussia's authority to consult state papers. The book appeared a year after in 8 vols. 8vo (and 4 vols. 4to). It was by far the most important and elaborate work he had yet produced, and greatly enhanced his reputation as a writer. His excellent coadjutor, to whom the credit of the composition was often attributed, has warmly disclaimed any right of paternity,—any merit save that of a most industrious and faithful Gibeonite.

At the close of September he returned to Paris, and was greatly shocked by the state of public affairs. The Parliament of Paris had just been banished to Troyes by Brienne, and things were daily looking worse. Advances were made to him by that crafty minister, but they were firmly declined. He was determined to preserve his independence till the fit hour came. While avowing his desire for active employment, he would remain in his obscurity "until there succeeds to the present confusion a regular order of things—until some great revolution, whether good or evil, command a good citizen, always accountable for his suffrage, and even for his talents, to raise his voice. That revolution cannot tarry long." The day after the refusal of the Parliament to register the enormous loan of 420 millions, he wrote to M. de Montmorin, showing in impassioned terms the fatal tendency of events, the wisdom of timely concessions, and the necessity of announcing the States General. But the curse of eyes that saw not, and ears that would not hear, had visited the rulers of France. They still hoped to do without the States General; and finding the Parliament obstructive, Mirabeau was strongly urged to write against it. The answer was noble from a man steeped to the lips in poverty, and with nothing to lose save the consciousness of independence: "Do not compromise a zealous servant who, when the time comes to devote himself to his country, will count the danger as nothing, but who, for all the thrones in the world, will never prostitute his name in support of an equivocal cause, where the end is uncertain, the principle doubtful, and the course dark and bodeful." In the summer of 1788, his friends Romilly and Dumont visited Paris. Mirabeau's character, the latter tells us, was "in the lowest possible state of degradation." Feared and suspected, the proud ruined aristocrat lived like an Ishmaelite—too well known but ignored, too honest to be bought, too poor to be courted. His old friends were afraid to compromise themselves by renewing the acquaintance, but they could not resist him; he took them by storm; and Dumont ere long was delighted and proud to hew wood and carry water for his gigantic friend.[1] Soon after this, doubtless under the pressure of sheer penury, he committed the grievous folly and wrong of publishing, under the title of *Secret History of the Cabinet of Berlin*, his confidential letters to the French ministry. This scandalous publication excited intense wrath against the author, and was ordered to be burned by the hands of the executioner.

At length the hour struck, long wished for, long delayed. On the 8th August 1788 De Brienne announced the convocation of the States General for the 1st of May 1789; and Mirabeau was up and doing. At length, out of the depths of darkness and humiliation, there broke upon him the light of day—the vision of a new and great arena, of victories and triumphs for his country and for himself. Now he would purge away the shame of the past in the glory of the future; France was to be saved, and saved by him! In January 1789 he took wing for Provence, launching, before his departure, another furious tirade against Necker, at that moment the idol of France. He presented himself for election to the nobility of Provence,—"the most ignorant, greedy, and insolent body of nobles" he had ever seen,—opposing them all single-handed in the discussions as to the mode of election, and drawing down upon himself their implacable hostility and rage. In reply to their attacks, he published a pamphlet literally blazing with indignant eloquence. "Generous friends of the peace!" he exclaims, "I do here appeal to your honour, and summon you to declare what expressions of mine are wanting in the respect due to the royal authority or to the nation's rights! Nobles of Provence, Europe is attentive; weigh well your reply! Priests of the living God, beware; God hears you! But if you maintain silence, if you entrench yourselves behind the vague declamations you have hurled at me, then suffer me to add one word:—In all countries, in all ages, the aristocrats have implacably persecuted the people's friends; and if, by some strange combination of fortune, such an one have arisen from among themselves, him above all have they struck at, eager to inspire terror by the choice of their victim. Thus perished the last of the Gracchi by the hand of the patricians; but struck with the mortal blow, he flung dust towards heaven, calling to witness the avenging deities, and from that dust sprang Marius—Marius, less great for having exterminated the Cimbri than for having overthrown in Rome the tyranny of the noblesse!" At the next meeting it was decreed that Mirabeau, having no fiefs of his own, had no right to sit in the Assembly; and the proud tribune, casting the dust from his feet, now threw himself into the arms of the Plebs. The story of his having, to win their favour, opened a clothiery shop at Marseilles, is too absurd for belief, had it even rested on good authority. Mirabeau needed no such devices to ingratiate himself with the enthusiastic Provençaux: he was already adored by them. His reception at Aix was triumphant beyond parallel. The whole country turned out; the air rang with *vivats*, with the thunder of cannon, and the pealing of bells; there were processions by day and illuminations at night. At Marseilles the enthusiasm was equal, and on the day of his departure he was escorted by "a hundred and twenty thousand" people and a retinue of three hundred carriages. At both cities famine, riot, and disorganization soon called for an exhibition of his magical faculty for subduing and pacifying the most formidable elements. Shortly after he was elected deputy both for Aix and Marseilles: on consideration he decided to sit for Aix.

At this point Mirabeau's history mingles with that of France. Into the remaining twenty-four months of his life were crowded events and labours fit for many years—labours that finally cut short the thread of a life in more senses than one too fast for human strength. Raised, as soon as prejudice had been conquered by his personal influence and the urgency of affairs, to indisputable supremacy in the Assembly, his aims throughout corresponded with his first professions. "*War with the privileged and with privileges*," that was his motto: "*To crush the ministerial despotism and relieve the royal authority*," that was

[1] This excellent man, whose *Recollections of Mirabeau* contain a good deal of striking truth and some very graphic pictures, with much confusion, vague reminiscence, and doubtful statements, amusingly describes his own feelings:—"When I worked for Mirabeau I seemed to feel the pleasure of an obscure individual who had changed his children at nurse, and introduced them into a great family: he would be obliged to respect them, although he was their father."

his aim. He soon found that the wreck of despotism was dragging with it the throne, that the blows which shook the one were undermining the other; and when he saw the very existence of the monarchy at stake he placed himself single-handed in the breach—too late, indeed, for his own fame and the good of his country. That he loved the breath of popular applause is true; that he scorned and braved the fierce *ardor civium*, when conscious of right, is not less so. His haughty soul may have inly spurned the many-headed monster which he had helped to loose. But let it not be denied him that he truly loved the People and battled for their rights, and as truly loved and battled for the Crown. How to reconcile these two—herein was his difficulty; a difficulty that might well have entangled and foiled a spirit less compassed with infirmity, an ambition more severely regulated than belonged to him. But that he basely pandered to the rage of a faction, and then sold himself in secret to the enemy with whom he professed to war—this is a view of his character that must be left to those whose special pleasure it is to lower our estimate of human nature, and who ever choose the worst hypothesis to account for what is dubious or abnormal in the conduct of men raised above their fellows.

On the 4th of May 1789 the national deputies marched in procession from Versailles to Nôtre Dame, amid the feverish expectation of all Paris and all France. Of the 600 members of the third estate, one alone attracted every eye. Among others who crowded the balconies of Versailles was Madame de Staël, who thus vividly pictures what she saw:—"You could not but look long on this man when once you had observed him. His immense black head of hair distinguished him among them all; you would have said his force depended on it like that of Samson; his face borrowed new expression from its very ugliness. His whole person gave you the idea of an irregular power, but a power such as you would figure in a tribune of the people." On his first appearance in the Assembly his name was greeted with murmurs; before many weeks had passed he swayed it at his will. He had already arranged for the publication of a *Journal of the States General*. Being free in its sarcasms, on Necker in particular, it was suppressed after the second number; but Mirabeau continued to enlighten the public in *Letters to his Constituents*, soon after converted into the *Courier of Provence*, under which name the journal went on long after he had ceased to have any concern in it. In this work he secured, with his usual marvellous power, the services of zealous coadjutors,—Dumont, Duroverai, Reybaz, and others. These assisted him also in the preparation of his speeches; and if Dumont speaks truly, he did not scruple to deliver orations wholly composed by other hands.[1] At first he spoke seldom, till he felt his way. He very soon discerned the dangerous and destructive temper of the Assembly; and while the question of the verification of powers was obstructing progress, he communicated his fears to the government through Malouet, a friend of Necker, urging them to be wise in time, and concluding with this offer:—"If they have a plan, and that plan be reasonable, I shall defend it." Unfortunately they had no reasonable plan. A meeting indeed took place between Mirabeau and Necker, but the severely respectable minister received the scandalous Count with chilling coldness and reserve. Mirabeau left him in indignation, saying, "I will go to him no more, but he shall hear of me!"

On the 23d of June occurred the memorable De Brézé scene, the turning-point of the Revolution. From that day Mirabeau was felt to be the foremost man, the ruling spirit of the Assembly. He was greatly moved at not having been warned beforehand of the intentions of the court. "It is thus," he said, "that kings are led to the scaffold." On the 11th of July the old Marquis died at Argenteuil, having lived to rejoice unstintedly in the triumphs of his son. Mirabeau, though urged by his friends to offer himself as a candidate for the mayoralty of Paris, with good prospect of success, hastened to attend to his father's obsequies, and for three days, days of terrible commotion, he mingled little in public business. Bertrand de Moleville, searching for the cause of this silence, attributes it to "profound intentions!" The truth is, that Mirabeau viewed with deep horror the frantic excesses of the populace, and in his letters to his constituents openly expressed his belief that "the continuance of popular dictation would expose the public liberty more than the plots of its enemies." "Too often," he added, "danger rallies absolute rule; and in the midst of anarchy a despot may even seem a saviour:" words prophetically true. On the 1st of September, in the face of fierce opposition and popular excitement, he spoke in favour of the King's absolute veto. On the 24th he defended the income tax of his enemy Necker, believing it necessary for the public salvation. "The force," says Dumont, "with which he presented so commonplace a subject was miraculous; he elevated it to sublimity. They who heard this speech will never forget it. From that day Mirabeau was considered as a being superior to other men: he had no rival. There were indeed other orators, but he alone was eloquent."

The suspicions of his complicity in the tumults of the 5th and 6th October, and of conspiring with the Duke of Orleans, have been utterly refuted by the testimony alike of friends and enemies. As has more than once been said, he never had any "party;" his only party was "his head." On the 6th November he opposed with all his energy the insidious motion against a deputy's being minister, or *vice versa*. His defeat on this occasion deeply wounded him; for the words "no deputy," he bitterly said, it might be as well to substitute "no deputy of the name of Mirabeau!"

Towards the close of the following spring appear to have begun his communications with the court, through the medium of his friend the Count de Lamarck. For a considerable time he had been comparatively silent, viewing the proceedings of the Assembly with a kind of sorrowful anger and disdain. In reply to the overtures made, he gave a full statement of his views in a letter dated May 10, 1790. He declares his invincible repugnance to enter on a new part, if he were not convinced that the restoration of the King's legitimate authority is the only means of saving France. He sees the nation daily drifting into anarchy, and he is "indignant at the bare idea of having contributed only to a vast demolition." He engages to serve the King with all his influence, but is as "utterly opposed to a counter-revolution" as he has been to the excesses already committed. He requires two months to collect his forces and arrange his plans; his conduct must not be judged by single speeches or acts; he promises finally to the King "loyalty, zeal, activity, courage,—everything but success." In conformity with this programme, he at once commenced operations, and established an agency throughout the kingdom for conveying intelligence and furthering his designs. That, in consideration of these services, in which Mirabeau really acted the part of an unrecognised prime minister, a few of his debts were paid from the civil list, and a monthly pension assigned him, which there is ground for supposing never to have been regularly drawn, are facts known to the world. How far they establish the charge of venality must be left to individual judgment; this at least is certain, that he in-

[1] Dumont, while doing his own best to strip Mirabeau of "his borrowed plumes," confesses that "Mirabeau had certainly a right to consider himself the parent of all these productions, because he presided at their birth, and without his indefatigable activity they would never have seen the light." He is speaking of other works, but the application holds good for all.

curred large expenses in the interest of the King, and that he died insolvent. Those who incline to the more favourable view of his conduct will see some force in the saying ascribed to himself,—"A man like me might *accept* 100,000 crowns, but I am not to be *bought* for that sum."[1] Be that as it may, from this time Mirabeau's whole strength was bent on the salvation of the monarchy. On the 20th May he supported the King's right to declare war or peace in a long and masterly oration. Great efforts were made to intimidate him; hawkers went bawling through the streets of Paris, "*Grande Trahison du Comte de Mirabeau!*" and the very tree was marked on which he was to hang. On the morning of the 22d the avenues leading to the Salle de Manège were thronged with angry crowds. His friends entreated him not to venture out, but his courage was of the kind that danger stimulates. "I know it well enough," he said, "I must come hence to-day triumphant or piecemeal!" Triumphant he did come.

About the end of May took place his celebrated interview with the Queen. What had passed between them none ever knew, save that the Queen was delighted with Mirabeau, and he with her. But neither Queen nor court thoroughly or sincerely co-operated in the great schemes of Mirabeau; they had their own little schemes, ever varying with the feelings and changes of the hour. On the 30th December he addressed a long memorial to the Queen, expounding in detail his plans, and offering advices,—plans and advices far too wise and simple to be followed, though perseveringly urged up to the time of his death.

On the 1st Feb. 1791 he took his place as President of the Assembly, a distinction hitherto withheld through envy, and now yielded in the hope of lessening his influence by compelling him into silence. A foolish miscalculation; there, racked by internal pains, his neck swathed in linen to stanch the blood of leech-bites, administered between the sittings, his life consuming fiercely as it neared the close, the great tribune, never so great as now, sat and swayed the elements that raged around him. "Never," says Dumont, "had this office been so well filled. He displayed in it a new kind of talent. He introduced a degree of order and clearness into the proceedings of which no member had previously the least conception. He simplified forms, could render the question clear by a single word, and also by a single word put down tumult."

The end was approaching; for many weeks he had felt that his life-blood was being drained. Confident in his great strength, he had never slackened his pace, never stinted his labours or his indulgences. "Had I not lived with Mirabeau," says Dumont, "I never should have known all that can be done in one day, or rather in an interval of twelve hours. A day to him was more than a week or a month to others. The mass of business he carried on simultaneously was prodigious; from the conception to the execution not a moment was lost." And now, added to frightful anxiety, toil, and excitement, came fever, ophthalmia, rheumatic swellings, and fiery pains. "If I believed in slow poisons," he said to Dumont, "I should think myself poisoned; for I feel that I am dying by inches—that I am being consumed in a slow fire." But there was no rest for him: on the Sundays, indeed, he was down at Argenteuil, among his flowers; on all other days "not an instant of rest from seven in the morning till ten or eleven at night; continual conversations, agitations of mind, and excitement of every passion; too high living,—in food only, for he was very moderate in drink." On the 27th of March, though frightfully ill, he proceeded to the Assembly, where he spoke five times; he left it exhausted, and had a bath; thought he could sit out the Italian opera, but had to go homeward after a few minutes to bed, to rise no more. His friend and physician Cabanis found death written on his face. The sensation throughout Paris was indescribable; all day the Chausée d'Antin was thronged with sad inquirers; bulletins were handed out every three hours to the eager multitudes, and messengers from the King came twice a day for tidings. All medicines were tried in vain, and Cabanis sat despondingly by the bed-side. "Thou art a great physician," said his patient, gazing on him, "but the Maker of the wind that overthrows all things,—of the water that penetrates and fructifies,—of the fire that quickens or decomposes all things,—He is a greater physician than thou!" Even in the intervals of convulsive agony, with the sweat of death on his brow, and its shadows gathering around him, his supreme self-consciousness never forsook him; he was himself to the end. "He dramatized his death," said Talleyrand. His friend Frochot supported his head. "Yes," said the sick man, "support that head; would I could bequeath it thee!" At daybreak of the 2d April his windows were opened to let in the fresh breath of spring. He called Cabanis: "My friend," he said, "I shall die to-day; there remains but one thing more to do; perfume me, crown me with flowers, environ me with music, so that I may enter sweetly on that sleep from which there is no awaking." For three-quarters of an hour he discoursed with Lamarck and Cabanis on his own and the public affairs. "I carry in my heart," he said, "the dirge of the monarchy; its remains will now be the spoil of the factious." Towards night he was speechless, and in his dreadful pain he signed convulsively for drink; he waved the offered potions away, and hastily put down the words "*Dormir!*" He prayed for opium, but the doctor resisted; recovering utterance, he reproached his friend for hesitating to cut short his agony. For some time he lay silent, till the sound of distant guns broke upon his ear, and he asked—"Have we already the Achilles funeral?" A moment after, he had ceased to breathe.

So passed away, at the age of forty-two, the last Count of Mirabeau. Amid the tears of the French nation, with honours never before paid to any citizen, seldom to any king, his body was laid in the church of St Geneviève, the newly-consecrated Pantheon of France. Thence it was removed at the dead of night, in September 1794, to the churchyard of St Catherine, in the Faubourg St Marceau, the resting-place of criminals.

The memoirs of Mirabeau by his adopted son, M. Lucas Montigny (Paris, 1836, 8 tom. 8vo), are as yet, in spite of grievous defects, the most valuable source of information on the subject. Of innumerable briefer productions, there is but one demanding special notice,—the inimitable essay of Mr Carlyle. (A. N.)

[1] "I imagine," Dumont shrewdly observes, "that in this kind of reputation Mirabeau has paid the usury of some offences to others. Exaggeration is the first penalty inflicted by the code of public opinion. He was so fully aware that if he had enjoyed personal consideration, all France would have been at his feet, that there were moments when he would have consented to pass 'seven times through the heated furnace' to purify the name of Mirabeau. I have seen him weep with grief, and heard him say, almost suffocated with sobs, 'I am cruelly expiating the errors of my youth!'"

MIRABEAU, *Victor Riquetti, Marquis de*, the father of the great Mirabeau, and one of the most eminent teachers of the doctrines of the Economists in France, was born at Perthuis on the 5th of October 1715. He was the heir of an ancient Italian family of the name of Arrighetti, afterwards corrupted into Riquetti, who had been expelled from Florence during some civil broil in 1267, and had found a refuge and a home in Provence. His ancestors had bequeathed to him a lawless, stormy, and imperious temperament, that sought its proper element in some all-engrossing action or in the prosecution of some arduous project. This restless energy first found vent in the pursuit of war. He entered the army at an early age, fought bravely at the sieges of Kehl and Philipsburg, at the battles of Dettingen and Clusen; and won the Cross of St Louis in 1743. By this time his father had died, and had left him an independent fortune. The new Marquis now appeared in the character of a complete aristocrat, swelling with hereditary importance, stiff with haughty affectation, and enveloped in an atmosphere of contemptuous indifference, which was ever liable to be dispersed by storms of lurking passion. Quitting the army, he married the Marquise de Saulvebeuf, and taking up his abode in the old family castle of Mirabeau, on the banks of the Durance, he thought to lead on his tenantry to his ideal standard of improvement, to exact from them in return the most reverential respect, and to reign a despotic sovereign on his own estate. But all his ardent and benevolent exertions could not bend his stiff-necked peasantry into that pliability of submission upon which his imperious soul was so intent. He therefore abandoned his hereditary castle for ever, and settled in his newly-bought estate of Bignon, about 15 miles from Paris. Here his restless mind found a new crotchet in the political economy of Quesnay. Becoming a thorough-going disciple of that philosopher, he commenced to advocate his peculiar views in a work entitled *Ami des Hommes*, and in several other books and tracts. The only prominent result was, that he was lodged for some time in the Bastile. Nevertheless, on his release he continued pertinaciously to write on, indulging in strange and whimsical speculations, entangling his thoughts in hopelessly-complicated sentences, venting his pent-up passion in covert satire and bursts of eloquence, and sinning against all good taste by his egotisms, mannerisms, and forced metaphors. At the same time his whole parental authority was kept perpetually on the strain in endeavouring to mould his rising family into a conformity with his own educational theory. But the young Mirabeaus, rigid with the self-will of their race, could not be bent by the paternal efforts, persistent though they were. The result was an endless series of domestic broils, waxing hotter and hotter. The employment of confidential servants exasperated the turmoil, and the introduction into the household of an artful Swiss lady, Madame Pailly, brought it to a crisis. The wronged wife abandoned for ever the home in which she had lived for fifteen years. It was shortly after this that the Marquis directed the full torrent of his educational fury against his eldest surviving boy, Gabriel Honoré, and began that merciless system of tutorage which, however well meant, only resulted in bringing into play the wild irregularities of his great son's character. After the boarding-school and the army had failed to tame the fiery young spirit, the exasperated father did not hesitate to employ harsh imprisonment. Then his eye was ever on the watch to detect any attempts to escape from the imposed punishment, and his hand was always ready to thrust his culprit into severer bondage, if occasion required. He even thought upon banishment to the unhealthy climate of Surinam as an ultimate cure. At the same time the Marquis was instituting a series of law-suits against his wife, which made him the subject of the gossip and scandal of the entire country. He was also ruling the rest of his children with a rod of iron, and was issuing against them numerous *lettres de cachet*. Once, it is said, he held his entire family under confinement, and sat alone by his household hearth in stubborn resignation, consoling himself with his political economy. Yet, like all his other projects, this project of subduing his family proved impracticable. The law-suits, after lasting for fifteen years, were decided against him to the almost utter ruin of his fortune. His son Gabriel Honoré turned out to be the most daring despiser of those very conventionalities which he had been so long forcing him to respect. The rest of his children went their own several ways in spite of him. These disappointments seem to have combined with advancing old age to soften down the asperities of the Marquis's character. His imperious temper became subdued into a perverse censoriousness. His philanthropy assumed the more definite form of a morality, grim, austere, and pompous, as became the nature of the man. He called his children together, was reconciled to them, and declared himself only fit now for sitting in the chimney-nook, and "patching his brains together again." Yet scarcely had he ceased from his lifelong and ineffectual struggles, when the aggrandizement of his family name,—that object at which he had so long aimed,—was suddenly achieved by a stroke of destiny. The French revolution opened up for his gifted son a path to the highest influence and renown. The hereditary pride of the old Marquis was at length gratified. He died on the 13th July 1789, when the name of Mirabeau had already become famous throughout Europe.

MIRACLES. A miracle is usually defined to be a suspension of the laws of nature, or a deviation from the uniform manner in which God exercises his power throughout the created world, or from the uniform method in which second causes operate and produce their effects. It follows that a miracle cannot be performed by human power. It is necessary, however, to distinguish between the *negative* and the *positive* element in miracles. A phenomenon is miraculous in the former sense when it is simply inexplicable by any known laws; but in the latter sense inexplicable events require to bear upon the interests of religion, as distinctive signs, in order to be considered miraculous. In the negative sense, a real deviation from ordinary phenomena may be admitted without necessitating an acquiescence in miracles in the positive and religious sense. Not a few phenomena in physical science are possessed of this negative element of miracles without being considered miraculous. They exhibit the character of a *prodigium*, or *τέρας*, without being what the religious miracle always is, a *σημεῖον*, or sign by which the Divine power is made known. It is in the latter sense that miracles are regarded here.

The person who professes to have received a revelation from God to be communicated to his fellow-men is bound to produce his credentials, in order that they may know that he is not either a deceiver or deceived. They have a right, and it is their duty, to demand sufficient evidence that his revelation is really from God before they place entire confidence in its truth and Divine authority. The working of a miracle will furnish incontestable proof that his statement is true. If an effect be produced which cannot be referred to the operation of natural laws, we at once recognise it as the act of Him who is the God of nature, and who alone can suspend its laws and produce effects in another way. If, therefore, a miracle be wrought by one who claims to be the bearer of a Divine revelation, we are warranted to conclude that his claims are well founded, and that God speaks by him. Man indeed is so constituted that he must draw this conclusion; for, "to try the theorem upon a simple case," after the example of Paley, if any man in the possession of his senses were to witness the performance of a miracle,—the restoration, for example, of sight to the blind, or the raising of the dead,—under circum-

stances which satisfied him that there could be no deception or mistake, he would, without doubt, believe that he who wrought the miracle was the messenger of God, and spoke God's truth. The evidence of supernatural and Divine interposition in this way would be irresistible. Jesus himself has given his sanction to this reasoning, for He expressly suspends the authority of his doctrines, and his claims to man's belief, on the fact of his miracles: "The works that I do in my Father's name, they bear witness of me," &c. He repeated in the presence of the messengers of John the Baptist many of his most wonderful works: He healed the sick, cleansed the lepers, restored sight to the blind, raised the dead, and then dismissed them with this injunction,—"Go your way, and tell John what things ye have seen and heard." These miracles were proofs both of Divine power and of Divine goodness. They are works of a nature far superior to those which the uniform experience of mankind has taught us to consider as lying within the range of human power,—works, in short, which no man could do unless God were with him. At his word the storm was hushed into a calm, the deaf heard, the dumb spake, and the dead were raised to life; at his touch diseases fled, the blind saw, the lame walked, and the lepers were cleansed. His miracles were not only above the reach of human power, but they were benevolent in their motives and eminently useful in their effects. They tended in every instance to alleviate suffering and wretchedness, or to teach an important moral or doctrinal lesson. The benevolent tendency, therefore, of these miracles, as well as their wonderful character—the combination in them of might and mercy—proved that they were of God. They were performed by Christ for the express purpose of proving his claims to a Divine commission, and were constantly appealed to by Him as signs and seals of that commission,—as proofs of the truth of the system of doctrines and moral precepts which He taught. And it is obvious, that unless the doctrines which Jesus promulgated had received the Divine approbation, these miracles could not have been performed. Nicodemus gave expression to the instinctive feeling of human nature when he said to Jesus, "We know that thou art a teacher come from God, for no man can do those miracles that thou doest except God be with him" (John iii. 2).

A similar inference must of course be drawn from the miracles performed by the Apostles and Evangelists. Their works, like Christ's, were beyond the unassisted powers of man. Like Him, too, they appealed to these miraculous works as the credentials of their Divine commission. They affirmed "that the things which they taught, God had revealed to them by his Spirit."

But were these miracles actually performed? What evidence is there that these alleged miraculous works are not, as Strauss and his followers affirm, a collection of myths, or, as others say, mere illusions.[1] First of all, these miracles, if they were either illusions or frauds, were imposed alike on friend and foe, and triumphed over not only the strongest prejudices, but the deepest enmity. They were publicly performed in open day before multitudes of inveterate enemies, who had every motive to induce them keenly to scrutinize the evidence, and to detect and expose the deception, if the miracle was not genuine. We are expressly informed that the Pharisees narrowly examined into the reality of a miracle performed by Jesus on a man that was born blind; and we may be sure that they must have done so in the case of other miracles also. Prejudice, self-interest, and malignant hatred of Christ, must have made them eager to detect any falsehood or fraud in his conduct, if such had existed; and yet they were constrained to acknowledge with the Sanhedrim, in the case of the cure wrought by Peter and John on the lame man who sat at the gate of the temple, "that indeed a notable miracle had been done, and they could not deny it." Modern infidels deny the reality of the miracles related in the New Testament; but the ancient infidels who lived on the spot at the time, and were eye-witnesses of the events, were compelled to admit their miraculous character, though they ascribed them to the agency of evil demons. This acknowledgment by unbelieving Jews and pagans of the reality of the miracles of Christ and his apostles, shows that the evidence for them, after the strictest hostile scrutiny, was undeniable.[2]

Secondly, The miraculous facts of the gospel history are proved by the testimony of the Apostles and Evangelists, who have narrated what they saw and heard. They were not only competent, but also unprejudiced and disinterested witnesses; not only had they no prepossession to mislead their judgments and bias their minds in favour of the claims of Jesus of Nazareth, and no interest to serve by falsifying or misrepresenting what they had heard or seen, but they had many deep-rooted prejudices to overcome in embracing the religion of Christ, and many powerful motives to induce them to "resist even the evidence of their senses, and stifle the very firmest convictions of their mind." Like the rest of their countrymen, they entertained most erroneous notions respecting the character and office of the expected Messiah; and it was not till some time after the resurrection and ascension of Christ, that the pleasing dream of temporal grandeur which had captivated their minds was completely dispelled, and they became thoroughly convinced that their Master's kingdom "is not of this world." The witnesses of Christ's miracles, therefore, had none of the motives which usually influence human conduct to induce them to become his followers or to bear testimony in his behalf. On the contrary, they were solicited by the united ties of nature, of habit, of education, and of interest, to reject the claims of a religion which disappointed all their early associations and prejudices, all their favourite hopes and schemes. So that it is impossible to account for their conduct on any rational principle, except that they were fully convinced of the truth of what they declared, and "could not but speak the things which they had seen and heard."

Thirdly, the credit given to their testimony, and the

[1] The absurdities of the theory propounded by Paulus of Heidelberg, that the disciples of Christ mistook natural phenomena for supernatural occurrences, have been thus forcibly exposed by Quinet:—"The pen which wrote the *Provincial Letters* would be necessary to lay bare the strange consequences of this theology. According to its conclusion, the tree of good and evil was nothing but a venomous plant, probably a manchineel tree, under which our first parents fell asleep. The shining face of Moses on the heights of Mount Sinai was the natural result of electricity; the vision of Zechariah was effected by the smoke of the chandeliers in the temple; the Magian kings, with their offerings of myrrh, of gold, and of incense, were three wandering merchants who brought some glittering tinsel for the Child of Bethlehem; the star which went before them, a servant bearing a flambeau; the angels in the scene of the temptation, a caravan traversing the desert, laden with provisions; the two angels in the tomb, clothed in white linen, an illusion caused by a linen garment; the Transfiguration, a storm." (*Voice of the Churches*, by Dr Beard.)

[2] "But some people may say that the ancient Jews and pagans, who so readily believed in magical arts and the power of demons, must have been very weak and credulous men, and that therefore they may have given credit to tales of miracles without making any careful inquiry. Now there is, indeed, no doubt that they were weak and credulous; but this weakness and credulity would never have led them to believe what was against their early prejudices, and expectations, and wishes: quite the contrary. The more weak and credulous any man is, the harder it is to convince him of anything that is opposite to his habits of thought and inclination. He will readily receive without proof anything that falls in with his prejudices; and will be disposed to hold out against any evidence that goes against them." (Whately's *Introductory Lessons on Christian Evidences*.)

consequent establishment and propagation of Christianity, can be accounted for only on the supposition that the miracles were really performed. Indeed, the Apostles, so far from commanding belief, would never have obtained even a hearing among the wealthy, refined, and proud inhabitants of the great Roman and Grecian cities, if they had not at the outset produced their credentials, and roused men's attention by the display of superhuman powers. The doctrines the Apostles preached were alike obnoxious to Jewish prejudices, destructive of Jewish hopes, and offensive to Grecian pride. To the one class they were "a stumbling-block," and to the other "foolishness." Their converts had to make a total revolution in their whole habits,—to incur the loss of all things, often of life itself,—to encounter foes in their own household,—to be separated from all they held dear in life,—to suffer ridicule, and contempt, and calumny, and violent persecution. And yet in a few years this mere handful of obscure and illiterate Jews induced vast multitudes of all ranks, and of different races and nations, to renounce the religion of their ancestors and to embrace the faith of Jesus of Nazareth. On the supposition that the miracles to which they appealed in confirmation of their statements were spurious, this is altogether unaccountable, and indeed incredible. The difficulty, therefore, as Whately remarks, of believing that the Christian religion was propagated by means of miracles, is nothing in comparison with the difficulty of believing that it could have been propagated without any. In the well-chosen words of Butler, "the miracles are a satisfactory account of the events of which no other satisfactory account can be given, nor any account at all, but what is imaginary merely and invented."

We are met, however, by the oft-repeated assertion, that a miracle is an impossibility, and therefore that no amount of evidence can prove that a miracle has been performed. This is the fundamental axiom of Strauss, who acknowledges that if it were not true, he would not think it worth while to attack the credibility of the Scripture history. "No just notion," he remarks, "of the true nature of history is possible without a perception of the inviolability of the chain of second causes, and of the *impossibility of miracles.*" (Strauss's *Life of Jesus*, vol. i., Introduction, sect. 13.) The assumption that miracles are an impossibility is probably the most specious and widely-urged objection to Christianity in our day; and though enunciated with all the pretension of a new discovery, was one of the main arguments of the older infidels, as it is of their modern successors still. The main difference is, that the deists of a former day accounted for the miracles on the supposition of the grossest fraud acting on the grossest credulity; while Strauss and his disciples explain them by the theory of illusion or myth.[1] Strauss seems to regard the assertion as a self-evident truth, for he offers no argument whatever in its support. But it would not be difficult to show that the man who denies the possibility of miracles in any circumstances cannot consistently stop short of atheism. The atheist who repudiates the notion of a distinct and independent Deity, and confounds Him with what is called Nature, may consistently deny the very possibility of a miraculous interposition; but he who believes in the existence of a God must admit that a miracle is at least not impossible. Surely the Being who created the universe can govern it as seems good in his own sight, and He who established what are called the laws of nature is not restrained by an invincible necessity from altering them as He sees fit, but may at his pleasure suspend their operation in any given instance, or introduce amongst them a new cause which will produce a new and different effect. Neander profoundly remarks on this subject:—"Although, from their very nature, miracles transcend the ordinary law of cause and effect, they do not contradict it, inasmuch as nature has been so ordered by Divine wisdom as to admit higher and creative agencies into her sphere, and it is perfectly *natural* that such powers, once admitted, should produce effects beyond the scope of ordinary causes. In the Divine plan of the universe (of whose fulfilment the connection of causes in the visible world manifest only *one side*), miracles stand in relations of reciprocal harmony to events occurring in accordance with natural laws. From the chain of causes involved in that great plan, indeed, no events, natural or supernatural, are excluded; both circles of phenomena belong to the realization of the Divine idea." (*Life of Christ*, b. iv., part 2.)

It is asserted by others, who do not venture to deny the possibility of miracles, that they are so improbable, that if they were wrought, no evidence could establish them. "Miracles are incredible," says Hume, "because they are contrary to experience." "But strictly speaking," as Paley remarks, "a miracle is only contrary to an experience when it is said to have been performed at a time and place, at which time and place, we being present and looking on, perceived no such event to have taken place; and this is a contrariety which no evidence can surmount." But it is preposterous to say that we are entitled to draw the same conclusion in the present instance, and to affirm that the miracles of Christ did not take place, merely because we have never witnessed a like event. Ten thousand of our Lord's Jewish contemporaries might have said that no such event as the raising of Lazarus from the dead ever occurred within their observation or experience, and their testimony might have been quite true; but it would in no way contradict the testimony of the Apostles, who declared that they were present and witnessed the resurrection of their Master's friend. In the same way, the testimony of all the men of the present day, that they have never seen the blind restored to sight or the dead raised to life, does not contradict or invalidate the evidence of those who say they did witness these miraculous interpositions. The truth of the one testimony does not disprove the truth of the other, for both may be true. They differ from, but do not contradict, each other. Experience teaches us that diseases are *generally* cured by the application of

[1] "Myths have been defined as fabulous narratives allegorically describing some physical or moral phenomena, philosophical principles, systems, &c., under the figure of actions performed by certain ideal personages; these allegories having been afterwards, through the mistake of the vulgar, believed as history." (*Historic Doubts*, p. 51.) On this mythical theory Dr Strauss explains the whole of the evangelical history, and affirms that the acts attributed to Christ are to be regarded, not as historic verities, but as allegorical fables, or at least as combining only a very slender portion of facts and truth with an immense mass of fiction and fable. He admits at the same time that strict historic investigations bring this collection of myths within thirty or forty years of the very time in which all the alleged wonders they relate are said to have occurred. According to this theory, Christianity is a system of mythology which originated in one of the most enlightened ages the world has ever seen, while all other mythologies have had their origin in an age of barbarism and of remote antiquity, before the commencement of authentic history. All other mythical systems have been of slow and gradual formation and reception, but the Christian "myths" sprung up at once within a single generation, and were received as historic facts by multitudes who must have been well aware of their recent origin. They originated among a people who expected a Messiah entirely different from Jesus of Nazareth, and were attached with the most intense bigotry to the faith which his gospel proposed to supersede. While other mythologies rarely, if ever, extend beyond the limits of the races which have originated them, Christianity was embraced by thousands of different races and nations, to whom it was most obnoxious on every ground—national, political, religious, and personal. And, finally, this accidental collection of fable and fiction, with a few facts interspersed, in a few years, though unaided by military power, or court authority, or philosophy, or science, triumphed over the prejudices of ignorance and superstition, and the vigilance of scepticism, the policy of government, and every other obstacle. The man who can believe this may believe anything. (*Eclipse of Faith*, 3d edition, pp. 209–212.)

medical remedies; the testimony of the Apostles affirms that they were *sometimes* removed at the mere word or touch of the Saviour; but these facts are not necessarily inconsistent or irreconcileable. "Each fact may arise from its own proper cause, each may exist independently of the other, and each is known by its own proper proof, be it of sense or testimony." (White's *Bampton Lecture*, p. 285.)

If, then, we are told that miracles are incredible because they are contrary to uniform experience, we ask the objector what he means by experience? Does he speak of his own experience and that of his friends and neighbours? Then, on this principle, the Indian prince of whom Hume speaks, who affirmed that there could be no such thing as ice because it was contrary to his experience, was right in rejecting the possibility of such an occurrence. Does he mean the general experience of mankind? If so, his statement is true, but it is nothing to the purpose. Miracles are, from their nature, comparatively of rare occurrence, and being rare, are necessarily at variance with the experience of the greater part of mankind. If they were not, they would, as Paley remarks, be no miracles. Or does the objector mean that miracles are contrary to the uniform experience of all mankind in all ages? This were a mere begging of the question in dispute. He affirms that no one has ever witnessed a miracle, and when challenged to produce his evidence, he merely asserts in effect that nobody has ever witnessed one. Besides, how does the objector know that miracles are contrary to either the general or universal experience of mankind? Of course, by testimony and nothing else. So that, after all, it is on testimony which he derides, and not on experience, that the weight of Hume's argument depends. Farther, the experience of which Hume speaks extends to the mental and spiritual as well as to the physical and material part of nature—to the world of mind no less than to the world of matter. He expressly admits "that there is a uniformity in both the moral and physical world, and that nature does not transgress certain limits in either the one or the other." Again he says,—"We readily and universally acknowledge a uniformity in human motives and actions as well as in the operations of body." And he adduces an argument for the doctrine of "philosophical necessity," drawn entirely from the general uniformity observable in the course of nature with respect to the principles of human conduct, as well as those of the material universe, from which uniformity, he observes, it is that we are enabled in both cases to form our judgments by means of experience; "and if," he adds (*Essays*, p. 85, 8vo, 1817), "we would explode any forgery in history, we cannot make use of a more convincing argument than to prove that the actions ascribed to any person are directly contrary to the course of nature." It is admitted, then, by the objector to miracles that there are moral laws of nature as well as physical, and that the violation of the one, no less than of the other, beyond a certain point, is to be regarded as a miracle. Let us apply this admission to the present case. Here we have a considerable number of individuals declaring that in their presence certain works of wonder, of which they were competent to judge, were performed different from the usual manner in which the laws of nature operate, and which could not be accounted for according to those laws; that they saw the most inveterate diseases healed—the deaf, the blind, and the lame cured, and the dead raised by the mere word of Christ. In proof of their belief of these miracles, they renounced the religion in which they had been educated, and to which they had been previously attached with intense bigotry; they constantly adhered to this testimony, not only without any assignable motive, but in opposition to all the motives by which mankind are usually influenced; they persisted in affirming that these statements were true, in spite of ridicule and contempt, of insult and wrong, of the scourge, the dungeon, the axe, the cross, and the stake. They had hundreds and thousands of associates of both sexes and of all ranks and ages, and yet not one of them was ever induced, either by the hope of reward or the fear of punishment, to betray their cause or to confess that it was an imposture. That this uniform and inflexible constancy should have been displayed in support of an unprofitable falsehood, by men who taught and preached the purest system of morality the world has ever heard of, is utterly at variance with all the principles of human nature, and would be a greater miracle than any work of wonder recorded in the Scripture history. If their testimony be false, the physical miracles must of course be false too; but then the moral miracle must be true. The denial of the one necessarily implies the belief of the other, and the falsehood of such testimony, in the circumstances of the case, would be more incredible far than the truth of the miraculous interpositions which it attests. (*Eclipse of Faith*, 3d edition, pp. 270–274.)

The argument of the sceptic has been most dexterously turned against himself in the masterly refutation of infidelity just referred to (p. 278). It is there shown that Strauss and Hume, and others who affirm that a miracle is impossible, would, if they saw what seemed a miracle, distrust their senses, and believe that they were deceived. The position, then, of those who deny and of those who assert miracles is exactly the reverse of Hume's statement. The man who believes "transubstantiation" distrusts his senses, and rather believes testimony; and in the same way, the man who believes that miracles are impossible, if he were to witness any event that has a miraculous appearance, must, on his principles, be prepared to deny the evidence of his senses, and to trust to testimony—to that general experience which comes to him, and can come to him only in that shape. It is the infidel, therefore, and not the Christian, who is affected by the argument of Hume.

The impossibility of a miracle—or at least the impossibility of proving a miracle—has been defended by Rousseau on an entirely different ground. A miracle he defines to be an exception to the laws of nature; and as we do not know, he says, what the laws of nature are, we cannot determine whether any given event be or be not a deviation from these laws; and therefore it is impossible to prove the reality of a miracle. It is true, we do not know universally what the laws of nature are; but there are certain events so different from their uniform results, that we may confidently affirm that they cannot have been produced by the operation of these laws. We do not know the full extent of the powers of medicine; but we do know that the cure of blindness, or deafness, or paralysis, by a word or a touch is at variance with all medical laws, and must therefore have been the result of another and totally different cause—the special interference of a superhuman power. The fertility of the earth varies in different countries and climates, and may probably hereafter, by the applications of science, be increased far beyond anything yet attained; but in no country, and by no possible application of science, could a few barley loaves and small fishes be instantaneously multiplied so vastly as to suffice for a meal to five thousand persons faint with hunger. We do not know fully the nature of fire or the utmost extent of its power; but this we do certainly know, that it is the nature of fire to burn; and therefore, when Daniel's three companions were thrown into the burning fiery furnace, and came out unhurt, this result was contrary to the nature or the laws of fire, and must therefore have been produced by a miraculous interposition.

Again, it has been said that no miracle can prove a moral truth, because there is no natural relation between the displays of physical power and any such truth. The performance of a miracle, therefore, it is alleged, is a mere evidence of extraordinary power, and is neither a proof of the veracity

or Divine commission of the person by whom it is performed, nor of the Divine authority of the religion which he may teach. It is true that a miracle, considered by itself, proves merely that its author is endowed with superhuman power over the operations of nature; but the miracles of Christ do not stand alone—they form only one link of the chain of Christian evidences, and must be taken in connection with their circumstances and the purposes for which they were performed. Their character and tendency, as well as their miraculous nature, must be taken into account, together with the fact that they were constantly appealed to by our Lord as credentials of his mission. It is not from the miracles of Christ, considered merely as superhuman works, but from their benevolent character, which proves that they originated in a benevolent source,—the union in them of power and goodness, combined with the fact that they were performed in attestation of his claims to the office of Messiah, and in support of the system of doctrines and precepts which he taught,—that we draw a conclusive argument in favour of his Divine authority.

Lastly, it has been alleged, that whatever may have been the original strength of the evidence of the Scripture miracles, it has undergone a very serious diminution by being transmitted through a number of successive individuals and generations, and will in the end become extinct. "Suppose a fact to be transmitted," says Laplace, "through twenty persons,—the first communicating it to the second, the second to the third, &c.,—and let the probability of each testimony be expressed by nine-tenths (that is, suppose that of ten reports made by each witness, nine only are true), then at every time the story passes from one witness to another, the evidence is reduced to nine-tenths of what it was before. Thus after it has passed through the whole twenty, the evidence will be less than one-eighth." That is, the chances for the fact thus attested being true will be less than one in eight. "The diminution of evidence," he adds, "by this species of transmission may be compared to the extinction of light by the interposition of several pieces of glass. A small number of pieces will be sufficient to render an object entirely invisible which a single piece allowed to be seen very distinctly." (Laplace, *Essai Philosophique sur les Probabilites.*) Now it must be admitted that if any statement as to a matter of fact were to be transmitted successively through twenty persons, and we ourselves were to receive the account from the twentieth narrator alone, the credibility of the report would be very considerably diminished; in other words, the probability of error or mistake would be largely increased. But in the present instance we have not merely the testimony of the last, but of every preceding witness, to the truth of the gospel narrative. We can travel back step by step, in regular and unbroken order, through every link in the chain of testimony from the present time to the days of the Apostles, the eye-witnesses and original relaters of our Lord's miracles. We have not only the testimony of those who heard the Apostles tell their simple story, but of the Apostles themselves, who have declared what they heard and saw. In this way, to recur to the illustration of Laplace, we can remove one by one the interposing pieces of glass which intercepted the rays of the light of truth, until we are enabled to see the object presented to our view as clearly, and to judge of it as correctly, as the original spectators. (Benson's *Hulsean Lectures* for 1820, p. 80.)

The truth of the miracles recorded in the books of Moses can be established by similar arguments to those which have been adduced in proof of the reality of Christ's miracles. Both have all the marks which are necessary to prove them worthy of full credit. The four well-known rules laid down by Leslie as infallible tests of the genuineness of an alleged miracle, all meet in the works of wonder performed by Moses as well as by Christ; and they never have met, and never can possibly meet, in any imposture or pretended miracle:—1. That the facts related be such as that men's outward senses—their eyes and ears—can be judges of them; 2. That those facts be done openly and publicly in the face of the world; 3. That not only public monuments, but outward institutions and actions, should be appointed and perpetually kept up in memory of them; 4. That these institutions should commence from the time the facts were done. The miracles of Moses,—the passage through the Red Sea, the miraculous supply of manna and of water from the rock in Horeb, and the passage over Jordan, &c.,—were all events regarding which the senses of the spectators could not be deceived. These miracles were performed in the most public manner, and in the presence of many witnesses; so that there was every opportunity to subject them to the most searching scrutiny. Not only were public monuments erected, but various institutions—such as the feast of the Passover—were appointed at the time to be observed in remembrance of these miraculous interpositions, and were observed by the Jewish nation in all succeeding ages,—institutions which, from their nature, it would have been impossible to induce any people to observe unless fully satisfied of their Divine authority. And the books in which these miracles are related are not only a history of the Jewish people, but their very statute-book, containing their municipal as well as civil and ecclesiastical laws, which, like the history, are inseparably connected with the miracles wrought by the legislator. (See Leslie's *Truth of Christianity Demonstrated;* and *Short and Easy Method with the Deists.*)

In comparing the evidence for the miracles recorded in Scripture with that which can be offered in support of any other miracle, it is proper, as Paley shows, to lay out of the case—

1. Such accounts of supernatural events as are written a long time after their alleged occurrence. On this principle we may at once set aside the miraculous story of Pythagoras, written 800 years after his death; the prodigies of Livy's history; the fables of the heroic ages; the whole of the Greek and Roman mythology; a great part of the accounts of Popish saints; the miracles of Apollonius Tyanæus, published more than 100 years after his death; and the miraculous powers ultimately claimed for Ignatius Loyola.

2. We may lay out of the case accounts published in one country of what passed in a distant country, without any proof that such accounts were received or known at home. The Gospels are not only a contemporary history, but they were first published, and the Christian church first planted, in the place where its Founder lived and performed his miracles, and died; while the accounts of the alleged miracles of Apollonius Tyanæus, of Francis Xavier, and others, were published at a great distance from the supposed scene of the wonders.

3. We ought to lay out of the case *transient* rumours. On the first publication of any story, unless we are personally acquainted with the facts of the case, we cannot know whether it is true or false. We look to the confirmation or contradiction of the account by its increasing notoriety or its dying away, and to its permanency or disappearance for the discrimination of truth from falsehood. Tried by this criterion, the miracles recorded in Scripture are presented to us in the most favourable light.

4. We lay out of the case what may be called *naked* history,—history found merely in a book, unattended with any evidence that the accounts given in the book were credited and acted upon at the time when the events are said to have occurred, and unsupported by any collateral or subsequent testimony, or by any important visible effect. This certainly is not the case with the history of the miracles of Christ. That history is to be combined with

the institutions of Christianity, with the time and place and circumstances of its origin and progress, as collected from other historical sources, with its prevalence to the present day, with the fact of our present books having been received by the advocates of Christianity from the first, with a great variety of subsequent books referring to the transactions recorded in the four Gospels, and containing accounts of the effects which flowed from the belief of those transactions,—those subsequent books having been written with very different views, "so disagreeing as to repel the suspicion of confederacy, and yet so agreeing as to show that they were founded in a common origin."

5. A mark of historical truth, although only to a certain degree, is *particularity* in names, dates, places, circumstances, and in the order of events preceding or following the transaction. The gospel history, in this respect, affords extraordinary facilities for detecting its falsehood if it were an imposture, and it has stood the test most triumphantly.

6. We lay out of the case stories of supernatural events upon which nothing depends, and in which no interest is involved,—stories which require only an indolent assent, and which pass from one to another without examination.

7. We lay out of the case those miracles which were performed in confirmation of opinions already adopted. It is easy to account for the reception of those alleged miracles which go to support a system of religion already established; but Christianity is the only religion that was ever introduced—and introduced among enemies—by miraculous pretensions. (See Whately's *Introductory Lessons.*) The miracles recorded in the gospel history "were wrought in the midst of enemies, under a government, a priesthood, and a magistracy decidedly and vehemently adverse to them and to the pretensions which they supported. They were Protestant miracles in a Popish country; they were Popish miracles in the midst of Protestants." They made converts among those who were most unwilling to credit these evidences, and who, in consequence of believing them, were required to abandon their most deeply-rooted opinions and inveterate prejudices.

8. We lay aside all those events which can be accounted for by a heated imagination, false perception, momentary insanity, or any other natural principle. But the miracles of Christ cannot be accounted for in any such way, or be resolved into the operation of the common powers of nature. When a person born blind was restored to sight, or the deaf and dumb to hearing and speech, or a man who had been dead four days was restored to life, we are sure that such events must be ascribed to a superhuman cause. (Paley's *Evidences of Christianity;* Douglas's *Criterion of Miracles;* Leland's *Deistical Writers;* Campbell *On Miracles.* (J. T—R.)

MIRAMICHI, a river of North America, the second in size of those of New Brunswick, is formed by two branches, called the N.W. and the S.W. Miramichi respectively; and after a course of about 100 miles, falls into the Gulf of St Lawrence, forming by its estuary the Bay of Miramichi. The banks of the river and the adjacent country are covered with pine forests; and timber is exported in large quantities from the river and bay. The mouth of the Miramichi is impeded by a sand-bar; but there is sufficient depth of water for vessels of 600 or 700 tons; and the river is navigable for a distance of 40 miles from its mouth. The most important towns on its banks are Newcastle and Chatham. The bay is about 20 miles wide at its mouth, and stretches inland for 21 miles. It contains several islands, the principal of which are Fox Island and Portage Island.

MIRANDA, DON FRANCISCO, the founder of the independence of Spanish America, was descended from a noble family, and was born at Caraccas, in South America, about the middle of the eighteenth century. He early began to meditate the liberation of his country. While holding the commission of colonel in the Spanish service, he endeavoured to excite a revolution among the soldiers. His designs, however, were detected, and he was forced to flee into exile. After he had travelled through several European countries, acquiring their respective languages, liberalizing his opinions, and receiving encouragement in his patriotic aspirations from the leaders of the English opposition and others, he settled at St Petersburg. The Russian empress, Catherine II., patronized him, and pressed him to enter her service. But Miranda had for some time been observing in the French revolution the outburst of a freedom that might yet extend to his native country. He therefore repaired to Paris in 1790, was recommended by Pitt to Péthion, and was appointed a major-general by the Girondists. In this capacity he attended Dumouriez in his campaign against the Prussians. Yet in spite of his native sagacity, and his skill in strategy and engineering, he was foiled in his attempt to take Maestricht, and was defeated, along with his superior in command, at the battle of Neerwinden, in 1793. For the latter of these disasters, Miranda was blamed by Dumouriez, and was arraigned before the revolutionary tribunal. But after a trial of eleven days he was acquitted by the unanimous verdict of the jury. The fall of the Girondists, about the same time, left him exposed to the malice of the Mountain party. He was impeached before the Directory on the eighteenth Fructidor, and would have suffered transportation had he not opportunely contrived to escape into England. His return to France in 1803 was met by a verdict of banishment from the government of the First Consul. Miranda now began to use more direct measures for effecting the favourite project of his life. In 1806 he set sail from New York in a vessel manned by volunteers. After chartering two schooners at St Domingo, he was approaching the shore of his native country, when he was stripped of his late reinforcement by Spanish cruisers, and escaped with difficulty in his own vessel. On landing at Venezuela in the month of August, he was received with cold indifference by the inhabitants, and was forced to re-embark. A more successful attempt was made in 1810, and resulted in 1811 in the triumph of republican principles. But the friends of the Spanish monarchy gained the ascendancy in the following year, and obtained possession of General Miranda. In utter violation of the conditions on which he had surrendered himself, he was conveyed to Spain, and cast into the dungeons of the Inquisition, where he died in 1816.

MIRANDA, *Saa de*, an eminent Portuguese poet, was born of a noble family at Coimbra in 1495. Destined by his parents for the legal profession, he studied law, and was appointed professor of jurisprudence in his native city. But no sooner had his father died, than he threw up his appointment, and resigned himself to the far more congenial pursuit of poetry. A lengthened visit which he then paid to Spain and Italy was the cause of his introducing a new and striking feature into the literature of his country. On his return he began to publish eclogues in the Spanish language, and in the forms of the Italian poets Dante and Petrarch. He was thus the introducer of the Italian style into Portuguese poetry, and of the custom which led many of the subsequent poets of his native country to write in the language of Spain. Saa de Miranda was greatly esteemed and liberally patronized during his lifetime. He held an appointment at the court in Lisbon, until a quarrel with some nobleman forced him to resign it. With no great reluctance he repaired to his country seat near Ponte-de-Lima, in the hope of spending the rest of his days in rural amusements, domestic enjoyments, and the cultivation of his genius. For some time his expectation was not disappointed. From the fondness he manifests of introducing into his poetry rural pictures and rural allusions, we may imagine how pleasantly his days would glide past amid the sights and

sounds of the country. But the death of his son in 1553 cast a shadow over this pleasant scene. The loss of his wife soon afterwards surrounded his existence with a settled gloom; and he died in 1558 of a broken heart. Besides eclogues, Saa de Miranda wrote two dramas in the style of Macchiavelli and Ariosto, and several lyrics and poetical epistles. As a writer of the language of Spain he occupies a high position among the authors of that country. His compositions in his native language also place him in the first rank of Portuguese poets. Of the many editions of his works, that of 1614 is the best.

MIRANDOLA, Giovanni Pico della, Count and Prince of Concordia, one of the most brilliant scholars of his day, was the youngest son of Gianfrancesco della Mirandola, and was born in 1463. After receiving his elementary education from his mother, and astonishing every one by the precocity of his talents, he was placed at Bologna at the age of fourteen to study the canon law. In the course of two years, however, he abandoned this branch of knowledge in disgust, and turned with eager delight to philosophy and theology. The next seven years were spent by him in visiting the most celebrated universities of France and Italy, in sitting at the feet of eminent professors, in entering the lists against the most redoubtable controversialists, and in the most assiduous private study. His memory was now so tenacious that it retained every fact that was presented to it; his elocution was fluent and forcible; and his mind could unravel the most intricate problems with unfailing tact and rapidity. Thus equipped with his extensive acquirements and ready talents, Mirandola appeared at Rome in 1486 as a controversial champion. Propounding as the subjects of debate 900 theses on every possible branch of knowledge, he threw down the gauntlet to the whole learned world. At the same time he promised to defray the expenses of all those disputants who should come from a distance. No one responded to his challenge. His puerile vanity, however, was not suffered to enjoy this triumph long. Some dignified individuals, disgusted with the self-conceit, and envying the accomplishments of so young a scholar, accused him before the Pope of advocating heresies in 13 of his propositions. This was the beginning of a persecution which, though resulting in a full vindication of his orthodoxy, humbled his vanity and deepened his devotional feelings. He now renounced the study of profane literature, threw into the flames five books of amatory poems which he had composed in Italian, and devoted all his time to investigations into religion and the Platonic philosophy. To reconcile the tenets of Plato with those of Aristotle became his favourite attempt, and is the object of his treatise *De Ente et Uno*. The latter part of his life was spent at Florence in the midst of his books, in the enjoyment of a liberal fortune, and in daily intercourse with the most enlightened men of that time. He was cut off at the age of thirty-two in 1494. His collected works, published at Basel in 1601, contain treatises on the Lord's Prayer, the Kingdom of Christ, the 15th Psalm, the Rules of a Christian Life, &c. A Life was prefixed to his works by his nephew and pupil Gianfrancesco Pico Mirandola. More valuable, however, is the biography by the Rev. W. Parr Gresswell, 8vo, Manchester, 1805.

MIRECOURT, a town of France, in the department of Vosges, on the Madon, 17 miles N.W. of Epinal. It is irregular and ill built, but is pleasantly situated, and adorned by several fountains. It has a civil tribunal and one of commerce, and a library containing 7000 volumes. The principal manufacture is that of musical instruments, for which the town is somewhat noted. In the town and neighbourhood are about 20 establishments, giving employment to more than 6000 hands, and producing annually upwards of a million of violins, guitars, organs, and other musical instruments. Lacemaking, embroidery, and similar occupations are also extensively carried on, and afford employment to many females in the town and surrounding country. Mirecourt has a considerable trade in the produce of these manufactures, and in wines and cattle. Pop. (1851) 5443.

MIREPOIX, a town of France, department of Ariège, on the Lers, 14 miles E. of Paniers. It is clean and well built, and contains several squares adorned with trees and fountains. It was formerly surrounded by ditches, but these have been filled up, and are now used as boulevards. The principal buildings are,—the parish church, a town-hall, a communal college; an hospital, with several schools attached to it; a handsome stone bridge of seven arches; and a square tower, all that remains of its ancient castle. Coarse woollen stuffs, linen, cotton, flannel, worsted, and soap are manufactured here; and there is a considerable trade in grain, and in the iron which is obtained in considerable quantities in the neighbourhood. Pop. 4476.

MIREVELT, Michael Jansen, an eminent portrait-painter, was the son of a goldsmith, and was born at Delft in 1568. While a pupil of Blocklandt, he made such rapid progress that he soon rivalled his master. His first works were altar-pieces for some of the churches in his native town. In a short time, however, he turned to the more lucrative vocation of painting portraits, and speedily rose into repute. He was often summoned from his settled residence at Delft to the Hague, to paint the princes of the House of Nassau. The Archduke Albert conferred upon him a considerable pension. In 1625 he was invited to England by Charles I., and would have complied with the request had not the plague been then raging in London. Meanwhile Mirevelt must have been amassing a fair fortune, since the very smallest of his numerous works was sold for no less than 150 florins. He died at Delft in 1641, after he had executed, according to Sandrart, nearly ten thousand portraits. "The portraits of Mirevelt," says Stanley in his *Dutch and Flemish Painters*, "are well drawn, full of expression, solidly coloured, and with a proper degree of finishing without the appearance of labour." Mirevelt's son Peter possessed some merit as a portrait-painter.

MIRGOROD, a town of Russia, in the government of Poltawa, situated on the Khorol, about 50 miles N.W. of the town of Poltawa. It contains three churches, and is the principal seat of the ecclesiastical dignitaries of the government. It has an extensive trade in earthenware and other articles; and five annual fairs are held here, which are of considerable importance. Pop. (1852) 8951.

MIRROR. See Optics, and Burning-Glasses.

MIRZAPORE, a town of Hindustan, and the principal place of the district of the same name. It is situated at the foot of a range of hills on the south bank of the River Ganges. The town consists of handsome European houses and native habitations, with clusters of Hindu temples crowding the banks of the Ganges, and making a lively appearance when seen from the river. It is one of the greatest inland trading towns in Hindustan, and the depôt of all the cotton from Agra and the Mahratta countries. It has also an extensive manufacture of carpets and some iron-works. Several opulent merchants and indigo planters, both native and European, reside in the town and its vicinity. The travelling distance from Benares is 30 miles. The East India Railway from Calcutta to Delhi passes by this town. E. Long. 82. 38., N. Lat. 25. 6.

The district of which this city is the capital has an area of 5235 square miles, with a population of 831,388, most of whom are Hindus, the Mohammedans being comparatively few. A portion of the tract was ceded to the East India Company by the Vizier of Oude in 1775, and the remainder in 1801.

MISENUM (*Capo di Miseno*), in ancient geography, a famous promontory on the coast of Campania, which formed the northern boundary of the *Sinus Cumanus* (Bay of

Naples). It is said to have derived its name from Misenus, who is represented by one legend as a companion of Ulysses, but by Virgil and others as the trumpeter of Æneas. Towards the close of the Republic its vicinity became a favourite site for the summer residences of the citizens of Rome. There, on the brow of a hill commanding an extensive seaward view, stood the villa of Marius, which afterwards, in the possession of Lucullus, attained to a more than regal magnificence. The promontory is mentioned by Cicero as a resort of the Cilician pirates. In the reign of Augustus its land-locked harbour became the permanent station of the fleet that was entrusted with the defence of the Lower Sea. A considerable town in consequence gradually rose around the port. Pliny the Elder was stationed here in command of the "Classis Misenensis," when he was induced, A.D. 79, to visit that eruption of Mount Vesuvius in which he perished.

MISHNA, a part of the Jewish Talmud, containing the text on which the Gemara is a commentary. (See TALMUD.)

MISKOLCZ, a market-town of Hungary, capital of the county of Borsod, is situated on the Sinwa, at the foot of the valley of Diós Gyor, 25 miles N.E. of Erlau. The town is well built, containing many fine houses and two squares, including a Roman Catholic church and convent, 1 Greek and 2 Protestant churches, a synagogue, several schools, and a county-hall. The inhabitants are chiefly Protestants, and are employed for the most part in agriculture. The town has a large trade in fruit, wine, and a peculiar sort of bread for which the place is famous. Iron of fine quality is extensively mined in the vicinity. Markets are held at Miskolcz weekly; and there are five annual fairs of considerable importance. Pop. (1846) 30,000.

MISSAL, the Roman Catholic book containing the several masses which are said on particular days. (See MASS.)

MISSIONS, RELIGIOUS. It is impossible within the limits of our article to give even a hasty sketch of those great religious movements which have exercised their influence at the dawn of every civilization on the face of the globe, and have done more to change the features of national life than the sword of kings or the scourge of conquerors. The civilization of Egypt can be traced upwards to sacerdotal colonies, slowly effecting a religious revolution, and prosecuting missionary work from centres of religious influence which at first were isolated and weak. From these religious schools swarms of colonists, chiefly priests, migrated into other lands and planted a sacerdotal civilization wherever they went. Not dissimilar in kind was the advance of the Brahmins over India, spreading by colonies and conquest a religious culture not indigenous to the country; and the progress of the Buddhists, who disseminated a foreign creed as far as Japan and Central Asia. In the traditions of many barbarous nations there is a floating recollection of religious change, and of a time when their present worship was adopted by their ancestors as an improvement, at the suggestion of teachers from some other clime. Unlike the forms of worship that rose and fell around it, Judaism seems to have made few converts in the days of its prosperity; and when its doctrines became known in the Western World by means of the dispersions, it was the internal tenacity of the system, and not its expansive power, that gave it a missionary character. The Jewish colonies, although they commanded respect from their heathen neighbours, served as little more than stepping-stones conveniently placed for the spreading of Christianity when it should be revealed. From the Greek tongue and the Greek race Christianity borrowed the great machinery of its speedy diffusion. Even in the East its chief seats were the Greek colonies, and from them "it spread into China and Tartary, and from its ancient success in these quarters kept in suspense the emperors who wielded the sceptre of Zengis, whether they should desolate the world with the sword in the one hand and the Koran or the Bible in the other." In apostolic times the choice long hung trembling in the balance whether the efforts of the first preachers were to be directed to the East or to the West; and to the operation of a few seemingly trivial causes we owe it that western Christianity is now carrying its gospel to the East, instead of missionary societies in Tartary sending their agents to convert the savages of Britain.

Under the supremacy of Rome much more might have been expected of the popes for the diffusion, if not of religion, at least of tenets that were favourable to their own interest and sovereignty, than was actually performed by them. Their attention was too much distracted by the quarrels of nominal Christendom, and the more tempting opportunities of increasing their power at home at the expense of Christian kings, to enable them to look steadily and far abroad, or to form any settled plan for extending their spiritual dominion over foreign nations. Another obstacle presented itself; the Papists were inferior in knowledge to the Moslem; the Greek church might boast of some superior civilization, but the Franks were despised by the Saracens for their ignorance and barbarity, as well as held in abomination for their gross idolatry. Their missions, therefore, were there chiefly confined to tribes of kindred and German origin, whose conversion was facilitated by the greater number of their own tongue and blood having already submitted to the papal sway.

But if the popes did little in comparison with their resources, individuals did much. The mission of St Patrick to Ireland may compare in zeal and in success with whatever had been undertaken for the spread of Christianity since the times of Constantine; and its effects were not confined to Ireland, but spread over Scotland and the north of England, and reached even to Germany. The popes, indeed, when aroused by the fear of a Tartar invasion, despatched an ill-contrived and hopeless mission to the sovereigns of Tartary, in order to avert the danger which threatened Europe, by converting them; but any real and disinterested zeal throughout the dark ages is chiefly to be found in individuals who, like the ingenious but fantastical Raymond Lully, were meditating plans for extending religion whilst the rest of the Christian world were careless and asleep.

The Reformation gave a revival to Popery itself; and as the Carthaginians sought to regain the resources which they had lost nearer home by founding a new empire in Spain, so the Roman Catholics endeavoured to counterbalance the loss of the third of Europe by extending the spiritual dominions of the church over the regions of the boundless and populous East. Of all religious revivals, the Reformation least abounded in missionary efforts, because in its origin and spread it was least of all dependent on the personal exertions of missionaries. It was the first great manifestation of the power of printing, and for a time so new and mighty an engine seemed to supersede all other exertions. It is true that so early as September 1556 fourteen Swiss missionaries took their departure from Geneva for Brazil, and the example was followed by many of the Reformed Churches; but not till the Reformed faith had suffered a long eclipse and been again restored to vigour, were any commensurate efforts made to carry the gospel to heathen territory. In modern times the scale of missionary effort has rapidly risen, until at the present moment there are few sects of Christians, however weak, who do not bestow some of their activity on this work. Instead of entering into particular details, which must be sought for in the lives of eminent missionaries given in this work, we prefer to begin our survey by a comprehensive table, containing a list of the principal missionary bodies, the sphere of their missions, the number of communicants reported as belonging to their churches, and of scholars attending their schools.

Missions.

Origin.	SOCIETIES, &c.	MISSIONS.	Communicants.	Scholars.
	ENGLISH.			
1701[1]	The Society for the Propagation of the Gospel in Foreign Parts	India, Ceylon, Borneo, South Africa, British Guiana	5,576[2]	...
1786	The Methodist Missionary Society	West Indies, Western Africa, Southern Africa, India, Ceylon, China, New Zealand, Friendly Islands, Fiji Islands, Hudson's Bay Company's Territory	75,091	39,333
1792	The Baptist Missionary Society	India, Ceylon, Western Africa, West Indies	4,588	3,476
	Jamaica Baptist Union	Jamaica	16,106	3,096
1795	The London Missionary Society	South Sea Islands, South Africa, India, China, British Guiana, Jamaica, Mauritius	15,150	...
1799	The Church (of England) Missionary Society	Western Africa, Eastern Africa, India, Ceylon, China, New Zealand, British Guiana, Hudson's Bay Company's Territory, Greece, Asia Minor, Palestine, Egypt, Mauritius	18,786	...
1816	The General Baptist Missionary Society	India (Orissa)	329	246
1840	The Welsh Foreign Missionary Society	India (Hill Country N.E. of Bengal)	28	193
1844	The (Free) Presbyterian Church in England	China	47	58
1844	The Patagonian Missionary Society	Patagonia	...	...
1845	The Naval Missionary Society for the Loochoo Islands	Loochoo Islands	...	...
1850	The Chinese Evangelization Society	China, Penang	...	132
1796	The Scottish Missionary Society	The missions established by these societies in India, Jamaica, and Caffraria, are now carried on by the General Assembly of the Free Church and by the United Presbyterian Synod.		
1796	The Glasgow Missionary Society			
1825	The General Assembly of the Church of Scotland	India	...	1,975
1835	The United Presbyterian Synod	Jamaica, Caymanas, Trinidad; West Africa (Old Calabar), Caffraria	5,182	3,100
1842	The Reformed Presbyterian Synod	New Hebrides	44	...
1843	The General Assembly of the Free Church of Scotland	India, Caffraria	582	8,791
1840	The General Assembly of the Presbyterian Church in Ireland	India	20	472
	CONTINENTAL.			
1714	The Royal Danish Mission College	Greenland	...	...
1732	The United Brethren	Greenland, Labrador, Indians in North America, Danish and English West India Islands, Surinam, South Africa, Australia	19,583	...
1797	The Netherland Missionary Society	Dutch East India Islands, China	...	...
1821	The German Missionary Society (Basle)	Western Africa, India, China	1,009	2,062
1822	The Paris Society for Evangelical Missions	South Africa	1,283	310
1828	The Rhenish Missionary Society	South Africa, Borneo, China	985	...
1833	The Berlin Missionary Society	South Africa	...	...
1835	The Swedish Missionary Society (Stockholm)	Lapland	...	...
1836	Gossner's Missionary Society	India, New Holland, &c.	...	...
1836	The Evangelical Lutheran Missionary Society	Southern India, New Holland	2,111	706[3]
1836	The North German Missionary Society	Western Africa, New Zealand	...	...
1842	The Norwegian Missionary Society	South Africa (Zulu country)	...	...
1846	The Swedish Missionary Society (Lund)	China	...	...
1850	The Berlin Missionary Union for China	China	...	...
	AMERICAN.			
1810	American Board for Foreign Missions	India, Ceylon, China, Sandwich Islands, Micronesia, Indians in United States, Greece, Turkey, Asia Minor, Syria, Assyria, Persia, Western Africa, South Africa	26,976	19,366
1814	American Baptist Missionary Union	Burmah, India, Siam, China, Indians in United States	14,274	3,000
1819	American Methodist Episcopal Missionary Society	Indians in United States, Liberia on West Coast of Africa, China	2,718	...
1820	American Episcopal Board of Missions	Greece, Western Africa, China	266	...
1833	The Free-Will Baptist Foreign Missionary Society	India (Orissa)	79	131
1837	American Evangelical Lutheran Foreign Missionary Society	India	86	400
1837	The General Assembly of the Presbyterian Church in the United States	India, Siam, China, Western Africa, Indians in United States, Chinese in California	900	4,595
1842	The Seventh-Day Baptist Missionary Society	China	6	...
1843	The Baptist Free Missionary Society	Haiti	66	...
1845	American Methodist Missionary Society (South)	Indians in United States, China	4,308	265[4]
1845	The Missionary Board of the Southern Baptist Church	Western Africa, China	644	800
	The American Missionary Association	United States, Jamaica, Western Africa, Siam	...	...
	The American Indian Mission Association	United States	1,320	177
1848	The Synod of the Presbyterian Church in Nova Scotia	New Hebrides	50	...

[1] The first missionary institution in England was "The Corporation for the Propagation of the Gospel in New England and the adjacent parts of America." It was erected in 1649. Of this society the Honourable Mr Boyle was about thirty years the governor.
[2] This return includes only India and Ceylon. [3] India. [4] Indians.

The following is a Table of the Countries in which Missions have been established by these Societies :—

Countries.	SOCIETIES, &c.	Communicants.	Scholars.
EUROPE.			
Lapland	Swedish Missionary Society at Stockholm	...	...
Greece	Church Missionary Society, American Board, American Episcopal Board of Missions	...	...
Turkey	American Board	148	93
ASIA.			
Asia Minor and Armenia	American Board, Church Missionary Society	478	1,058
Syria	American Board	80	816
Palestine	Church Missionary Society	...	...
Assyria	American Board	30	243
Persia	Do. do.	100	1,230
India	Baptist, London, Church, Methodist, General Baptist, and Welsh Missionary Societies; Propagation Society; General Assemblies of the Church of Scotland, of the Free Church, and of the Irish Presbyterian Church; the German (Basle), Evangelical Lutheran, and Gossner's Missionary Societies; American Board, General Assembly of Presbyterian Church, Baptist Missionary Union, Free-Will Baptist, and Evangelical Lutheran Foreign Missionary Societies	19,370	64,806
Ceylon	Baptist, Methodist, and Church Missionary Societies; Propagation Society; American Board	3,447	13,972
Burmah	American Baptist Missionary Union	13,907	...
Siam	American Baptist Missionary Union, General Assembly of the Presbyterian Church in the United States, American Missionary Association	37	...
Dutch East India Islands	Netherland Missionary Society	...	...
Borneo	Propagation Society, Rhenish Missionary Society	...	...
China	London, Church, and Methodist Missionary Societies; Chinese Evangelization Society, Free Presbyterian Synod in England; Netherland, German (Basle), Rhenish, and Swedish Missionary Societies; Berlin Missionary Union for China; American Board, Baptist Missionary Union, General Assembly of Presbyterian Church, Episcopal Board of Missions, Methodist Missionary Societies (North and South), Seventh-Day Baptist Missionary Society, Board of Southern Baptist Church	924	1,467
Loochoo Islands	Naval Missionary Society	...	...
New Holland	United Brethren, Gossner's Missionary Society, Evangelical Lutheran Missionary Society	...	...

Countries.	SOCIETIES, &c.	Communicants.	Scholars.
AFRICA.			
Western	Church, Methodist, and Baptist Missionary Societies; United Presbyterian Synod; German (Basle), and North German Missionary Societies; American Board, General Assembly of Presbyterian Church, Methodist Missionary Society, Episcopal Board of Missions, Board of Southern Baptist Church, American Missionary Association	16,509	12,338
Southern	United Brethren, London, and Methodist Missionary Societies; Propagation Society; General Assembly of Free Church; United Presbyterian Church; Paris, Rhenish, Berlin, and Norwegian Missionary Societies; American Board	11,945	...
Eastern	Church Missionary Society	...	...
Northern	Do. do. do. (Egypt)	...	...
AMERICA.			
Greenland	Danish College of Missions, United Brethren	888[1]	...
Labrador	United Brethren	370	...
British America (Indians)	Church Missionary Society, Propagation Society, Methodist Missionary Society, United Brethren	2,158	841
United States (Indians)	United Brethren, American Board, Baptist Missionary Union, Methodist Missionary Societies (North and South), General Assembly of Presbyterian Church, American Missionary Association, American Indian Mission Association	9,228	1,400
West Indies (Negroes)	United Brethren, Methodist, Baptist, and London Missionary Societies; Jamaica Baptist Union; United Presbyterian Church; American Missionary Association, Baptist Free Missionary Society	88,807	18,064
Patagonia	Patagonian Missionary Society	...	...
POLYNESIA			
Society Islands	London Missionary Society	2,272	...
Hervey Islands	Do. do. do.	1,312	...
Navigator's Islands	Do. do. do.	2,1 7	...
Loyalty Islands	Do. do. do.	67	...
New Zealand	Church, Methodist, and North German Missionary Societies	9,125	...
Friendly Islands	Methodist Missionary Society	6,265	6,044
Fiji Islands	Do. do. do.	4,251	10,556
Sandwich Islands	American Board	22,766	11,059[2]
Micronesia	Do. do.	...	...
New Hebrides	Presbyterian Synod in Nova Scotia, Reformed Presbyterian Synod in Scotland	94	...[3]

In the preceding tables we have stated the number of communicants connected with the principal Protestant missions, so far as we have been able to ascertain them. If we had given also the baptized, the numbers would have been much greater, and they would have been still further augmented, if to them we had added others under special instruction. Thus, in the missions of the United Brethren the numbers of these several classes in 1856 were as follows :—

[1] United Brethren.

[2] The schools in the Sandwich Islands are results of the mission, but they are now entirely supported by the Hawaiian Government.

[3] These statistics, particularly in the second table, are in various instances incomplete. Where they are so, the numbers given are of course under the truth.

Missions.

Communicants	19,583
Baptized adults	10,607
Baptized children	21,245
Candidates for baptism, new people, and excluded	19,912
Total	71,347

In the missions of the Society for the Propagation of the Gospel in Foreign Parts, these classes in India were as follows:—

Communicants	5,133
Baptized adults and children	19,901
Unbaptized persons under instruction	6,697
Total	31,731

In most missions, however, the numbers of the baptized and unbaptized persons connected with them bear a much less proportion to the communicants.

With the view of giving some idea of the expense of such varied and extensive operations, we shall here subjoin a statement of the receipts and expenditure of the principal missionary bodies for one year:—

English.	Year.	Receipts.	Expen.
Society for the Propagation of the Gospel in Foreign Parts, *General Fund*	1855	L.66,753	L.65,672[1]
Methodist Missionary Society	1856	119,205	112,608[2]
Baptist Missionary Society	1856–7	21,467	22,039
London Missionary Society	1856–7	68,095	74,003
Church Missionary Society	1856–7	123,175	118,658
General Baptist Missionary Society	1856–7	2,940	3,196
Free Presbyterian Ch. in England	1856–7	1,549	1,146
Mis. Society for the Loochoo Islands	1854	302	637
Chinese Evangelization Society	1857	2,255	2.355
General Assembly of the Ch. of Scotland	1856–7	3,538	4,647
United Presbyterian Synod	1856	14,284	13,269
General Assembly of the Free Church of Scotland	1856–7	12,273	15,317
Edin. Medical Missionary Society	1856	715	698
General Assembly of Presbyterian Church in Ireland	1856–7	3,653	3,243
Continental.			
The United Brethren	1856	13,565	13,353
Netherlands Missionary Society	1854–5	7,499	6,206
German Missionary Society (Basle)	1854–5	13,012	14,124
Paris Society for Evangelical Missions	1855–6	4,545	5,371
Rhenish Missionary Society	1850	5,992	5,184
Berlin Missionary Society	1853	4,152	3,448
American.			
American Board of Foreign Missions	1856–7	73,486	74,081
American Baptist Missionary Union	1856–7	23,184	22,824
American Episcopal Board of Missions	1855–6	14,512	14,533
Free-will Baptist Foreign Missionary Society	1855–6	1,583	1,193
Evangelical Lutheran Foreign Missionary Society (average of 2 yrs.)	1855	1,229	1,196
General Assembly of Presbyterian Church in United States	1856–7	43,226	45,524
Baptist Free Missionary Society	1855–6	594	339
Missionary Board of the Southern Baptist Church	1856–7	6,652	6,927

These statements are nearly complete as regards the societies of this country; but they are imperfect regarding those of the continent of Europe and America. We have, however, found about L.380,000 expended in one year on British missions among the heathen; about L.48,000 on continental, including those of the United Brethren, and about L.167,000 on American. The continental and American societies which are not included in the above list, are for the most part inconsiderable; and if we make a moderate allowance on account of them, we shall have an expenditure of about L.600,000 a year by the Protestant churches on missions among the heathen.

It is a fact not unworthy of notice, that of the heathen races who have been brought to receive the gospel, by far the greatest numbers are Negroes and their descendants. In the West Indies, including British and Dutch Guiana, and on the western coast of Africa, the communicants connected with various missions amounted to no fewer than 105,315. In 1843 there were also 128,410 black and coloured people, members of the Methodist Church in the United States, and it is probable the numbers have since that time greatly increased. There were also considerable numbers connected with the Baptist, the Presbyterian, and other churches in that country. We are well aware, indeed, that the instruction which is given to the slaves in the Southern States is in many, perhaps most cases, very defective, and in some shamefully perverted; yet even among them, we doubt not, there may be found many real, though perhaps not very intelligent converts. Taking these several statements into account, we would not be surprised though it should be found, that in the present day there are more real converts from among the Negro race than from among all other heathen nations put together. But be this as it may, the facts we have stated furnish a striking example of the providence of God overruling the wickedness of man for good, seeing it has been through means of the system of slavery, as carried on by men calling themselves Christians, that so many of the Negro race came to have an opportunity of receiving any religious instruction whatever.

Missions and missionaries have been very falsely estimated both by their friends and advocates, and by those who have been hostile or indifferent to them. Such as were opposed to them commonly looked on missionaries as ignorant, weak-minded enthusiasts; while their friends and advocates have no less erred in looking on them as men of more than ordinary piety, zeal, disinterestedness, and devotedness. In engaging in this work, some noble spirits are doubtless animated by what has been emphatically called "a passion for missions," and some by "the romance of missions;" but the generality, there is ground to conclude, make choice of the service on the same principles, and with the same views, as most persons choose their employments in life, and, in a special manner, from the same motives (often very much mixed) as many choose the Christian ministry as their profession. The truth is, missions afford to many an opening in life,—opportunities of rising in the world, or at least of obtaining a position which they might not so readily otherwise obtain. There are, of course, differences among them, corresponding somewhat to the characteristics of the several churches to which they belong; but in general they will not be found superior, as regards piety, zeal, disinterestedness, devotedness, and other moral qualifications, to the better class of ministers in their respective denominations who remain at home. Many people associate ideas of hardships, privations, and sufferings with their picture of missionary life; but in reality, with a few exceptions, missionaries are generally better off, in regard to salaries and the outward accommodations of life, than most of them could have expected to be in their own country. The chief points in regard to which missionaries are often placed in disadvantageous circumstances are, an unhealthy climate, and the difficulties they often have regarding the education and settlement of their children in life.

Intellectually, the character of missionaries has latterly much improved. When missionary societies were formed in England and Scotland, toward the end of the eighteenth century, an idea appeared to prevail, that persons would do well enough as missionaries to the heathen whom no one

[1] By much the larger portion of the funds of the Propagation Society are raised for, and expended on, the English Church in the British Colonies. Of the sum above mentioned, the portion expended on missions among the heathen probably did not exceed one-third.
[2] Part of this expenditure is on account of missions in Ireland, France, Germany, and in various of our colonies.

would have thought of for ministers at home. But the standard of the education of missionaries has gradually risen; and a large proportion of those who are now sent out as missionaries are well-educated men, and have for the most part enjoyed a regular training for the ministry. Several of the societies established institutions for the education of missionary students; while numbers who had received the usual education for the ministry, particularly in this country and America, have offered themselves for the service. In the early stage of our missionary societies individual medical men were also sent out, and some even of those who had enjoyed nothing more than a common education were put in the way of receiving some medical instruction before leaving their native country; but latterly, in America especially, a physician has been a very common constituent of a mission; and some years ago a society was established in Edinburgh under the name of the "Medical Missionary Society," which is chiefly under the management of gentlemen of the medical profession in that city, who have shown great interest in the cause.

Missionaries, many imagine, are not much to be relied on as to the accounts which they send home; but we are satisfied that for such suspicions there are no sufficient grounds. There may have been individuals who, giving way to their imaginations, or studying effect in their narrations, or seeking to raise themselves in public estimation, have sent home coloured and exaggerated accounts of their labours, successes, and prospects; but of the general truthfulness of the letters and journals of missionaries we are perfectly satisfied. We may not always form the same judgments as they form of the things related by them, nor be prepared to draw the same conclusions from them; but the simple facts themselves it seldom enters into our minds to question.[1] We cannot, however, say so much for the advocates of missions at home. In printed books, in sermons, and in speeches at public meetings, we frequently meet with coloured, exaggerated, one-sided representations.

Though the success of missions has been considerable, yet it is by no means equal to what is commonly supposed. Of the difficulties in the way of the conversion of the heathen few persons have any adequate idea. To say nothing of the many and powerful moral obstacles, the darkness of the heathen mind is such, that it must generally be exceedingly difficult even to lodge Christian ideas in it,—ideas so foreign and often so opposite to all its previous ideas and its habitual trains of thinking. Nor is the success of missions to be estimated by mere figures. Though the numbers of the baptized, and even of the communicants, in the several missions, and especially in those of particular societies, may appear considerable, yet there can be no question that a large portion of these can be reckoned as converts only in name. Missionaries who exercise much strictness in the admission of members into the church, though the numbers they receive should be comparatively small, are probably more really useful than such as open the door wide, and count their converts by hundreds or by thousands.

Though the following statements have reference to converts from among the Hindus and Africans, they are probably extensively applicable to converts from among heathen nations. Speaking of Hindu converts, Dr Brown remarks:—"Of the general character of the converts we wish we could speak favourably; but it must be acknowledged that even in those missions in which considerable care is exercised in the admission of persons to baptism, it was for the most part very imperfect. Of the sincerity of many who professed Christianity there was room to doubt; but even those who, it was hoped, were truly converted, laboured under many and great defects."

Dr Livingstone gives the following as his impressions of the effects produced on the natives of Africa by missionary labours:—"Many hundreds of both Griquas and Bechuanas have become Christians, and partially civilized, through the teaching of English missionaries. My first impressions of the progress made were, that the accounts of the effects of the gospel among them had been too highly coloured. I expected a higher degree of Christian simplicity and purity than exists either among them or among ourselves. I was not anxious for a deeper insight in detecting shams than others; but I expected character such as we imagine the primitive disciples had, and was disappointed. When, however, I passed on to the true heathen, in the countries beyond the sphere of missionary influence, and could compare the people there with the Christian natives, I came to the conclusion that, if the question were examined in the most rigidly severe or scientific way, the change effected by the missionary movement would be considered unquestionably great. We cannot fairly compare these poor people with ourselves, who have an atmosphere of Christianity and enlightened public opinion, the growth of centuries, around us, to influence our deportment; but let any one from the natural and proper point of view behold the public morality of Griqua Town, Kuruman, Likatlong, and other villages, and remember what even London was a century ago, and he must confess that the Christian mode of treating aborigines is incomparably the best.

"The Bechuana mission has been so far successful, that, when coming from the interior, we always felt, on reaching Kuruman, we had returned to civilized life. But I would not give any one to understand by this that they are model Christians,—we cannot claim to be model Christians ourselves,—or even in any degree superior to the members of our own country churches. They are more stingy and greedy than the poor at home; but in many respects the two are exactly alike. On asking an intelligent chief what he thought of them, he replied, 'You white men have no idea of how wicked we are; we know each other better than you. Some feign belief to ingratiate themselves with the missionaries; some profess Christianity because they like the new system which gives so much more importance to the poor, and desire that the old system may pass away; and the rest—a pretty large number—profess because they are really true believers.'"[2]

It may appear surprising that so many of the converts from heathenism should turn out to be only nominal Christians. It might naturally be thought, that in giving up with the religion of their country and their forefathers, and embracing a new religion of an entirely opposite character, we might calculate on its being the result of inquiry and consideration, and that, if not particularly intelligent, the generality of them would yet be true Christians. But to say nothing of the fact, that in all countries and in all ages (unless, perhaps, in apostolic times) the great majority of professed Christians have been Christians only in name, there are circumstances which, especially in some countries, will account for the natives coming over to the religion of the missionaries, without there being any substantial or spiritual change in their own state and character. Nowhere in modern times have missions been considered as achieving such great and glorious triumphs as in the South Sea Islands; yet, while we have no doubt that much good was in various ways effected in these islands, it yet appears

[1] In making these observations, it must not be imagined that we mean to detract from the intellectual character of missionaries. Among them there are men of highly respectable talents and acquirements, and taking them generally, they will be found to possess a fair average measure of ability and sound-headedness. We have, for the most part, a great respect for their judgment; only we are not disposed to receive it implicitly, just as we are not disposed to receive implicitly the judgments of any other class of men on other subjects.

[2] Livingstone's *Travels in South Africa*, pp. 107 and 109.

that the religious revolution which took place in many of them was materially the result of the example and influence of the chiefs,—more, in the first instance, than of the teaching of the missionaries. So long as the chiefs adhered to the religion of their fathers, the people had no thought of changing it; but as soon as they declared in favour of the new religion, their subjects were ready to follow them. They would now destroy their *morais*, burn or deliver up their idols, profess to be Christians, erect places of worship, observe the Sabbath-day with great outward strictness, while yet they continued to indulge in the most degrading vices, living like the beasts of the field. As regards the great body of the people, the revolution wanted not only purity, but reality. Christianity now became in a manner the national religion, and the mass of the population outwardly conformed to it. It is also worthy of mention that, among the Sandwich Islanders at least, it was a great object of ambition to be received as members of the church. "A *tabu* meeting (*i.e.*, a meeting consisting of selected persons) was to the mind of a Hawaiian one of the most desirable things on earth. Hence the constant pressure by them at the door of the church. It would have been the easiest thing imaginable to have added as many to it in one day as the Apostles did on the day of Pentecost." Among the Hottentots it was also observed there was a great anxiety to be received as members of the church. We have already seen that the numbers of communicants of the Negro race are very great as compared with other classes of heathens; and though we do not recollect ever to have seen it stated as a fact, yet we greatly suspect that pride is often at the bottom of their desire to be baptized,—that their being so raises them in their own estimation above their unbaptized countrymen, and brings them a step nearer to White men, to whom, though often their oppressors, they cannot help looking up as their superiors. These circumstances, and in some cases self-interest in one form or another, will explain how professed converts from among the heathen are so often only nominal Christians.

The earlier missions of our societies were directed chiefly to uncivilized tribes; and it was strongly argued by many who were opposed to the whole scheme, that civilization must of necessity precede Christianization, and that it was vain to think to communicate the sublime principles of the gospel to barbarians and savages. But the promoters of missions had then scarcely access to civilized nations (India and China, for example, were in a manner closed against them), and unless they sent to barbarous tribes, they could scarcely send forth missions at all. But they had a still further answer to the objection, namely, that the gospel was adapted to, and intended for, all mankind, whether civilized or uncivilized,—"to the Jew and the Greek, the barbarian and the Scythian, the bond and the free." This answer was no doubt well founded; but it is not unworthy of remark, that what might then perhaps be deemed only theory has since that time been completely established by numerous, varied, and undoubted experiments. Numerous missions have been established in North America among various tribes of the Indians; in the islands of the Pacific Ocean,—the Society, the Hervey, the Navigator, the Friendly, the Fiji, and the Sandwich Islands, and also in New Zealand; among the Negroes in the West India Islands and on the Western coast of Africa; and in South Africa, among the Hottentots, the Griquas, the Bechuanas, the Kafirs, and the Zulus. Numerous missions have also been established among civilized or demi-civilized nations, as in the East Indies, in Burmah, in Siam, and in China. Now, though we may not be able to state with anything like exactness the comparative amount of labour bestowed on civilized and uncivilized countries, nor yet the comparative extent of success in the one and the other, yet it will be seen from the preceding statistics that great numbers from among barbarous tribes have been brought to profess themselves Christians through the labours of missionaries, and there is ground to hope that among them there have been many who have been brought to something more than a mere profession of Christianity,—have, in fact, been genuine believers in Christ. The number of both these classes among uncivilized nations is even greater than among the civilized nations of the East, in India, Burmah, Siam, and China.

It would, however, be a grievous mistake to conclude from this that uncivilized countries are to be preferred as fields of missions to civilized countries, and that the prospects of success are greater among barbarous and savage tribes than among more cultivated nations. Though the statement of the opponents of missions, as to the necessity of civilization in order to Christianization, possessed no weight as an objection, there was great weight in it as a *consideration*, involving important truth, which was deserving of much more attention than it has received to this day,—the connection between civilization and Christianization, and their mutual influence and bearing upon each other. "Christianity and barbarism are certainly not incompatible with each other, yet they are antagonist principles. They may exist together, but they cannot flourish together. Barbarous and savage tribes are generally inconsiderable as regards population, and are often widely scattered and commonly migratory. Their language, from its imperfection and poverty, is ordinarily little fitted for expressing the truths of religion, or, indeed, any idea beyond their daily and immediate wants. It is also commonly unwritten, and they are without books and mental culture of any kind. The untrained and unthinking minds of savages are for the most part less able than educated minds, even supposing them to be inclined, to give continued attention to instruction, and are less capable of understanding, remembering, and applying the instruction given them. If any of them are brought under the influence of religion, their piety partakes of their degraded character and low condition, and there is little prospect of raising up among them a well-qualified native agency to carry on the good work among their countrymen, or among neighbouring tribes and nations. The advantages to which we have alluded are to be found only among nations somewhat advanced in civilization, and in its ordinary accompaniments, education and literature. It is a remarkable and not uninstructive fact, that Judea, the point from which Christianity originally emanated, was the very centre of the then civilized world, and that the countries in which it was at first chiefly propagated, so far as appears from the New Testament and other authentic records, were the countries in which civilization, education, and literature principally prevailed."

It is not unworthy of remark, that while considerable numbers of pagans have been brought to embrace Christianity, there have been very few Mohammedan converts. This is no doubt partly accounted for by the fact, that where the ruling power is Mohammedan, it is death for any one to renounce the faith of the prophet and to embrace another religion; and with death thus staring them in the face, we need scarcely wonder that few or none should embrace the gospel. But in countries where the ancient churches are still in existence—Turkey for example—there are other and powerful obstacles besides these to the conversion of the Mohammedan population, arising out of the character of these churches. The Mohammedans in the Levant sustain a better character than the Christians. The universal testimony of the Franks is, that there is more honesty, more fair dealing, and more punctuality to engagements among the Turks than among the Christian sects. "It may even be fairly made a question, whether Mohammedanism is not a better religion than the Christianity of the East, from which they naturally take their ideas of what Christianity

is. Assuredly it is in various respects a less absurd religion. The form in which it is daily presented to them is as a system of idolatrous worship, of gross superstition, of senseless rites and ceremonies, of absolute and pure mummery; while both priests and people are, in point of morals, generally much below themselves. They have thus exhibited before their eyes very natural and very plausible reasons for rejecting Christianity; and it is no wonder that these objections should carry entire conviction to their minds, and lead them to think any further inquiry in regard to it perfectly unnecessary." But even in those countries where the government is not Mohammedan,—India for example,—the Mussulman part of the population are much more opposed to Christianity than the Hindu. They at once despise and hate it. We accordingly find comparatively few converts among the Mohammedans even in India.

Missionary societies have not confined their labours to heathen nations. Several of them have also established missions among the members of the ancient churches, as among the Greeks, the Armenians in Turkey, the Copts in Egypt, the Abyssinians, the Syrians, and other sects in the mountains of Lebanon, the Nestorians in Persia, and the Christians of St Thomas, on the coast of Malabar. It is not unworthy of notice, that these societies, though differing essentially from each other in their character and views on other subjects, wonderfully agreed in the principles on which they proposed to carry on their missions among the ancient churches. The grand object which they had in view was to introduce and diffuse Scripture truth among them, and thereby to revive spiritual life among them, in the hope of effecting their reformation through the instrumentality of their own members: they repudiated the idea of drawing converts out of them, or forming them into separate churches. But after the several societies had prosecuted this scheme for many years, they came, one after another, to the conclusion that it had entirely failed of its great object, and that the only way to deal with these churches was to receive the converts from them and to unite them with their own churches, just as they would do with heathen or Mohammedan converts. The result of such experiments might, we think, have been easily foreseen, and having now been fully tried, we trust they will not be again repeated.

"It is a remarkable fact, how generally missionaries in various parts of the world, and among diverse tribes and nations, bear testimony to the equality of the acquiring faculties of the children in the schools with that of European children. We could adduce testimonies to this effect regarding the Greenlanders, the North American Indians, the Negroes in the West Indies, the South Sea Islanders, and even the savages of New Holland. Nor do we recollect of ever meeting with a single testimony of a contrary nature. It may therefore be considered as an established fact, that whatever differences there may be in the original intellectual capacity of individuals, there is no material difference in the original intellectual capacities of tribes and nations, so far as the *learning* faculties are concerned, at least in regard to the more common branches of education, with the exception, perhaps, of arithmetic. Whether their original powers of reasoning, of imagination, of invention, are equal, is another question. On that point we have not sufficient evidence to enable us to form an opinion."

Missionaries have contributed largely to the science of philology. They have drawn up grammars, vocabularies, and dictionaries of numerous languages, most of them never before reduced to writing, or little known to scholars; and they have made translations of the Holy Scriptures, in whole or in part, and also of other books, into many of them. Many of these works are probably not very well executed, their authors not having been previously much engaged in the study of languages; but others of them, we doubt not, are scholar-like productions; and the whole cannot but be held a valuable contribution to philological science. In the oriental languages missionaries have particularly distinguished themselves; there are, in fact, few men to whom oriental literature is under such great obligations as to the missionaries in the East.

It is also worthy of notice into how many countries the printing-press has been introduced by means of missions. As regards the extension of the press to new countries, and its application to new languages, there is no class of men to whom mankind are under such obligations as to the missionaries of modern times. India itself is deeply indebted to them, particularly to the Baptist missionaries, who, though they were not the first to employ the press in that country in printing the oriental languages, contributed greatly to its extension and improvement. This powerful engine in diffusing opinions is now in extensive use by the natives themselves, and is employed by them in defence of Hinduism, Mohammedanism, and Parseeism, and in attacks on Christianity itself. The weapons of the missionary are thus turned against himself.

These statements refer exclusively to Protestant missions; but before we close we shall make some brief references to the missions of the Roman Catholic Church. She entered on the work earlier than the Protestant churches, and has prosecuted it for a much longer period. Having at the Reformation lost much ground in Europe, she sought to retrieve her losses by extending her power in other quarters of the world. In this service the Franciscans, Dominicans, and Capuchins, but especially the Jesuits, particularly distinguished themselves. They established missions in India, in Siam, in China, in Japan, and in some of the East India Islands; in Abyssinia, on the Western coast of Africa, in Canada, in Louisiana, in Paraguay, and many other parts of the world; and brought great numbers of the inhabitants of these countries within the pale of the Romish Church. But in the course of the eighteenth century the Catholic missions greatly declined; their pecuniary resources were materially dried up; the missionaries died, and no successors were found for them; and the consequence was, that many of them fell into a state of decay. (*Annals of the Propagation of the Faith*, vol. v., p. 134.)

But in 1822 an "Institution for the Propagation of the Faith" was formed at Lyons, with a view to the promotion of missions by the Romish Church. It now carries on its operations through two councils, one at Lyons, the other in Paris; and it has drawn to itself the support not only of the rest of France, but of the various countries of Europe, and other parts of the world, where Roman Catholics are found. Through its influence and exertions the ancient spirit of missions has been revived in the Romish Church; many of the old missions have been restored to somewhat of their former vigour, and many new ones have been undertaken in various parts of the world, including our own and other Protestant countries—to which, indeed, their eyes appear to be specially directed. To show the extent of their missions in the present day, we shall here state the number of bishops and priests engaged in them, and the amount of money expended on them.

In 1844 the number of bishops and priests engaged in them was as follows:—

	Bishops.	Priests.
In Europe	27	843
„ Asia	71	2736
„ Africa	6	168
„ America	28	890
„ Oceanica	7	113
	139	4750

Since that time the number of labourers of one description

or another, including Sisters of Charity, appears to have been greatly increased. (*Annals*, vol. v., pp. 138, 148, 153.)

In 1856 the receipts of the Institution for the Propagation of the Faith amounted to 3,905,067f. 71c., which, taking the exchange of the franc at 10d., makes L.162,711, 3s. 1d. sterling; and its expenditure on account of the missions was 3,689,663f. 22c., or L.153,735, 19s. 4d., viz:—

Missions in Europe	819,221f.	70c.
„ Asia	1,314,796	87
„ Africa	277,642	0
„ America	909,397	35
„ Oceanica	368,605	30
	3,689,663	22

The following were the receipts and expenditure in Great Britain, her colonies in America, the United States, and in India and China, in 1856:—

	Receipts.		Expenditure.	
England	40,825f.	65c.	123,500f.	0c.
Scotland	3,528	0	58,000	0
Ireland	132,446	68	100,000	0[1]
British America	64,661	3	235,690	35
United States	51,643	23	596,707	0
India and Ceylon	1,979	15	379,604	57
Chinese Empire	—		347,031	71
	295,083f.	74c.	1,840,533f.	63c.

It thus appears that the expenditure on the missions in Great Britain and the other countries now named, forms just about one-half of the whole expenditure of the Society on missions throughout the world. (*Annals of the Propagation of the Faith*, vol. xviii., pp. 150, 158, 160, 162, 174, 179, 181, 183.)

As regards the methods of conversion employed by Protestant and Romish missionaries, there is little in common. There is one means of regeneration employed by the latter which seems quite a favourite measure with them, and is deserving of notice as a specimen of their system,—the baptizing of sickly and dying infants, a singular compound of gross error, frivolity, and deception.

"For a long time"—(we here quote the *Annals of the Propagation of the Faith*)—"it was not possible to regenerate in the waters of baptism the children of infidels—only in some isolated places. The number of those who went from the cradle to the grave with the seal of baptism was still small, and for this reason we have seldom made mention of it in our *Annals*. But of latter years this benefit has been extended in a most consolatory degree. Our missionaries, with the assistance of the alms of the Association, have succeeded in rendering it general among the principal Christian congregations of Asia. We shall soon have much to do to reckon the young elect with which they will people heaven. Even now the account of those whom they have sent there is sufficiently large to draw forth the gratitude and the admiration of our faith; and accordingly we offer it to our associates with a religious eagerness. It will consist of figures only; but figures are very affecting when they express a multitude of souls gained for the happiness of heaven."

"The mission of Su-tchuen," writes his lordship, Doctor Perocheau, vicar-apostolic of Su-tchuen, "continues its work of baptizing children in danger of death, and the Lord continues to bless it. Each year the number of those whom they regenerate goes on increasing:—

It was in 1839	12,483
„ 1840	15,766
„ 1841	17,825
„ 1842	20,068
„ 1843	22,292
This year (1844) amounts to	24,381

"We have remarked that about two-thirds of the number of these children died in the year in which they were baptized. Thus, out of the number of 1844, 16,763 winged their flight a short time afterwards to everlasting bliss.

"We pay some Christian men and women, who are acquainted with the complaints of infants, to go, seek out, and baptize those whom they find to be in danger. It is easy for them to meet them, particularly in the towns and large villages, where on fair days there is to be seen a crowd of poor people, reduced to the greatest poverty, who come to seek alms. It is in winter especially that the number is highest, because want is more pinching at that time. You see them on the roads, at the gates of the towns and villages, or crowded together in the streets; poor people without number, with hardly any clothing, having neither fire nor lodging, sleeping in the open air, and so attenuated by the protracted torture of hunger, that they are nothing but skin and bone. The women, who are in this case the most to be pitied, carry on their backs children reduced to the same extremity as themselves. Our baptizing men and women accost them in the gentle accents of compassion, offer them gratis pills for their little expiring creatures, give often to the parents a few farthings, always with great kindness of manner, and an expression of the liveliest interest in their situation. For these poor creatures it is a sight of transport almost unheard of. They willingly allow our people to examine into the state of the child, and spill on its forehead some drops of water, which they declare to be good for it, while at the same time they pronounce the sacramental words." (*Annals of the Propagation of the Faith*, vol. vi., pp. 322, 324.)

Dr Perocheau does not appear to reckon so much on the success of his mission among the adult population as with these poor children, and he glories in the great increase of their numbers. In a letter dated Sept. 4, 1848, he thus writes:—"In spite of the obstacles which the mandarins throw in the way of the conversion of the infidels, we have received as catechumens 1280 neophytes, and baptized 888 adults in the year. God be praised! But our Angelical Society it is which gives us the greatest consolation. The number of the children of the infidels baptized in danger of death continues constantly to increase. This year it amounts to 84,416, about two-thirds of whom, already in possession of unutterable felicity, will love and praise God eternally. The more we receive aid from Europe, the more will this work extend its benefits. We have opened in several cities small shops, where Christian physicians gratuitously distribute pills for young persons who are sick, and generously give attention of all kinds to the children brought to them. This work produces marvellous effects, causes a very large number of children to be baptized, and singularly pleases the heathens. In order to explain the prodigious success of our angelical work, you must be informed that all China is covered with poor persons, reduced to the last degree of wretchedness, and burdened with numerous families. Their children lack everything; no food, no clothes, almost no shelter. The mothers die of hunger and cold; the infants they support perish with them. It is these nurses which give an abundant harvest to our baptizers, who seek these poor wretches in preference to others, accost them with kind words, testify a warm interest in their young families, give pills, and sometimes add alms. They are therefore regarded as angels descended from heaven, and are easily allowed to baptize the perishing little ones. Some of our physicians have often effected wonderful cures, and though their skill is small, enjoy extraordinary repute. Hippo-

[1] We have included in this sum 58,000f. on account of "Missions of the Rev. Father Oblates of Mary in England and Ireland," not being able to apportion the particular sums appropriated to each country.

Missions. crates was not lauded so much. Sponges are here unknown. We fell on the idea of getting some from Macao, as more convenient than cotton for baptizing. The pagans admire these sponges, and regard them as an infallible remedy. They are delighted at seeing the foreheads of their sick children laved with so marvellous an instrument. We hope that next year the number of our baptized infants will reach a hundred thousand; by and by it may amount to two hundred thousand a year if you send us good support. In no other part of the world can your money achieve the salvation of so many souls. After the conversion of China, which contains more than three hundred million of inhabitants, you may compute the multitude of little Chinese which will every year ascend to heaven."

Dr Retord, bishop and vicar-apostolic, Tong-King, after reporting the baptism of 9649 infants in 1849, states as among the means of this success the following:—"A collection is made, and a small capital acquired. This capital is employed in trade, or laid out in the purchase of a piece of land. With the income we purchase boards to make coffins and religious and funereal tokens; then, when the children of the pagans die, the society give them a solemn interment, with music and a drum, and a troop of little children of both sexes, who follow the procession. The heathens are ravished with the pomp; so that when one of their children falls sick, they of their own accord entreat us to go and baptize it. There is in the mission at present a great zeal for this work; but to sustain this ardour I must get many books, images, and chaplets made. All the objects of the kind you have sent me are used for this purpose; but they are not enough. I am getting made here many chaplets for this purpose. Nevertheless, we shall never reach the number of baptisms in China, for the people here are very fond of their children." ("Annales de la Propagation de la Foi," 1850, p. 127, and 1851, p. 273, in *Journal of Sacred Literature*, April 1852, p. 23.)

M. Fontaine, missionary-apostolic in Cochin-China, gives the following account of the plans followed in that country:—"You will receive with pleasure some particulars concerning one of our works, little in appearance, but productive of great results for the salvation of souls; I allude to the pagan children baptized on the point of death. Every one can take part in it; but we may say that it is principally the business of the women: they can more easily get into the houses, and people are less on their guard against them than against men. Through their charitable cares a considerable number of these little creatures have hardly received life before they exchange it for the unending joys of paradise.

"In a village of which the mayor is a Christian there exists a house of nuns, whom his lordship (the bishop) sends out in different directions to look for these hapless children. They go generally two by two,—an old one and a young one; and while the elder one enters into conversation, the other, who, in good manners, should leave her to speak, draws near the mother, who is holding the sick child, or sits down near the mat on which it is left. She fondles it, takes it in her arms, and whilst she caresses it, she succeeds in dropping on its forehead a little water out of a bottle which she keeps concealed in her long, wide sleeve. (*Annals of the Propagation of the Faith*, vol. vi., p. 328.)

The missions in the South Sea Islands have been established but of late years; but here also we find a similar practice. "I have always with me," says Dr Battaillon, bishop and vicar-apostolic, "a flask of scented water and a flask of plain water. I begin with sprinkling a little of the scent on the head of the infant, under pretence of comforting the babe, and whilst the mother takes pleasure in spreading it over the baby's face, I dexterously change the flask, and use the water which conveys regeneration, without any suspicion being excited of the nature of the action."

We also read the following statement in a letter inserted in the *Annals*:—"The child which we baptized so hastily, since it seemed at its last hour, died last night, *to our great joy*, for its death ensures its eternal happiness."

We leave these statements to speak for themselves. We would scarcely have ventured to give them if they had not rested on the most undoubted Roman Catholic authority.

(For a general history of Protestant Missions, we may refer to Dr Brown's *History of the Propagation of Christianity among the Heathen*, in 3 vols., third edition, 1854. We regret we are not able to name any general history of Roman Catholic missions.) (W. B—M.)

Mississippi. MISSISSIPPI, one of the largest of the southern states of the North American Union, is bounded,—N. by Tennessee, W. by the Mississippi River, which separates it from Arkansas and Louisiana, S.W. by the Pearl River, S. by Louisiana and the Mexican Gulf, and E. by Alabama. It lies between N. Lat. 30. 10. and 35., and W. Long. 88. 12. and 91. 36. It extends for about 330 miles from N. to S., with a mean breadth of 120 miles, and contains an area of 47,156 square miles, or 156 square miles more than that of New York. The state, in its physical aspect, presents no prominent hill-ranges, but abounds in rivers. The Mississippi with its tributaries on the west, the Tombigbee and Pascagoula on the east, Pearl River in the central section, and the Tennessee skirting the north-east corner, drain the entire territory. Among the tributaries of the Mississippi the principal are,—the Yazoo, which flows from N.E. to S.W., almost parallel with the main stream, and joins it near Vicksburg; and the Big Black, a smaller tributary, which joins the Mississippi some forty miles lower down. All of these rivers are navigable for steamers. A chain of lagoons and bays form the southern or gulf coast of Mississippi, among which are Pascagoula Inlet, Biloxi Bay, St Louis Bay, &c. The upper portion of the state, which has been in cultivation for about twenty years, possesses an undulating surface heavily wooded with oak, hickory, &c.; it is, however, but scantily watered. The uplands produce abundantly, but only for a short time; while the soil of the valley lands is much firmer, though liable to be submerged by quantities of sand brought down from the higher grounds during the heavy floods. The prairie or Tombigbee country covers the north-eastern section of the state. Its surface is uniformly level, presenting an almost unbroken flat, with scarcely a tree, covered with rank grass, and dotted with pools and marshes. The soil, formed of a dark heavy loam, has, however, surprising strength and fertility. East Mississippi, along with the southern and south-eastern sections, is the healthiest part of the state: the air is pure and the water good. Its soil varies very much in quality, in some quarters being deep and rich, while in others exceedingly poor. It is generally well adapted for pasturage; and indeed the rearing of cattle forms the chief employment of the inhabitants. The section of the state washed by the Gulf of Mexico is well known for its healthy watering-places, which are frequented during the hot season by the wealthier classes of the entire southern country. The interior of this portion of the territory between Pascagoula and Pearl Rivers is occupied by a sandy, broken tract, covered with pines, which have been recently used for the production of turpentine. The most fertile soil of the whole state, however, is to be found in the valley of the Mississippi, where it possesses all the strength without the adhesive and corrosive nature of the prairie land. The climate of this region is likewise not insalubrious. A great drawback, however, exists here in the frequent occurrence of inundations, which have as yet not been wholly prevented by the construction of dykes sufficiently strong and elevated.

In such portions of the state as are removed from stagnant waters, which in this climate must always be deleteri-

Missis-sippi.

ous to health, and where access to pure spring water is to be had there is perhaps no part of the Union where the inhabitants enjoy better health. Though bilious attacks are generally prevalent, the people are exempt from pulmonary and catarrhal affections, so fatal in the more northern states. The central and southern sections have a climate similar to that of South Alabama, Georgia, and the northern portions of Louisiana and Florida.

Agriculture.

Every product of the South may be grown in Mississippi, including the sugar-cane,—which, however, is but little cultivated,—tobacco, corn, rice, cotton, potatoes, indigo, grapes, oranges, figs, peaches, &c. Cotton, the grand staple of the state, comes to perfection in every part of it, and is almost the exclusive object of attention with agriculturists. In 1850 there were 15,110 cotton plantations, producing annually more than five bales each, being a larger number than in any other state except Alabama. The cotton crop of Mississippi is one-fifth of the whole North American growth, and is almost exclusively the product of slave labour. The number of slave-holders at the last census was 23,116; and of these 3640 possessed only one slave, 6228 held from one to five slaves, 5143 from five to ten, 4015 from ten to twenty, 2964 from twenty to fifty, 910 from fifty to a hundred, and 216 from one hundred to five hundred. In 1850 the state contained 33,960 farms, comprising 3,444,358 acres of improved land, whose cash value amounted to L.11,403,631; that of the implements employed thereon to L.1,190,609. The number of horses, asses, and mules, at the same date, was 170,007; of neat cattle, 733,970; sheep, 304,929; and swine, 1,582,734. There were also 137,990 bushels of wheat produced, 22,446,552 bushels of Indian corn, 5,003,277 of Irish and sweet potatoes, 193,401,577 lb. of cotton, 2,719,889 lb. of rice (rough), 49,960 lb. of tobacco, and 559,619 lb. of wool. The above are the leading agricultural products. Besides these there are rye, oats, barley, buckwheat, hay, hops, seeds, butter and cheese, pease and beans, fruit, honey, wax, poultry, wood, molasses, sugar, silk, wine, &c.

Manufactures.

Manufactures are in their infancy in Mississippi, and do not seem likely to make any early advances. The capital invested at last account was but L.361,962; the production about L.625,000; and the hands employed, 3178. Of this capital L.7916 was employed upon cotton manufactures, and L.20,883 upon iron castings.

Commerce.

Commerce is confined almost entirely to the operations connected with cotton, and to the retail trade; and although there are several towns of considerable population, nearly the whole foreign commerce of Mississippi is conducted through the cities of New Orleans and Mobile.

Internal communication.

Within the last two years much spirit for internal improvements has been evinced in Mississippi. The Southern Railroad extends from Vicksburg to Brandon, 60 miles, and it is intended to connect it with the railway system of Alabama. The New Orleans, Jackson, and Great Northern Railroad will traverse the entire state in the direction of Nashville; and some portion of the work is already completed. The Central Railroad is also being constructed with vigour, and is intended to connect the capital with Holly Springs, and, pursuing a northerly direction, with the mouth of the Ohio River. The Charleston and Memphis Railroad passes through a small part of the northern portion of Mississippi. From the facilities of construction, it may be asserted that the railway system of Mississippi will soon exceed that of any other south-western state. In 1855, 239 miles of railroad were completed, and 755 were in progress.

Constitution.

The state constitution of Mississippi was adopted in 1817, and revised in 1832. Suffrage is free. The legislature consists of a Senate and House of Representatives, and meets biennially. The governor is elected for two years, and receives a salary of L.800 per annum. The judiciary consists of a high court of errors and appeal, circuit courts, a superior court of chancery, district courts of chancery, and a probate court in each county. All the judges are elected by the people, this being one of the earliest states to adopt that system, the bitter fruits of which are beginning to show themselves in many quarters.

In 1855 the expenditure of the state government was L.65,260, the principal items of which were—Executive department, L.2900; judiciary, L.21,500; university, L.3280; internal improvements, L.20,600. The net revenue amounted to L.100,775, the sources of which were,—Taxes, L.68,970; internal improvement fund, L.13,200; school land fund, L.12,400. In 1856 there were 15,913,532 acres of land subject to tax.

On the 1st of January 1856 the Northern Bank of Mississippi had a capital of L.50,000; loans and discounts of L.101,750; specie, L.1619; circulation, L.67,516; deposits, L.7000.

Education.

An asylum for the blind, one for the deaf-and-dumb, and a lunatic asylum, are in operation, under the support of the state, at Jackson, where the penitentiary is also located. There is no uniform common school system for the whole of the counties; each county has its school lands, allotted by government and leased for long periods, the money being invested for the benefit of the schools. There is also a fund made up in the several counties; but the whole is very inadequate to the wants of the state. In 1850 there were 11 collegiate institutions in the state, with 862 students; 782 public schools, with 18,746 pupils, and L.53,000 income; and 171 academies or other schools, with 6628 students; total number attending school, 48,603. There were at the same time 1016 churches, of which 385 were Baptist, 454 Methodist, 13 Episcopalian, 143 Presbyterian. Four tri-weekly papers were published, 46 weekly, and several daily. The public libraries of schools, colleges, &c., contained 22,000 volumes.

History.

The settlement of Fort Rosalie near Natchez was the first permanent one made in Mississippi by the French, under Bienville; but a general massacre of the whites soon followed, which left the country again in the hands of the savages. A series of conflicts ensued, terminating generally in favour of the whites; and at the peace of Paris 1763 Mississippi became a part of the English territory. Settlers from Nova Scotia and the eastern states soon followed fast upon each other. The district was surrendered to the United States after the peace of 1783; and in 1804 the Mississippi territory comprised the whole of the present state of Alabama, from the 31st to the 35th degree of north latitude. This territory was organized under that name in 1798; but in 1818 the eastern portion was separated, and the remainder was admitted into the Union as the state of Mississippi.

The following statistics will show the progress of Mississippi in population from the earliest records:—

	1800.	1810.	1820.	1830.	1840.	1850.
Whites........	5179	23,024	42,176	70,443	179,074	295,718
Free coloured	182	240	458	519	1,366	930
Slaves..........	3489	17,088	32,814	65,659	195,211	309,878
Total......	8850	40,352	75,448	136,621	375,651	606,526

The following are the principal towns of Mississippi, with their population at the last census:—Vicksburg, 3678; Natchez, 4334; Columbus, 2611; Jackson, 1872; Yazoo City, 1910.

Mississippi (*Missi Sipi*, "The Great Water"), the most important river in North America, and, with the Missouri, its principal affluent, or more properly its main branch, the longest river in the world. In N. Lat. 47. 10., W. Long. 94. 54., and at a height of 1680 feet, on the summit of the Hauteurs

de Terre, a dividing ridge from the Red River basin of the north, are the sources of this great river. At first, a little rivulet, it pursues its timid course over sand and pebble, ever and anon blending with kindred streams, and at length forming a small lake. Another rivulet issues thence with increased velocity, giving rise to more decided bends, and emptying at last into the Itasca Lake. There, beyond the haunts of civilized man, the "father of waters" takes his course through glades, over crags and precipices,—now a broad stream, and now a confined impetuous torrent,—gradually gaining in strength and vigour as kindred waters meet and sweep on together, leaving the savage intractable forest, and the creatures which inhabit it, to be cheered by sounds of industry and toil as it nears the ocean.

After flowing in a very tortuous course through various climates and eighteen degrees of latitude, and washing the shores of many populous states, the Mississippi empties itself through several mouths into the Gulf of Mexico, in Lat. 29. N., Long. 89. W.

The following table is made up on the authority of the engineer Nicollet, who in the service of the American government explored this region:—

Distances on the Mississippi.

	From Gulf of Mexico. Miles.	Altitude. Feet.
New Orleans cathedral	104	10·5
Mouth of Red River	340	76
Natchez	406	86
Mouth of Yazoo	534	...
New Madrid, Missouri	1115	...
Mouth of the Ohio, north side	1216	324
St Louis cathedral	1390	382
Mouth of Illinois River	1426	...
Prairie du Chien	1932	642
Upper Iowa River	1978	...
Mouth of St Peter's River	2192	744
Falls of St Anthony	2200	856
Lake Cass	2775	1402
Itasca Lake	2890	1575
Utmost sources of the Mississippi	2986[1]	1680

If the Missouri be considered as a continuation of the Mississippi, the length of the entire river will be 4350 miles.

The following table, prepared for his *Geographical Dictionary* by Mr Darby, gives the area of the Mississippi valley, or the region drained by that river and its tributaries:—

	Miles.
Valley of the Ohio	200,000
Mississippi proper	180,000
Missouri	500,000
Lower Mississippi	330,000
	1,210,000

The valley of the Mississippi comprises nearly one-half of the territory of the American states.

Professor Riddell of Louisiana estimates the true superficial area of the delta of the Mississippi, or that portion of its basin below Baton Rouge, where the last bluffs show themselves, at 15,000 square miles,—the alluvial mass being 200 miles in length, 75 miles in width, and ⅒th of a mile in depth. The rise of the basin of the river is only 9 feet before reaching New Orleans, and beyond that not more than an average of 6 inches in the mile. The delta gains upon the sea not more than a mile in 100 years; and Professor Lyell estimates that 100,000 years were required in its formation.

Large sums are continually appropriated by the government for deepening the channels, but hitherto without permanent effect. In the early part of 1857 a fleet of vessels were aground in these passes at the same time. Old channels are continually being filled up, and new ones formed.

As indicative of the vast growth of the Mississippi valley, it may be stated, that in 1790 the whole population of the valley amounted to 205,280; in 1800 to 582,619; in 1810, 1,337,946; in 1820, 2,419,369; in 1830, 3,794,477; in 1840, 5,983,707; in 1850, 8,641,754; and in 1857, may be safely set down at between 10 and 11 millions. Even this is but a density of about 7 persons to the square mile, while the average density of the Atlantic states is 19·98 to the square mile, and of the middle states 57·79: that of England is 332 to the square mile. With this last density, the valley of the Mississippi could accommodate more than 400,000,000 persons, or about one-half of the present population of the earth.

The inauguration of steam on the western waters in 1811 was the first step in the enormous progress of this valley, and without which it must have remained a wilderness, notwithstanding the great lines of communication that have been opened to the Atlantic coast. In 1815, 14 steamers were employed; in 1829, 230; in 1843, 600; and in 1856, 1500. The total commerce afloat in 1852 was estimated by the secretary of the Treasury, Mr Corwin, at L.70,729,738, or, with the great lakes, L.136,245,042, nearly equal to double the foreign imports and exports together of the entire Union at that time.

Steamers of magnificent size and accommodation ply on this river, and make the trip from New Orleans to St Louis in five days, to Louisville in about the same time, to Cincinnati in six or seven days, and to Pittsburgh (2175 miles) in ten days, at a charge for passengers of the first class ranging from L.3 to L.5. In no part of the world can such economy in travelling be found.

Below the mouth of the Ohio the depth of the Mississippi varies from 90 to 120 feet, and its breadth from 600 to 1200 yards. At New Orleans the width is ⅓d of a mile, and the depth 100 feet. The lower river is restrained within its channel by embankments thrown up with great labour and expense. The average height of the flood of the river below the Missouri is 15 feet; at the mouth of that river, 25 feet. Below the Ohio the rise is often 50 feet; at Natchez it seldom exceeds 30 feet; and at New Orleans 12 feet. Large ships have seldom ascended the river higher than Natchez.

The Mississippi had been casually visited in 1542 by De Soto, but not in any proper sense discovered. He saw but a few leagues of its course, from which no idea was obtained of its rise, direction, extent, or relations with the continent. It is mentioned in Coxe's *Carolana*, that in 1678 a number of persons went from New England to Mexico, in which expedition they crossed the Mississippi, and on their return gave an account of their discovery to the governor at Boston. During the missionary labours of the Jesuits in Canada, two fathers, Joliet and Marquette, having heard vague rumours of the existence of the "Great River" left Mackinac in 1673, ascended the Fox River from Green Bay in canoes, passed to the Wisconsin, and down that river to the vast waters of the Mississippi, which they navigated for 1100 miles. Some years afterwards La Salle reached the Mississippi from Canada, and, returning to France, fitted out an expedition to explore the river from the gulf. The expedition made land on the 1st January 1685, 100 miles westward of the mouth of the river, which but a small portion of the party succeeded in reaching, and returned thence to Canada. In 1700 M. Iberville colonized the country; in 1769 it was ceded to Spain; in 1800 was retroceded to France; and in 1803 passed into the possession of the United States. (J. D. B. De B.)

[1] Schoolcraft makes the distance 3160 miles.

Missouri.

MISSOURI, one of the middle western states of the North American Union, bounded on the N. by Iowa, E. by Illinois, S.E. by Kentucky and Tennessee, S. by Arkansas, and W. by the Indian territory and the territories of Kansas and Nebraska. It is the largest of the states in the American Union, with the exception of Texas and California, having an area of 67,370 square miles.

Physical aspect.

A large portion of the south-eastern section of the state, to a considerable distance W. from the Mississippi River, is low, swampy, abounding in lakes, and subject to inundations. Beyond this the country swells into roundish hills, rising continuously to the mountainous districts of the lead mines. Farther still it is broken and hilly, until it reaches the boundless prairies of the western limits of the state. The lands of Missouri are generally more loamy and friable, and the soil less stiff, than upon the Ohio. The rich uplands are of a darkish gray colour, except about the lead mines. The poorer uplands are generally covered with white oak, and are of a light yellow colour; the prairies are for the most part level, and of an intermediate character between the richer and poorer uplands. Those which are alluvial, as in the N. between the Mississippi and Missouri, are always rich; as are also the bottoms of all the water-courses. Those of the Missouri are loamy, intermixed with sand; those of the Mississippi are blacker, more clayey, less sandy, and, if not so immediately fertile, are more inexhaustible. Great varieties of soil abound in Missouri, from best to worst, and there are extensive tracts of each; but in general the better districts are of great fertility, indicated by a rank and abundant vegetation.

The Ozark Mountains traverse a large part of Missouri. The Missouri River, which gives name to the state, and the Mississippi washing its boundary, give to Missouri the navigation of two of the greatest rivers in the world. By means of this navigation she can open her commerce with the Gulf of Mexico, and by the waters of the Ohio with the Atlantic states. The tributaries of the Missouri within the state are the Chariton and Grand Rivers from the N., and the Osage and Gasconade from the S.; whilst the Mississippi receives the Salt and the Maramec. The St Francis and White Rivers are on the south-eastern part of the state, and pass on to Arkansas.

Mineral resources.

The mineral wealth of Missouri has long been proverbial. Of lead the state produces immense quantities. The iron mountains are estimated to contain 600,000,000 tons of that metal. Copper is next in importance, and has been discovered in the Current River and on the Maramec, and in the southern parts of the state. Cobalt occurs in the form of black oxide and sulphuret, and is found in thin layers or in connection with manganese. Zinc also abounds in the lead mines, and might be worked to great advantage. It is estimated that the average quantity of silver contained in the Missouri lead mines is from six to eight ounces to the ton; but it has never been attempted to separate this before bringing the lead to market. Tin also is found. Nickel accompanies the copper; and cobalt and manganese are abundant over the southern parts of the state. Limestone is found in great quantities, and also marbles, beautifully crystalline and veined; gypsum, sandstone, porphyries, sienite, saltpetre, kaolin, and inferior clays. Bituminous coal exists in vast beds on both banks of the Missouri; and the largest body of cannel coal known is in Callaway county. A geological survey of the state has been ordered, and is in progress. The coal trade of St Louis alone in 1856 was estimated, on high authority, at L.528,150. The coal beds of the state, says the state geologist, can furnish 100,000,000 tons annually for 1300 years. In 1855 nine iron establishments at St Louis produced L.521,000, and the whole capital of the city invested in that branch of industry was about L.625,000. The smelting works engaged in Missouri in 1856 were estimated to produce 35,000 tons of pig-metal; and the state geologist says,—"There is ore enough of the best quality above the surface of the valleys to produce 1,000,000 tons per annum for 200 years, which would be worth L.1,042,000,000. But this is but a small part of the iron resources of the state, which would reach nearer L.20,000,000,000." (*Western St Louis Journal*, vol. xv., No. 3.)

Climate.

Below the mouth of the Ohio the climate approximates to that of the southern states. Throughout the state, however, it is generally of a variable character. The transitions are in many parts rapid and unfavourable to health. Winter commences about the last of December, when the Missouri becomes one solid mass of ice; and is mostly over in February. The snows are not deep. The greater part of the summer is intensely hot, though the freedom of the country from mountains admits of more or less breeze. The air is dry and pure. Autumn is serene, temperate, and delightful. Except in deep bottoms and unfavourable situations, however, the chances of life are as great in Missouri as in most countries reputed to be healthy.

Agriculture.

Farming is very easy. The soil is readily worked, and generally fitted for the plough. Fencing material is the only deficiency, and artificial hedges have been resorted to. In 1850 there were 54,458 farms or plantations, containing 2,938,425 acres of improved and 6,794,245 acres unimproved lands. The average number of acres to each farm was 179, and the average value, L.242: total value of farming lands, L.13,172,000; value of farming materials, L.829,500. The chief agricultural productions of the state were,—Swine, 1,702,625; wheat, 2,981,652 bushels; oats, 5,278,079 bushels; Indian corn, 36,214,537 bushels; potatoes, 1,274,511 bushels; hemp, 16,000 tons; cotton, 121,122 lb.; tobacco, 17,113,784 lb.; wool, 1,627,124 lb. It will thus be perceived that tobacco, hemp, Indian corn, and wheat are the leading agricultural products of Missouri. Among the smaller products were,—rye, barley, buckwheat, hay, hops, seeds, wax, honey, wood, flax, maple, sugar, molasses, rice, silk, wines; besides dairy, garden, and orchard products. In the state there were 5762 families holding 1 slave; 6878 holding more than 1 and under 5; 4370 holding 5 and under 10; 1810 holding 10 and under 20; 345 holding 20 and under 50; 420 holding over 50. The value of the real estate of Missouri in 1850 was L.13,917,128; personal, L.6,623,600 as rated for taxation; but the true value of both was given at L.28,593,270.

Manufactures.

This state, like others of the west and south-west, has as yet made but small advances in the manufactures. The latest official reports show that the capital invested was L.1,891,600; raw material used, L.2,593,000; hands employed, 16,870; wages paid, L.663,500; annual product, L.4,947,760. Of the above capital L.21,250 was invested in cotton manufactures, L.4375 in woollen, L.129,000 in pig-iron, L.39,000 in castings, L.8770 in wrought iron, L.62,500 in breweries and distilleries. The present amount of manufacturing capital in Missouri may be stated at double of the above statistics. In 1855, 603,352 barrels flour were manufactured in St Louis alone.

Commerce.

The large and growing commercial importance of St Louis, the chief city of Missouri, is universally acknowledged. Its chief receipts in the year ending 1st January 1856 were,—1,307,818 sacks corn; 331,368 bushels flour; 315,556 pigs lead; 18,000 hhds. and packages tobacco; 407,000 sacks salt; 58,215 hhds. sugar; 81,328 barrels and 8712 casks pork; 52,046 barrels molasses; 22,767 casks and 959,635 pieces bacon; 98,000 barrels and kegs lard; 93,186 bales hemp; 136,610 sacks coffee; 21,000 barrels and tierces beef; 64,868 sacks barley; 1,769,768 sacks wheat; 68,488 barrels whiskey. The number of arrivals of steamboats in the same year was 3449, of a tonnage of 918,791. Real estate, which in 1820 reached in value but L.857, in 1853 was valued at L.8,600,000. The foreign direct trade of

Missouri is very small, and scarcely exceeds L.200,000 or L.250,000.

Internal improvements.

The internal improvement system of Missouri is so devised that the business to be conducted will receive accessions from almost every road that can be constructed to the W. of the Mississippi. Diverging from a common point, and extending to the state line, her railroads will each form the basis of a system in the adjoining states; and as the revenues of the great west and of the Mississippi are developed, their business must increase to an amount almost incredible. The state is very liberal in its grants of aid to the railroads. Among those in progress are,—the Pacific Railroad, extending westward to Kansas, &c.; the Hannibal and St Joseph; the St Louis Iron Mountain; the North Missouri, connecting with Iowa: estimated length of these roads, 922 miles; and estimated cost, L.8,600,000. The actual miles in operation in the state are from 75 to 100. Missouri has pledged her state credit to the extent of L.3,960,000 in aid of this magnificent system of public works.

The state constitution of Missouri was adopted in 1820, but was amended in 1822, 1843, 1848, and 1850. The right of suffrage is free to all citizens of the United States who have resided one year in the state. The legislature meets biennially. The governor is elected for four years. The judiciary consists of a supreme court, circuit, county, and justices' courts, &c. The judges are elected by the people.

In 1856 the total expenditure of the state government was L.98,810, of which the poll tax was L.8224; land tax, L.32,660; slaves, L.13,240. The state debt of Missouri, as the railroads progress, will soon reach L.1,300,000. The banking capital in 1856 was L.251,000, with a specie basis of L.380,000, and a circulation of L.579,850.

There is a state lunatic asylum, with 80 inmates; a deaf-and-dumb asylum, with liberal endowment; an asylum for the blind; and a state penitentiary.

The school fund reaches in amount L.139,500, the revenue from which, and from state and from public schools, reaches yearly L.29,000, which is distributed among the counties. In 1850 there were 9 colleges, with 1009 students; 1570 public schools, with 51,754 students; and 204 other schools, with 8829 pupils. There are 2 medical schools, with 210 students; and the state university is liberally endowed. There were 878 churches, of which 300 were Baptist, 250 Methodist, 125 Presbyterian, 65 Catholic; value of church property, L.322,732. About 10 daily and 75 weekly or monthly newspapers are published in the state. The population of St Louis, the chief town, in 1850 was 77,860, and in 1857 was estimated at 125,000. The following statistics will show the progress of Missouri in population from the earliest records:—

Population.	1810.	1820.	1830.	1840.	1850.
Whites	17,227	55,988	114,795	323,888	592,004
Free coloured	607	347	569	1,574	2,618
Slaves	3,011	10,222	25,091	58,240	87,422
Total	20,845	66,557	140,455	383,702	682,044

By the state census of 1852, the white population was 623,319; free coloured, 2526; slaves, 87,172;—total, 713,017.

The region now known as Missouri was included by the French and Spaniards in the Illinois country, but was popularly and historically known as Upper Louisiana. In 1755 St Genevieve, the oldest town in the state, was founded, and in 1764 St Louis. Early settlements were made from Canada. When this country came into the possession of the United States in 1803, it was divided into two territorial governments,—Orleans, including the present Louisiana; and Louisiana territory, embracing Missouri and the upper regions of the Mississippi. In 1812 the name was changed to Missouri Territory; numerous American pioneers flocked in from Kentucky, Tennessee, Ohio, &c.; and American habits, institutions, and laws, soon became predominant. In 1817 application was made for admission as a state into the Federal Union, which led to fierce and stormy debates in Congress regarding the admission or exclusion of slavery. The discussion raged for two years, threatening the existence of the Union, and was only adjusted by a compromise, in which it was agreed that the institution of slavery should be recognised in Missouri, but in no other state north of the latitude of 36° 30′ which might be formed out of the territories of the Union. This compromise was abrogated by a new one made upon the admission of California; and when the territorial governments of Kansas and Nebraska were formed, the abrogation was distinctly referred to and confirmed. The supreme court of the United States has recently pronounced such a compromise to be *unconstitutional*, thus leaving the territories open to slavery or not, as may be determined upon by their inhabitants.

Missouri *River*. The Missouri River has its sources high in the Rocky Mountains, in Lat. 45. N., and Long. 110. 30. W., almost in the regions of British America. Its course is at first nearly N. to the Great Falls, when it bends to the E.N.E. till it joins the White Earth River, whence its course to its confluence with the Mississippi is generally S.E. But little serious impediment to navigation is interposed lower down than the Great Falls, a distance of 2575 miles from the mouth. The Missouri drains a basin of half a million square miles, and its whole length to its junction with the Mississippi is estimated at 3090 miles. Its course throughout is irregular and turbulent, abounding in rapids and bars. The United States engineers, who surveyed its whole extent in 1853–54, arrived at the conclusion that a steamer loaded, and drawing 24 inches, could navigate, from the opening of the season until the 1st of September, as far as Fort Union; and that one drawing 20 inches could go up even beyond Fort Benton. From the very elaborate report of these engineers, employed by the government to survey the several routes for a railroad to the Pacific, we condense the following interesting particulars in regard to the course of the river, its length, characteristics, and tributaries.

The Missouri enters the Mississippi in Lat. 38. 50. 50. N., and Long. 90. 13. 45. W. of Greenwich. Below the mouth of the Kansas its course is nearly E., and lies almost entirely in the state of Missouri. This portion is continuously settled with flourishing cities and towns; and the soil is of surpassing fertility, abounding in coal, iron, and other minerals. Its average velocity in this section is a little over five miles an hour. Concealed snags and sawyers are liable to occur in any part of the river, and its banks are heavily wooded from the mouth of the Kansas to the Mississippi. The principal tributaries between the mouth and Fort Leavenworth are the Osage, Grand, and Kansas Rivers, which are navigable,—the first, for six months in the year, 200 miles; the second at all seasons; and the last 150 or 200 miles, obstructed, however, by two sets of rapids. The valley of the Missouri possesses great resources for future wealth and influence. From the mouth of the Kansas to near the parallel 40. 38. N. Lat., this river separates the state of Missouri from the Indian territory, and from that point to the Big Sioux, separates Iowa from the Indian territory. Before reaching the Platte, the Nodawa, Little Tarkio, Big Nemaha, Nishnabotana, and Little Nemaha, minor streams, enter the Missouri. In uniting with the Missouri the Platte forms a delta, and debouches through three channels varying from 30 yards to 350 yards in width. The delta is composed of sand-bars, and intersected by numberless sloughs. From its mouth to Fort Laramie the

Platte is 700 miles long, and is less tortuous than the Missouri. Below the fork the bed of the stream is occupied with vast quantities of drifting sand or quicksand, so that the depth may not be more than 3 feet, and cannot be made available, it is thought, for purposes of navigation. The course of the Missouri from the mouth of the Platte to the Kansas is S.E., and its length 236 miles. Carboniferous limestone and coal measures form the principal geological features of this part of the river. From the mouth of the Platte to Fort Pierre the distance is 638 miles; from Fort Pierre to the Big Sioux the direction of the river is S.E. Council Bluff, situated on the left bank, is the last town now seen on ascending the Missouri, and is the *ordinary* head of steamboat navigation. The soil of the bottoms on this part of the river is very rich. The Big Sioux is 100 yards wide at its mouth, and navigable for steamers to the rapids; it is susceptible of improvement. Within a few years the channel of the Missouri has changed here several miles from north to south. From the mouth of the Platte to Fort Pierre the Missouri varies in width from 400 to 1000 yards, and its valley becomes less fertile. From the mouth of the Big Sioux to that of the White Earth the Missouri separates Minnesota from the Indian territory. From the mouth of the White Earth to Fort Clark the course of the river is S.E., and then is S. to Fort Pierre,—the whole distance being 715 miles. Here the great northern bend of the river is found. The Yellow Stone enters still further up, and is navigable 200 miles to the rapids. The channel of the Missouri becomes now entirely choked by sand-bars. In 1853 a steamer ascended in forty-two days to Fort Union, and returned to St Louis in seventeen days more; and but for the ice, steamers might even ascend to Milk River throughout the year, this being the highest point to which navigation has been carried.

The Missouri is affected by two annual floods, which greatly facilitate navigation by larger steamboats. The first and lesser flood is caused by the melting of snows on the prairies, and generally takes place in May; the second is occasioned by the melting of the mountain snows, and occurs in June. Steamers, heavily laden, and bound for the Yellow Stone, should leave St Louis about the middle of April, in order to have the benefit of the June rise. The river above Council Bluff City is closed by ice from about the middle of November to the 1st of April. (J. D. B. De B.)

MITAU, a town of Russia, capital of the government of Courland, situated in a flat marshy country on the Aa, near its confluence with the Drixe, 27 miles S.W. of Riga. The town, which is built principally of wood, covers a large space, and is well provided with gardens and pleasure-grounds. Its streets are narrow, irregular, and are for the most part unpaved. The principal building of the place is the castle, built by Marshal Biron in 1739 on an island inclosed by the Aa canals, and formerly the residence of the dukes of Courland. There are also a museum, an observatory, two public libraries, a gymnasium, and two creditable picture galleries. The manufactures, consisting of linen, leather, and soap, are of little importance; and its trade is carried on chiefly during the great fair which is held here in midsummer. In 1788, after a devastating fire, a great part of the town was rebuilt; and subsequently it was honoured by the residence of Louis XVIII., then travelling under the title of Count de Lille. Pop. (1852) 13,819, about half of whom were Germans and nearly a sixth Jews.

MITCHELL, THOMAS, a philologist, was the son of a riding-master, and was born in London in 1783. From Christ's Hospital he passed as an exhibitioner to Pembroke College, Cambridge, in 1802. As he did not enter into orders, a fellowship which he subsequently obtained at Sidney Sussex College was taken from him at the end of a limited period, and he was forced to support himself by private tuition and by writing for the press. Several essays in the *Quarterly Review* on Aristophanes, and a metrical translation of the plays of that poet, were the groundwork of Mitchell's reputation. These were followed by editions of five dramas of Aristophanes and the entire works of Sophocles. Mitchell died at his house near Woodstock in 1845.

MITCHELL, *Sir Thomas Livingstone*, one of the most successful explorers of Australia, was the son of Mitchell of Craigend in Stirlingshire, and was born there in 1792. From 1808 till the end of the Peninsular War he served in Wellington's army. He was then raised to the rank of major, and employed by government to make surveys of the great battlefields in the Peninsula. At a later period the office of surveyor-general of New South Wales was conferred upon him. In this capacity, between 1831 and 1836, he led three exploring expeditions into the interior of Australia, undergoing great hardships, and exposing himself to imminent peril, yet sedulously collecting all possible information, both on geography and natural history. The results of these journeys were the discovery of the Peel River, the Nammoy, and Australia Felix, and the exploration of the courses of the Darling and the Glenelg. Major Mitchell published an account of his three expeditions, in 2 vols. 8vo, London, 1838. While in England superintending this publication he was knighted by the Queen, and received the title of D.C.L. from the university of Oxford. His last great exploring tour was begun towards the close of 1845, and aimed at discovering a route between Sidney and the Gulf of Carpentaria. The result was published in his *Journal of an Expedition into the Interior of Tropical Australia*, 8vo, London, 1848. Sir Thomas Mitchell died at Sydney in October 1855, and was honoured with a public funeral.

MITCHELSTOWN, a market-town of Ireland, county of Cork, pleasantly situated on the slope of a hill near the Funcheon, 30 miles N.N.E. of Cork. The town consists of a large square and two main streets, and contains several well-built houses. It contains a handsome parish church, a large Roman Catholic chapel in the form of a cross, a national school and library, besides a charitable institution, called Mitchelstown College, endowed for the maintenance of twelve gentlemen and eighteen gentlewomen of the Protestant faith. The inhabitants trade in pigs, grain, and butter; while in the vicinity there are both flax and blanket factories. Near the town is the seat of the Earl of Kingstown, one of the finest mansions in Ireland, built in 1823. Pop. (1851) 3091.

MITFORD, MARY RUSSELL, one of the most successful delineators of English rural life, was the only child of a physician, and was born at Alresford in Hampshire in December 1786. At the age of ten she was sent to a London boarding establishment. She was placed at the same time under the private tuition of Miss Rowden, a lady who was an indefatigable writer of verses, was fond of going to the play, had already educated Lady Caroline Lamb, and was yet destined to educate "L. E. L." and Fanny Kemble. Under such a governess Miss Mitford became inspired with a passion for poetry and the drama. She pored over the tragic authors of France, and doated on Shakspeare and his great contemporaries. In a short time her own fancy was quickened, and she produced within two years three volumes of juvenile poetry, which were afterwards published, and received a grave censure from the *Quarterly Review.* At the age of fifteen Miss Mitford left the boarding-school and returned home. Her father, a good-natured spendthrift, was now squandering the last remains of a competent fortune. The gaining of a Chancery suit soon afterwards brought him to bankruptcy, and left him a burden in the hands of his daughter. She was now forced to adopt literature as a profession, and commenced to write for the stage. Her first successful drama, the tragedy of *Julian*, was per-

Mitford. formed at Covent Garden in 1823. About this time also, in some happy hour, she thought of describing the rural scenes and simple inhabitants in the place of her residence, the small hamlet of Three-Mile-Cross, near Reading. Her fresh and genial sketches appeared in the *Lady's Magazine*, under the title of "Our Village," and attracted general attention. They were published in a volume in 1824; and were afterwards continued until, in 1832, they had filled four other volumes. Meanwhile Miss Mitford had been diversifying such light and congenial occupation with the severe task of dramatic composition. Her tragedies *Foscari* and *Rienzi* were acted with success,—the former at Covent Garden in 1826, and the latter at Drury Lane in 1828. She was now in the enjoyment of a full reputation. It was the custom among young writers to try to catch the tone of her simple rustic sketches. Her cottage of Swallowfield, in the hamlet of Three-Mile-Cross, was visited by the highest and the most accomplished in the land. Yet necessity compelled her to ply her pen under much ill health and discomfort. In 1838 a pension from government alleviated her cares, but did not slacken her industry. She continued to engage in new literary enterprises, to publish corrected editions of her former works, and to treat her friends with great affection and sweetness of temper, till death closed her career in January 1855.

Miss Mitford also wrote *Atherton and other Tales; Country Stories; Belford Regis; Lights and Shadows of American Life; Recollections of a Literary Life; Tales for Young Persons; Charles the First, a Tragedy*, and other dramatic works.

MITFORD, *William*, author of a *History of Greece*, was the eldest son of John Mitford of Exbury in Hampshire, and was born in London in 1744. He studied at Queen's College, Oxford; but he showed no taste for any branch of knowledge except Greek, and left the university without a degree. His legal studies at the Middle Temple were becoming equally unsatisfactory, when the death of his father, in 1761, transferred the family estate into his hands, and rendered it no longer necessary that he should adopt a profession. He therefore fixed his residence at his country seat, and turned his attention from the hard details of law to his favourite Greek authors. In 1769 Mitford, entering as captain into the South Hampshire Militia, became acquainted with Gibbon, who was major in the same corps. His intercourse with the future historian, whose brain was then teeming with literary projects, gave form, and perhaps origin, to his purpose of writing a history of Greece. The first volume of this great work appeared in 1784, and the four remaining volumes followed in 1790, 1797, 1808, and 1818, respectively. The increasing infirmities of age prevented the historian from carrying his narration of events beyond the death of Alexander the Great. Meanwhile he had successively represented in Parliament Newport in Cornwall, Becralston, and New Romney. He had also been appointed professor of ancient history in the Royal Academy. His death took place at his hereditary seat in 1827. An edition of the *History of Greece*, with a Life of the author by his brother, Lord Redesdale, was published in 10 vols. 8vo, London, 1829. The other works of Mitford are,—*An Inquiry into the Principles of Harmony in Languages, and of the Mechanism of Verse, Modern and Ancient*, 8vo, London, 1774; and *A Treatise on the Military Force, and particularly the Militia of this Kingdom*, 8vo.

Previous to the publication of the great historical works of Grote and Thirlwall, Mitford was reckoned the highest authority on Grecian history. More intimate with the original narratives of Thucydides, Xenophon, and Arrian, than any of his predecessors, he discovered much that was new concerning the events and political questions of ancient Greece. Some of his most manifest faults are a cumbrous style, a deficiency in reflective power, and an occasional dullness in narration. Worse than all these, however, is that obstinate prejudice which invariably leads him to advocate tyranny and to misrepresent democracy.

Mithridates. MITHRIDATES, the name of several kings of Pontus, of whom the most distinguished was *Mithridates VI.*, surnamed Eupator, and usually styled "The Great," King of Pontus, who succeeded his father, Mithridates V., at the age of eleven, about 120 B.C. His reign began amid daring conspiracies, which summoned up prematurely his great tact and intrepidity. Afraid of being poisoned by his treacherous subjects, he followed the practice of swallowing antidotes, until his frame became thoroughly fortified against the action of the most deadly drugs. The more open attempts against his life he baffled by incessant activity. There was no warlike exercise in which he did not engage, and none in which he did not excel. He was also a keen and daring hunter, pursuing his sport into distant and desolate regions, disturbing the lair of the most savage animals, and sleeping on the ground under the most inclement skies. Under such a thorough training, he acquired an iron strength, great agility, a stature almost gigantic, and a spirit indifferent to the presence of any danger. His mind meanwhile was not neglected. He studied with success the physics and philosophy of that age, and cultivated his mind with so much diligence, that he is said to have acquired the languages of no less than twenty-five of the neighbouring nations. At the age of eighteen Mithridates began to govern in his own person. One of his first public acts, it is said, was to render his claim to the throne undisputed by the assassination of his mother and brother. He then directed the entire strength of his kingdom to foreign conquest. Leading his armies eastward along the shore of the Euxine, he conquered Lesser Armenia, Colchis, and other barbarian kingdoms. The wild Scythians of the Tanais, who had dared the might of so many conquering kings, were compelled to submit to his yoke; and his generals being then entrusted with the command of his armies, extended his conquests as far as the River Tyras (*Dniester*), and exacted tribute from the Tauric Chersonese. Shortly afterwards he seized upon the sovereignty of Bosporus, left vacant by the death of Parisades.

With his strength and resources thus augmented, Mithridates formed the design of wresting all the Asiatic states from the powerful grasp of Rome. Cautiously making his preparations, he first travelled in disguise through Asia Minor, and employed his intimate knowledge of the different languages of that country in ascertaining from the inhabitants the state of their defences and their feelings towards their Roman masters. He then formed an alliance with the Parthians and Iberians, and married his daughter to Tigranes, the powerful King of Armenia. He even entertained the gigantic design of banding together in one great league all the foes of Rome, and of convulsing her sovereignty in all parts of the world by one general shock. His legates accordingly travelled as far as the pillars of Hercules, negotiating with the rebel Marsians and every people and predatory band that were up in arms against the Romans. Before these preparations were completed he became involved in a war with his nephew Ariarathes, King of Cappadocia, who was an ally of the Romans. Ariarathes fell in battle, and Mithridates placed his own son upon the vacant throne. Rome, however, interfered, and seized the Cappadocian crown for Ariobarzanes, a creature of her own. Mithridates succumbed for a time; but about 90 B.C. he openly attacked and deposed the puppet of the Romans. At the same period he wrested the sceptre from the young King Nicomedes of Bithynia, another tributary of the Romans. Both the wronged sovereigns laid their cases before the senate of Rome, and were

Mithridates. reinstalled in their dominions. Mithridates again submitted; but no long time had elapsed before he was lying at the head of an army of 300,000 waiting for the Romans or their allies to strike the first blow. He did not wait long. Nicomedes, at the instigation of the Romans, invaded Pontus. Mithridates then poured his troops into Cappadocia, and in a short time overran and subdued the whole country. As speedily did his generals Archelaus and Neoptolemus prostrate the might of Nicomedes in a great battle on the banks of the Amnias, and wrest Bithynia from the remnants of his army. The neighbouring states, eagerly hailing the outbreak of a war that seemed likely to free them from the insatiable rapacity of their Roman oppressors, raised the standard of revolt. All the cities of Asia Minor, with a few exceptions, flung open their gates to the victorious King of Pontus, and he marched westward without opposition to the shores of the Ægean Sea. Lesbos, Delos, Eubœa, and the islands of the Cyclades, were next subjected to his sway, and even Athens was betrayed into the hands of his general Archelaus. In the height of his triumph Mithridates repaired to Pergamus, and abandoned himself to luxury and pleasure. It was then that he issued a decree for the extermination of all the Roman citizens in Asia Minor. With an eager promptitude the vengeful natives obeyed the order; and the massacre of 80,000, or, according to some, of 150,000 Romans, cut off Mithridates from all chance of reconciliation with his powerful foes. About the middle of 87 B.C. he was roused to his former activity by the news that a Roman army under Sylla was approaching Greece. He immediately despatched Taxiles with an immense force to co-operate with Archelaus. In the following year, however, the news arrived that Athens had been captured, and that his troops had been routed at the battle of Chæronea. With unslackened perseverance he equipped another army of 80,000, and sent it under the command of Dorylaus to the scene of conflict. But the tide of fortune was running against him; and in 85 B.C. his position had become critical. The time-serving Asiatics, estranged by his growing misfortunes, were rising in revolt around him, and assassinating the tetrarchs he had placed over them. An army sent by the Marian party at Rome had invaded Asia Minor, had defeated a large force under his son Mithridates, and was pursuing himself from place to place. About the same time he received the intelligence of the almost utter annihilation of his Grecian troops at Orchomenus. Almost his only resource, therefore, was a treaty of peace. This, after some difficulty, he purchased from Sylla in 84 B.C. at the expense of 2000 talents, 70 ships, and all the territories he had wrested from the Romans.

In spite of this treaty, Mithridates knew well that nothing less than his complete humiliation would satisfy his haughty enemies, and therefore he resolved to prepare for the worst. Several years were spent in building navies, in collecting magazines of arms and provisions, in recruiting his army, and in gathering hordes of mercenaries from every quarter both in Asia and in Europe. He equipped his troops with Roman arms, and attempted to infuse into them the magnanimous Roman valour by subjecting them to the severe Roman discipline. He even entered into an alliance with Sertorius the great Marian general in Spain. After such preparations he was bold enough, on the death of Nicomedes III. in 74 B.C., to lay claim to the vacant throne of Bithynia. He then burst into that country with a mighty army, swept through it without encountering opposition, and overwhelmed the forces of Cotta the prætor under the walls of Chalcedon. Marching then into Mysia, he sat down before Cyzicus, and invested that city by land and sea. Thither Lucullus the Roman general followed him. For some time the two armies lay encamped near each other without meeting in any general engagement. At last Mithridates, unable to provide for so large an army in so narrow a territory, was forced to raise the siege and to commence a retreat towards the west. Lucullus then hovered about his rear, threw his army into confusion, and took many prisoners. With great difficulty Mithridates embarked his shattered forces and set sail homewards. On the way a storm sunk his fleet, and he arrived in his own dominions with a fragment of that magnificent army with which he had set out. Yet Mithridates still retained his invincible energy, and that soon supplied him with another army. By the spring of 72 B.C. he had organized a large force of his own subjects, of Scythians, and of Parthians, and awaited the arrival of Lucullus in an impregnable position among the mountains at Cabira. Lucullus arrived, but found that his enemy had learned a lesson from former misfortunes, and that he was resolved to act merely on the defensive. He attempted to dislodge him, but was repulsed with great loss. In a short time he discovered that his provisions were effectually cut off, and that want was beginning to lay waste his camp. At this crisis an accident saved him. The forces of Mithridates, compelled by a misfortune to shift their camp, were struck with a sudden panic. A headlong flight ensued, and their ranks were cut to pieces and scattered over the whole country by the pursuing Roman cavalry. The King himself, after braving many dangers in his desperate attempts to rally his troops, fled to the kingdom of his son-in-law Tigranes, and left all his dominions in the power of Lucullus.

In 69 B.C. Tigranes mustered a large army to vindicate the cause of his father-in-law, and at the same time to defend his own territories against the invading Romans; but risking, in opposition to the advice of Mithridates, a pitched battle at Tigranocerta, he was defeated by Lucullus with great slaughter. The ensuing winter was spent by Mithridates in equipping a select force of 70,000 with Roman armour, and in inuring them to Roman discipline. In the summer of 68 B.C. he commenced to harass the advance of Lucullus into Armenia by cutting off his foraging parties, and by galling his rear with bodies of skirmishers. At length he was brought to a general engagement near Artaxata, and suffered a severe defeat. But no sooner had the enemy marched into Mesopotamia to lay siege to the strong fortress of Nisibis, than Mithridates betook himself to Pontus at the head of 4000 chosen troops, and commenced a sudden and daring guerilla war. Garrison after garrison was surprised and wrested from the Romans; his old soldiers rallied round his standard; the army under Fabius, the lieutenant of Lucullus, was cut to pieces; and when winter suspended the contest, Triarius was the only Roman commander who was capable of offering any effectual resistance. With him Mithridates prepared to engage in the spring of 87 B.C. A pitched battle soon took place, in which the Romans, after an obstinate struggle, fled, leaving their camp in the hands of the enemy and 7000 of their officers and private soldiers lying dead on the field. This defeat, the most disastrous blow that had fallen upon Rome for many years, left the greater part of Pontus in the hands of Mithridates.

The King of Pontus was engrossed with the re-organization of his government when Pompey the Great arrived in Asia in 66 B.C. to supersede Lucullus. That able general immediately formed an alliance with the Parthian king, and thus rendered it necessary for Tigranes to keep his troops for the protection of his own dominions. Mithridates was accordingly left to meet his great antagonist all alone. At first he tried negotiation, but scorned to stoop to the conditions that were offered to him. He then placed himself at the head of 32,000 well-disciplined troops, and resorted to his former plan of defensive warfare. For some time he attended the movements of the Romans, intercepting their provisions, destroying their foragers, and baffling

all their attempts to force him to a general engagement. At length desperation drove Pompey to attack him by night on the banks of the Euphrates. An accident spread a panic through the king's forces; in a few moments there was a general flight; and the greater part of the Pontine army were either slain by the Romans or drowned in attempting to cross the river. Mithridates himself, at the head of a few horsemen, cut his way through the legions of the enemy, and escaped to the border stronghold of Synoria. Thence he hastened with a considerable body of troops to take refuge in Armenia. But dread of the Romans prevented Tigranes from giving him any countenance. The only retreat now left to him was the kingdom of Bosporus, over which his son Machares reigned. Thither, therefore, he directed his course by forced marches through the country of Colchis, until he arrived at Dioscurias. Assured then that he was beyond the reach of Pompey, he halted, and passed the winter enlisting troops and equipping a fleet for the remainder of his journey. In 65 B.C. he continued his march through the midst of the most savage tribes, exciting the opposition of some and the enthusiastic admiration of others, yet pressing onwards with resistless constancy. At length he arrived at Panticapæum, the capital of the kingdom of Bosporus, and found that his son Machares, who had formerly sent in his submission to the Romans, had put an end to his life on hearing of his approach. Mithridates accordingly seated himself in the vacant throne. His newly-acquired power was far beyond the reach of the grasping tyranny of Rome, and he might now have rested from that disastrous struggle in which he had been engaged for the last twenty-six years. Yet hardly had he organized his government, when he conceived the daring plan of marching at the head of a large army round the north and west coasts of the Euxine, of rallying round his standard all those barbaric tribes who cherished a deadly enmity towards Rome, of bursting with an overwhelming horde into the Roman possessions, and of even penetrating into Italy and striking at the Eternal City itself. With all possible speed he set himself to muster the strength of his kingdom, and soon saw himself at the head of an army of 36,000, supported by a considerable fleet. However, as the desperate nature of the coming expedition began to be generally known, the soldiers began to falter in their allegiance. This growing disaffection speedily swelled into open revolt, through the intrigues of Pharnaces, the king's own son and heir. In vain did Mithridates attempt to awe his troops into obedience, and to excite filial regard in his son. He was forced to flee for his life into a strong fortress. There he resolved to die, that he might not fall alive into the hands of his remorseless subjects. He tried to poison himself; but his iron constitution, even at the age of sixty-eight, was proof against the deadly drug, and he was compelled to die on the sword of a faithful Gallic mercenary.

Mithridates is described by Peterculus as "a man who can neither be mentioned nor passed over without caution; most valiant in war, unrivalled for valour,—renowned at one time for success, at all times for magnanimity,—a general in council, a soldier in action, and a very Hannibal in his hatred of the Romans."

MITROWICZ, a town of the Austrian dominions, in the Slavonian military frontier, on the left bank of the Save, 24 miles S.S.W. of Peterwardein. The town possesses a castle, several churches and schools, and is the head-quarters of the Peterwardein regiment. It has also some Roman remains, and is supposed to occupy the site of the ancient *Sirmium*. Pop. 5500.

MITWEIDA, a manufacturing town of Saxony, in the circle of Zwickau, on the Zschopau, 35 miles S.E. of Leipsic. It produces woollen, cotton, and linen stuffs, and is provided with large bleachfields. Pop. 7012.

MITYLENE, or MIDULLU (the ancient *Lesbos*), an island of the Grecian Archipelago, belonging to Turkey, and lying off the west coast of Asia Minor. It is about 45 miles in length by 30 in extreme width, and contains an estimated area of 168,320 acres. The island is traversed by wooded hills, beautifully diversified by plains and valleys; while the two inlets Ports Culoni and Lero extend into the land for several miles, almost severing the island into two portions. The soil is excellent, and the climate salubrious; but want of proper irrigation has much impeded farm operations. The principal articles produced are,—olive oil, silk, cotton, fruit, and indifferent wine. Grain is not grown in sufficient quantity to supply the home consumption. The principal towns are Castro, on the S.E. coast, with 10,000 inhabitants; Molivo; and Culoni. Mitylene suffered much in the Greek war of independence, in the course of which it lost nearly the half of its inhabitants. Pop. 40,000, the majority of whom are Turks. (See LESBOS.)

MNEMONICS, or MNEMOTECHNY (from μνήμη, *memory*, and τέχνη, *art*), is the art of improving the memory by artificial means. Its discoverer is said to have been Simonides the poet, who flourished about B.C. 500. The story is, that he had been employed by Scopas, a rich Thessalian nobleman, to compose a song in commemoration of a victory gained by him at the Olympic games. This was sung at a banquet given in honour of the occasion; but Scopas was so displeased that part of it was occupied with the praises of Castor and Pollux, that he said he would pay the poet only one-half of the stipulated reward, as he had received but one-half of the praise, and that he might, if he chose, apply to his friends the Tyndaridæ for the remainder. Shortly after this, and while yet at the feast, a message was brought to Simonides that there were two young men at the gate very anxious to speak to him. When he went out he found no one; but while engaged in the search, the house he had just left fell down, killing Scopas and all that were with him. The bodies were so mutilated that they could not be recognised; but Simonides, by calling to mind the place that each had occupied at the feast, was able to distinguish them; and hence his attention was first directed to the important aid afforded to memory by the observation of material objects.

This art was practised and recommended by more than one of the ancients, amongst whom is Cicero, who says,—"There can scarcely be any one of so acute a memory that he can retain the order of words and sentences without observing and associating them with material objects; nor, on the other hand, is there any one of so dull a memory as not to receive aid from the use of this plan, ... those things being most fixed in the mind which have been given to it and impressed upon it by sense." In modern times the subject of Mnemonics does not seem to have generally received that amount of attention which its importance demands. Various works have indeed been written upon the subject, and various systems advocated, but none of them have met with any great degree of success. This is doubtless chiefly to be accounted for from the fact that the propounders of the various systems have had more in view the exhibiting of mere feats of memory, than the applying of the principles of the art to matters of real value and importance. What Lord Bacon says of the systems of his time is still in a great measure true, that those "now in use are but barren and useless. For immediately to repeat a multitude of names or words once repeated before . . . . I esteem . . . . no more than rope-dancing, antic postures, and feats of activity; and, indeed, they are nearly the same things, the one being the abuse of the bodily as the other is of the mental powers; and though they may cause admiration, they cannot be highly esteemed."

The value of any system of Mnemonics must necessarily depend upon the extent to which it is based upon the prin-

ciples and laws of memory. This term, as it is commonly used, implies both the power of retaining and of recalling whatever may have already been before the mind. These powers vary greatly, not only in different, but even in the same individual,—some having a good retention but a bad recollection, while others have a good recollection but a bad retention. Though thus apparently different in character, they yet seem in reality to be the result of one general principle; a good or a bad retention, as well as a good or a bad recollection, being alike and entirely dependent upon the laws of association. Indeed, so far as retention is concerned, it is held by many philosophers that there are no individual differences,—that whatever has once been the object of consciousness is ever thereafter retained, and that its being or not being recalled depends entirely upon association. In support of this doctrine we have numerous instances of persons recollecting, in the delirium of a fever, things that in ordinary circumstances had long been beyond the power of recall. Thus there have been instances of persons in such a state talking fluently in a language, that of their childhood, which they had long forgotten. In dreaming, too, many things are suggested to our minds which we know must be resuscitated ideas, even though we cannot recognise them as such.

Memory, then, depends upon what are by philosophers termed the laws of mental association, suggestion, or reproduction. The great law of association, and that to which probably all the others may be referred, is that of contiguity. Ideas that have been in the mind together, or in close succession, ever after manifest a tendency to recall or reproduce each other. As a general rule, we find this tendency most marked, as indeed was to be expected, in persons with few ideas among the ignorant and uneducated. Shakspeare's Mrs Quickly is an admirable instance of this, as she narrates with amazing minuteness the various incidents that happened at the time when Sir John Falstaff had made her a promise of marriage. Where, however, the mind has been actively at work, and has stored up a great number of ideas, those that have been frequently before it have become associated in a variety of ways with numerous other ideas. Such then have the power of suggesting, not only ideas that may have been associated with them at any particular time, but also those that may have been connected with them at various times. Were in such cases every idea to bring before the mind all with which it had at any time been connected, the result would be endless confusion. Instead, therefore, of a host of ideas, we find that generally only one or a few rise before consciousness. That some rather than others are selected and brought before the mind depends upon a variety of circumstances,—such as their affinity to immediately preceding ideas or to the general habits of thought of the individual, their recentness or abstractedness from other ideas, or their affinity to the suggesting idea, arising from the frequency or length of time they may have been associated with it.

An idea, however, may give rise to other ideas, with which it had never previously been associated. Thus, Hannibal may immediately suggest Napoleon, though they may have never been previously together in the mind. This is done by means of a third idea common to both: among the various ideas that have been associated in the mind with Hannibal, one is that he crossed the Alps with an armed force; but this latter idea has been also associated in the mind at another time with Napoleon, and hence he is immediately suggested. The common idea is here evident; but frequently it does not come before consciousness, though in every case its influence may be traced. This is what is called the law of *similarity*, though in reality it seems to be merely a modification of that of contiguity,—the one idea suggesting the other, not directly, but by means of a third idea common to both. To this same principle of contiguity, we think, may also be referred that tendency of the mind to proceed from one idea to its contrary,—as from virtue to vice, from light to darkness, from riches to poverty,—there being in every such case an intermediate idea common to both, of which the one is an abundance and the other a deficiency. It is this principle of association by similarity that we find to predominate in men of genius, as poets, artists, philosophers, and others. It was this that led Sir Isaac Newton to see the one principle of attraction governing alike the falling of an apple and the revolution of a world. Though depending chiefly on natural endowment, it is also to a great degree capable of cultivation.

Another principle of association is that of a part suggesting its whole, or a whole one or more of its parts. Most of our ideas are made up of a number of others. The paper I write upon is, in my mind, made up of ideas of form, colour, smoothness, &c. The mind has the power of analyzing and reducing such an idea to its component parts, so that it becomes merely a number of associated ideas. Any one of these may, in accordance with the ordinary principles of reproduction, suggest the whole idea, or the whole idea may suggest one or more of its parts. Paper may immediately suggest to the mind whiteness, and this whiteness may suggest another, or a number of other things, of which it is likewise a property. In like manner, a word may be resolved into its component parts or syllables, any one of which tends to suggest other words of which it forms a part. Thus, one word may suggest another word or words having the same initial or terminal syllables; and hence the rhythmical terminations of the lines in poetry make it much more readily remembered than prose, and the alliteration so frequent in proverbs renders them pleasing to the memory and easy of recall. The principles of mental association are well illustrated by Coleridge in the following passage:—"Seeing a mackerel, it may happen that I immediately think of gooseberries, because I at the same time ate mackerel with gooseberries as the sauce. The first syllable of the latter word being that which had co-existed with the image of the bird so called, I may then think of a goose. In the next moment the image of a swan may arise before me, though I had never seen the two birds together. In the first two instances, I am conscious that their co-existence in time was the circumstance that enabled me to recollect them; and equally conscious am I that the latter was recalled to me by the joint operation of likeness and contrast. So it is with cause and effect; so too with order."

It follows naturally, as a principle of contiguity, that, as a general rule, the closer ideas are brought together in the mind, the more strongly will they be associated, and the greater will be their power of reproducing each other. When an interval takes place between ideas brought before consciousness for the purpose of being associated together, there is ever a tendency of irrelevant ideas to spring up in the mind and interfere with their adhesion. This is especially marked when our circumstances are such as to readily suggest ideas to our mind apart from those we wish to impress upon it. Hence the importance to memory of sound health and a mind free from anxieties. Sensations exercise an important influence in the direction of our thoughts, and in giving rise to new trains of ideas; and indeed it seems highly probable that there are conditions of body, even beyond the pale of consciousness, that exert an important influence in this respect.

Memory, probably more than any of the other faculties of the mind, is dependent on the physical condition of the body. We may smile as we read in old works on Mnemonics of "plaisters to prevent a decay of memory," "a pouder for the memory," or "a perfumed apple for comforting the brain and memory;" but these all indicate a belief in the dependence of memory upon the physical condition of the body; and we find in the present day so high a medical

Mnemonics.

authority as Sir Benjamin Brodie supporting the same opinion when he says, "It is possible that by accurate observation the proper means may be discovered of preserving that temperament of the brain which is favourable to memory, and of remedying the disorders of that temperament."

Some ideas are much more easily retained and recalled than others,—those presented to us by the senses occupying in this respect the chief place. The mind is first awakened to consciousness by sensations, and these are ever the most easy of retention or reproduction. Of all the senses, that of sight is the one that furnishes the mind with most ideas, and these are always the most vividly and lastingly impressed upon it. In cases of loss of memory we frequently find that, after all other sensational ideas have been lost, those of sight may still be retained. Thus, a sentence when spoken may convey no idea to the mind, while the same when written may be readily understood; and one may be able to write what, from mere obliviousness of the sound, he is unable to speak. Most persons, too, may have experienced, when in doubt as to the correct spelling of a word, that they have frequently been put right by recalling to the mind the appearance of the word, or by writing it down. When two or more of the senses are employed in impressing a thing upon the mind, the advantage is greater than if one only were employed. Every schoolboy knows that he learns his lesson much more quickly by repeating it aloud, for in this case he has both the ear and the eye to assist him; and next to the eye the ear is, as an aid to memory, the most valuable of the senses.

We have been thus minute in explaining the principles of memory, because, as already said, it is only in accordance with these that memory can be judiciously improved; and further, because we believe that no one system of Mnemonics can be equally beneficial in every case. Mnemonics is the art of associating in the mind things difficult with things that are easily remembered, so that the former may be retained and recollected from being associated with the latter. Memory, however, varies greatly in different individuals, some manifesting the greatest facility in remembering places, others events, others names, and so on, according to the species of memory that each may have received from nature, or acquired by previous education. In each particular case it is of importance to know where the strongest points of memory lie, and to employ these in the assistance of the weaker.

One great principle of mental association is to bring together as nearly as possible in the mind ideas that we wish to connect, as by this means we guard against irrelevant ideas intervening that would injuriously affect their adhesion. It is upon this principle that what is called the Hamiltonian system of teaching languages is constructed,—that, namely, of bringing the foreign word and the English equivalent into the nearest possible proximity.

Another important principle that, from the foregoing considerations, we arrive at, is that of associating an abstract idea that we wish to remember with a sensational. Most persons must have observed, that in passing along a road which they had formerly travelled in the company of a friend, the particulars of a conversation in which they were then engaged are frequently suggested by the objects they meet with. They recollect that in such a place a particular subject was started, and as they pass the various houses, plantations, rivers, &c., on the way, the parts of the subject under discussion when these were last seen are immediately suggested to the mind. The same result will be obtained, though less perfectly, by merely bringing the various objects before the mind in imagination—the ideas associated with each will spring up. We may in this way connect ideas that we wish to remember with the public buildings of a town, the houses of a street, or the furniture of a room, and by going over these objects in reality or in imagination, the ideas formerly associated with them will spring up. This is the system of Mnemonics as recommended and practised by Cicero, Quintilian, and others.

Mnemosyne.

Another principle, even more important than the last, because it belongs to a higher and more advanced state of mind, is that of associating what we wish to remember with ideas already in the mind; and according to the familiarity of those ideas will be their value as a means of reproduction. As the mind enlarges and becomes stocked with ideas, we find that suggestion comes to depend more and more upon what are commonly called the laws of similarity or contrast. In reading the account of a battle, for instance, one will best remember it by associating it with another already in his mind, and noting the points of resemblance or contrast. It is the same with other branches of history, with biography, or with more abstract subjects. Hence the great importance of exercise to the memory, by which it is not only strengthened, but by which stores of materials are laid up with which to associate new acquirements. A law prevails in the mental world similar to that of chemical attraction in the material,—a law by which ideas with certain affinities are attracted to each other and all others repelled.

It may be considered necessary, before concluding the present article, to say something of the means commonly adopted by Mnemonicians for performing their great feats of memory. For this purpose a number of rooms are selected, the walls and floor of which are each divided in imagination into 9 equal parts or squares, 3 in a row. On the front wall (that opposite the entrance) of the first room are the units, on the right hand wall the tens, the left hand the twenties, the fourth wall the thirties, and the floor the forties. Nos. 0, 10, 20, and 30 each find a place on the roof immediately above their respective walls, while 40 is placed in the centre of the roof. One room will thus supply 49 places, and with 10 rooms we may have 500 places, all save one. Having fixed these in the mind so that the exact position of each place may be readily ascertained it is then necessary to associate with each of them a certain familiar object, so that, on the object being suggested, its place may be recalled; or when the place is before the mind, its object may immediately spring up. When this has been done thoroughly, the objects can be run over in any order from beginning to end, from end to beginning, or the place of any one can at once be given. It will also facilitate reference if the objects are arranged according to a certain plan. Each room may be devoted to one class of objects, the subdivisions of which may occupy the various places on the walls and floor, on the same principle as a librarian arranges the books of his library, or a naturalist the objects in his museum. All that is further necessary is to associate the subjects that we wish to remember with the objects in the various places, by which means they are readily remembered, and can be gone over in any order. In this way some are able to repeat in any order several hundred disconnected, or even unmeaning, words or ideas, after having once heard them.

To remember dates or sums, letters are substituted for the figures, and formed into words. Thus:

$$\begin{array}{cccccccccc} t, & n, & m, & r, & l, & d, & \underbrace{c\ k\ g\ q,} & \underbrace{b\ h\ v\ w,} & \underbrace{p\ f,} & \underbrace{s\ x\ z.} \\ 1, & 2, & 3, & 4, & 5, & 6, & 7, & 8, & 9, & 0. \end{array}$$

The vowels are of no value, but are merely introduced between the consonants to form words. In this way *tin, tone, ten, tun*, &c., stand for 12; *tins, tens*, &c., for 120; and *tabled* for 1856. This last branch of Mnemonics, which we cannot enter upon at greater length, will be found fully treated of in Dr Grey's *Memoria Technica*, and exemplified in history, geography, astronomy, &c.

MNEMOSYNE (*μνημοσύνη, memory*), according to fabulous history, one of the Titanides, and the daughter of Uranus, who married Zeus, and became the mother of the Muses. (Hesiod. *Theog.*, 54, 915; and Cicero, *De Natura*

Deorum, iii. 21.) A statue was erected to her honour at Athens; and, according to Pausanias, she had a sacred well and throne near the Trephonian oracle. The origin of this fable of the maternity of the Muses had doubtless a relation to the important part which the faculty of memory performs in the development of art and in the growth of science.

MOA ISLE, in the eastern seas, is situated off the eastern extremity of Timor, and intersected by the 128th degree of east longitude. Lat. 8. 20. S.

MOABITES, a tribe descended from Moab, the son of Lot, and consequently related to the Hebrews. (Gen. xix. 37.) Previous to the exodus from Egypt, the Moabites, after expelling the original inhabitants, called *Emims* (Gen. xiv. 5; Deut. ii. 11), had possessed themselves of the region on the E. of the Dead Sea and the Jordan, as far N. as the River Jabbok. But the northern portion of the territory, extending from the Jabbok to the Arnon, had passed into the hands of the Amorites, and hence the valley and river Arnon constituted the northern boundary of Moab. (Numb. xxi. 13; Judg. xi. 18; Josephus, *Antiq.* iv. 5, 1.) The Moabites, on the advance of the Hebrews towards Canaan, fearing the numbers that were marching around them, gave evidence of a spirit of hostility (Deut. xxiii. 3); and their king, Balak, hired Balaam to utter prophetic curses, which were converted into blessings in his mouth (Num. xxii., *sq.*) The Gadites now took possession of the northern portion of the territory, which the Amorites had wrested from the Moabites, while the Reubenites occupied the south. (Num. xxxii. 34; comp. Josh. xiii.)

We see the first hostilities breaking out in the beginning of the period of the Judges, when the Hebrews had been for a long time tributary to the Moabites, but threw off their yoke under Ehud. (Judg. iii. 12–30.) Peace and friendship, however, were afterwards restored; and Moab appears often to have afforded a place of refuge to outcasts and emigrant Hebrews. (Ruth i. 1; comp. 1 Sam. xxii. 3, 4; Jer. xl. 11; Isa. xvi. 2.) After Saul had waged successful war against them (1 Sam. xiv. 47), David made them tributary (2 Sam. viii. 2, 12; xxiii. 20); and the right to levy this tribute seems to have been transferred to Israel after the division of the kingdom (2 Kings i. 1, iii. 4; comp. Isa. xvi. 1). To avenge an invasion of their territory, in which the King of Judah had taken part, the Moabites formed a powerful confederacy with the Ammonites, Edomites, and others, who marched in great force into Judæa, and having formed their camp at Engedi, they fell out among themselves and destroyed each other.

The most natural explanation of the recovery by Moab (Isa. xvi.) of the territory between the Arnon and the Jabbok, and respecting which Jewish history is silent, is that of Reland (*Palæstina*, p. 720), Paulus (*Clavis*, p. 110), and Rosenmuller (*in loc.*), that, after the carrying away of Reuben and Gad into captivity, the Moabites occupied their territory. Still later, under Nebuchadnezzar, we see the Moabites acting as the auxiliaries of the Chaldæans (2 Kings xxiv. 2), and beholding with malicious satisfaction the destruction of a kindred people (Ezek. xxv. 8–11); yet, according to an account in Josephus (*Antiq.* x. 9, 7), Nebuchadnezzar, when on his way to Egypt, made war upon them, and subdued them, together with the Ammonites, five years after the destruction of Jerusalem. On the other hand, there is no authority in any one ancient account for that which modern historians have repeatedly copied from one another,—viz., that Moab was carried into exile by Nebuchadnezzar, and restored with the Hebrews under Cyrus.

Continual wars and contention must have created a feeling of national hostility between the Hebrews and the Moabites; and this feeling manifested itself on the part of the Hebrews in bitter proverbs and in the denunciations of their prophets. Moreover, the subjection of Moab finds a place in every ideal description of splendid wars and golden ages predicted for Israel (Isa. xi. 14, xxv. 10; Ps. lx. 8; Ps. lxxxiii. 6).

After the exile an intimate connection between the two nations had found place by means of intermarriages (Ezra ix. 1, *sq.*; Neh. xiii. 1), which, however, were dissolved by the theocratic zeal of Ezra. The last notice (chronologically) of the Moabites which occurs in Scripture is in Dan. xi. 41, which contains an obscure intimation of the escape of the Moabites from the overthrow with which neighbouring countries would be visited; but Josephus, in the history of Alexander Jannæus, mentions the cities between Arnon and Jabbok under the title of cities of Moab. (*Antiq.* xiii. 15.) Thenceforth their name is lost under that of the Arabians, as was also the case with Ammon and Edom. At the time of Abulfeda, Moab proper, S. of the Arnon, bore the name of Karak, from the city so called; and the territory N. of the Arnon, that of Belka, which includes also the Ammonites. Since that time the accounts of that region are uncommonly meagre; for, through fear of the predatory and mischievous Arabs that people it, few of the numerous travellers in Palestine have ventured to explore it. (For scanty accounts, see Büsching's *Asia*, pp. 507, 508.) Seetzen, who in February and March 1806, not without danger of losing his life, undertook a tour from Damascus down to the south of Jordan and the Dead Sea, and thence to Jerusalem, was the first to shed a new and altogether unexpected light upon the topography of this region. He found a multitude of places, or at least of ruins of places, still bearing the old names; and thus has set bounds to the perfectly arbitrary designations of them on the old charts. From June to September 1812, Burckhardt made the same tour; and the details of this journey, which are contained in his *Travels in Syria and the Holy Land*, 1822, threw much light upon the ancient topography and present condition of the lands of Moab and Edom. The accounts of Seetzen and Burckhardt give the substance of all the information which we even yet possess concerning the land of Moab. The *Travels* of Irby and Mangles in 1818, and Legh's Supplement to Dr Macmichael's *Journey from Moscow to Constantinople*, 1819, furnish the most valuable additions which have as yet been obtained to the information of Seetzen and Burckhardt. More recent travellers in Palestine have added little to our previous knowledge of the land of Moab.

From the sources already alluded to we learn that in the land of Moab, which lay to the E. and S.E. of Judæa, and which bordered on the E., N.E., and partly on the S. of the Dead Sea, the soil is rather more diversified than that of Ammon; and, where the desert and plains of salt have not encroached upon its borders, of equal fertility. There are manifest and abundant signs of its ancient importance. "The whole of the plains are covered with the sites of towns on every eminence or spot convenient for the construction of one; and as the land is capable of rich cultivation, there can be no doubt that the country, now so deserted, once presented a continued picture of plenty and fertility." (Irby and Mangles, p. 378.) The form of fields is still visible, and there are remains of Roman highways, which are in some places completely paved, and on which there are milestones of the times of Trajan, Marcus Aurelius, and Severus, with the numbers of the miles legible upon them. It was in its state of highest prosperity that the prophets foretold that the cities of Moab should become desolate, without any to dwell in them; and accordingly we find, that although the sites, ruins, and names of many ancient cities of Moab can still be traced, not one of them exists at the present day as tenanted by man.

MOAT. See Fortification.

MOBILE, a seaport-town of the United States of North America, capital of a cognominal county in the state of Alabama, is situated on the right bank of Mobile River,

immediately above its entrance into the bay of the same name, 165 miles E. by N. of New Orleans; N. Lat. 30. 41., W. Long. 88. 1. The site of the town is a sandy plain, slightly elevated above the river, and affording a sufficient fall for the purposes of drainage; while in its vicinity are extensive pine hills, resorted to in summer for their healthy exposure. The city itself is laid out in streets, crossing each other at right angles, but which, excepting in the mercantile quarter near the wharves, are rather incompactly built. Most of the wider streets have been tastefully planted with trees; and the houses are copiously supplied with excellent spring water. For many years, however, it had the unenviable notoriety of being one of the most unhealthy places on the Mexican Gulf; and indeed the devastating epidemics of 1819, 1825, 1829, and 1843, gave melancholy evidence of the fact. But subsequently there has been a marked improvement in this respect, owing to the filling up of the neighbouring marshes, and to the introduction of a system of drainage, as well as to greater attention being paid to the sanitary affairs of the town. The public edifices of Mobile are numerous: the chief are the Springhill college, founded in 1830, and possessing a library of 7000 volumes; the U.S. marine hospital; and a large new custom-house; besides many charitable and literary institutions. A battery, named Fort Morgan, defends the entrance of the bay, and a lighthouse stands in the same situation. Mobile is by far the most considerable town in Alabama, in regard both to population and commerce, and, after New Orleans, is the greatest cotton market in the United States. Communicating with the interior by the rivers Alabama and Tombigby, its harbour is supplied with the produce of the great cotton plantations of the state with ease, and at a trifling expense; while by railroads it will in a short time be united with the Ohio and the great lakes in the N., and with Georgia in the E. Its harbour may be considered to be the entire Bay of Mobile, which forms an inlet of great extent, and affords secure anchorage. On account, however, of some obstructions of a removable character, ships drawing more than 11 feet cannot reach the city. During the year ending June 30, 1856, the arrivals of shipping at this port amounted to 473,678 tons, of which 301,498 tons were engaged in the coasting trade. The clearances in the same year numbered 312,973 tons only, 98,264 tons of which went coastwise. Of this amount of tonnage about a fourth part belonged to Britain. The imports of Mobile chiefly consist of salt, oats, flour, corn, bacon, whisky, bagging, and railroad iron; but come considerably short in value of the exports, which comprise cotton, timber (rough and manufactured), hides, oysters, rosin, bricks, tar, and pitch. In the following table the total values are given for the years 1853, 1854, and 1856:—

	1856.	1854.	1853.
Imports (foreign) ...	L. 163,992	L. 183,664	L. 162,381
Exports do. ...	4,903,419	3,296,792	2,943,362

Of the latter, cotton is the most important, 557,243 bales having been shipped, coastwise as well as to foreign ports, during 1856, = L.5,389,432. More than the half of this was exported to Britain, and that chiefly in British ships. The next articles in point of value were masts and spars, amounting to L.35,678, and which were exported chiefly to France for naval purposes. Ordinary rough and hewn timber was exported in the same year to the value of L.18,889, hides to that of L.12,208, oysters to L.11,573, and rosin to that of L.8331. The manufactures of Mobile are inconsiderable compared with its general trade; and, with the exception of a cotton-mill, employing 180 hands, the factories are all of small dimensions. The prosperity of the city, however, can be better judged of by the valuation of the merchandise and real estate belonging to its inhabitants: in 1840 the total value of these amounted to L.3,388,986, and in 1850 to L.3,651,860.

The history of the place commences with the French possession of Louisiana. In 1702 Bienville founded the original town of Mobile at the mouth of Dog River, but in consequence of inundations it was removed, nine years afterwards, to its present site at the mouth of the Mobile River. An extensive fortress was built here, and the seat of government permanently fixed. At the peace of 1763 the town passed into the possession of the English. Under the latter its exports comprised indigo, raw hides, tobacco, timber, pecan nuts, and a small amount of cotton. In 1777 Bertram describes Mobile as extending back half a mile from the river, with a few good buildings occupied by the French or emigrants from England, Scotland, Ireland, and the North American colonies. At the close of the American revolution, the Spaniards again came into possession under the general treaty of peace; but on the cession of Louisiana to the United States, the Americans took final possession of Mobile without striking a blow. Pop. (1788) 1468, (1820) 1500, (1840) 12,672, and in 1850, 20,513; of which 12,997 were whites, 715 free coloured, and 6803 slaves; 752 were English and Scotch, 2009 Irish, 552 German, and 303 French. Total pop. in 1855, about 24,000.

MOBILIER, Crédit (*La Société Generale de Crédit Mobilier*), is a bank founded in Paris, under the sanction of a decree of the imperial government, bearing date the 18th of November 1852, and is of such a peculiar design and nature as to deserve a lengthened notice. The name is derived from an intentional contrast with companies known on the Continent as *Sociétés de Crédit Foncier.* These companies, which are in the nature of land banks, advance money on the security of real, or, in the language of continental jurists, *immoveable* property, and raise the money so to be used by the issue of debentures for sums of moderate amount, in some cases for so little as four pounds. The Crédit Mobilier, according to its original design, was to obtain money in a somewhat similar way, by the issue of debentures, and to employ the funds so obtained in giving the same aid to the owners, or some of the owners, of *moveable* property, that the companies of *Crédit Foncier* afforded to persons possessed of land. Such aid was not, however, to be given by the new company in what are clearly the simplest ways, by the discount of bills or advances. There were already in France institutions, such as the Bank of France and the Comptoir d'Escompte, which aided commercial men by loans in these forms. The Crédit Mobilier was to effect a similar object in a mode less direct and more peculiar.

"It is to play," said M. Pereire, one of the original founders of the company, "with respect to the fixed capital employed in industry, a part analogous to that which banks of discount fill with respect to its circulating capital. The first duty of our society," he continues, "is to aid the development of national industry, to facilitate the completion of great enterprises, which, without such assistance, are perfected with so much difficulty." And in language which we give in the original, because the peculiar tone of the language is most characteristic of the temper in which the company has been planned, and can scarcely be preserved in a translation, he remarks,—

"La pensée du Crédit mobilier est née de l'insuffisance des moyens de crédit offerts à l'organisation des grandes affaires du pays, de l'isolement où étaient réduites les forces financières, de l'absence d'un centre assez puissant pour les relier entre elles.

"Elle est née du besoin d'amener sur le marché le concours régulier de capitaux nouveaux destinés à aider au développement du crédit public et du crédit industriel;

"Elle est née de l'exagération des conditions auxquelles se faisaient les prêts sur fonds publics et des difficultés qui en naissaient pour le classement définitif des meilleures valeurs.

"Elle est née encore du besoin de centraliser le mouvement financier et administratif des grandes Compagnies et notamment des Compagnies de chemins de fer, d'utiliser ainsi, au plus grand avantage de toutes, les capitaux dont chacune dispose successivement, de manière à ménager les ressources communes, aussi bien au profit des Compagnies qu'à celui de leurs nombreux actionnaires.

"Elle est née enfin de la nécessité d'introduire dans la circulation un nouvel agent, une nouvelle monnaie fiduciaire, portant avec elle son intérêt de chaque jour, et faisant fructifier les épargnes les plus humbles, aussi bien que les capitaux les plus considérables.

"Créer une telle institution, c'était donner à l'industrie et au crédit public le plus puissant encouragement, c'était mettre à leur disposition l'instrument le plus propre à leur fournir à bon marché les capitaux nécessaires à leur développement."

The simple statement of this rather enthusiastic language is, that the Crédit Mobilier is to employ its funds in taking shares in companies whose public objects are important; and that it is to obtain such funds by the issue of drafts and debentures, some of which may pass as currency. As will be evident from the remarks which we have cited from the address of Pereire, the promoters of the undertaking claim to have a public object, and distinctly undertake to confer a great benefit on the French nation, as well as to obtain a profit for themselves.

The opponents of the company, however, contest the truth of these professions. They say that its promoters do not really care about the completion of great national undertakings; that they are wholly uninterested about the actual construction of railways or canals; that it is only intended that the company should buy and sell shares for a profit; that the object of those who organized it is a selfish one; in a word, that the sole intention is to speculate in the share market.

Particular circumstances attaching to the politics of the moment have given to the controversy between the partizans of this company an unusual interest. The government of Louis Napoleon has been compelled to ally itself rather closely with wealth, and especially with newly-made commercial wealth. The single defence of the *coup d'état* was the necessity of preserving industry and credit from the attacks of multitudes, who, either from bad theories or bad motives, were anxious for a new distribution of property. The trading class, who live by their industry and their credit, were influenced by this argument, and leaned towards the new government. The classes connected with the former governments of France were naturally disinclined to it. The legitimist noblesse could not approve the revival of the Bonapartist dynasty; the literary and oratorical statesmen of the Orleanist monarchy could find no place for their characteristic abilities in a government which enforced a silence on parliamentary eloquence and on newspaper eloquence, which did not wish to be supported by abstract speculation, which only valued administrative ability. These are the natural results of human nature. It is, perhaps, equally so that the class of mercantile men who would most rally round a court, would not be the highest class. A close proximity to a gorgeous gaiety does not suit a sober and stable industry. The eager speculator who is in haste to be rich, in order that he may spend his riches, will seek the scenes of expenditure the moment he is thought to have riches. From causes such as these, the imperial government of France has been obliged to surround itself with a certain class of speculators rarely found in palaces, without a greater check from men of higher cultivation and more stable opulence. It has been contended that the Crédit Mobilier, which has been avowedly patronized by the imperial government, is in reality a speculation of these courtiers. "I do not know," said M. Berryer, in an action brought by a M. Goupo against the company, "if, since 1828, M. Goupo has frequented the Bourse; but suppose he has, who is it that reproaches him with it? La Société de Crédit Mobilier; that is to say, the greatest gambling-house which the world has ever seen. We must not be misled by words. These are magnificent ones, I know: the protection of industry, the enfranchisement of the national credit, the development of private credit, the consolidation of all commercial stocks,—a dream. All that is the surface: they have given gambling a new name; they call it in their reports the industry of credit. The industry of credit! what is that? These twenty-eight millions of profit, how have they been produced? They are not due to the prosperity of the enterprises in which the Crédit Mobilier has taken a share, and to whose aid it has brought its great influence. No; they are the realizations which represent the difference between the price at which they sell, and the price at which they buy. It is gambling which has produced them. You are, then," he tells the company, "an institution of public utility; you have limited liability, and you play; you are irresponsible, and you gamble; you are a bank of play which sees the cards," &c., &c. In order to test the accuracy of these two conflicting views, we must refer to the statutes of the Crédit Mobilier which embody its design, and the accounts which record its history.

The preamble to its statutes states that its object is to "aid the progress of public works, and to consolidate into a common stock the shares and bonds of trading companies" (*de favoriser le developpement de l'industrie des travaux publics et d'opérer par voie de consolidation en un fonds commun, la conversion des titres particuliers d'entreprises diverses*). The statutes specify that the company is to be one of limited liability, with shares of L.20 each (made out to bearer, and not the holders by name), and that its capital is to be L.2,400,000. The detail of its operations is to be as follows:—

"1. To subscribe or to acquire public funds or stocks; and also shares or bonds in various industrial enterprises, constituted on the principle of limited liability; particularly in railways, canals, mines, and other public works founded or to be founded.

"2. To issue, to the extent of a sum equal to the sum employed for purposes of the subscriptions and purchases aforesaid, the separate obligations of the society itself.

"3. To sell, or give as security for advances, all effects, shares, and obligations acquired or held by the society; and to exchange such effects, shares, and obligations against other values.

"4. To underwrite all loans, to undertake and realize them; also to undertake and realize all enterprises for public works.

"5. To lend on public securities, and on the deposit of shares and bonds, and to open credits, on account current, on the deposit of different kinds of value.

"6. To receive money on account current.

"7. To undertake all kinds of collections for companies, as aforesaid; to pay their interest and dividend warrants; and generally to undertake all business relating to such companies.

"8. To open a bank of deposit for all the securities issued by the companies aforesaid.—All other operations are interdicted.

"9. It is expressly understood that the society shall never undertake sales *à decouvert* [that is, sales of stock, &c., merely for the account day or settlement], nor purchases *à primes* [that is, purchases which may be annulled by the payment of a mere fine or option].

"10. After the complete issue of the joint-stock capital of the society, the obligations created by the society may attain a sum equal to *ten times* the said joint-stock capital [that is, to (10 × 2,400,000) L.24,000,000].

"11. The accumulated amount of the sums received on account current, and the obligations of the society created, payable at *less* than one year's date or sight, shall not exceed twice the amount of the paid-up capital [that is, shall not exceed (2 × 2,400,000) L.4,800,000]."

(This translation of the statutes, which seems to us quite accurate, is taken from Tooke's *History of Prices*, vol. vi., p. 105.)

The government of the company is vested in a board of fifteen directors, elected by the shareholders, of which three go out annually, but are re-eligible. The board is bound to elect a president and two vice-presidents every year, who are likewise re-eligible, and to nominate a committee of management of five of its members, who are to regulate the detail of its affairs. The general meetings of the society are to be annual, but the directors have power to summon special meetings. At each general meeting an exact account of the financial state of the company is to be presented to the shareholders, and every six months such an account is to be laid before the minister of the interior, the head of the police, and several other public departments; and the minister of finance is to be at liberty to demand a statement in full detail of its intermediate operations whenever he pleases. No particular form of periodical accounts is prescribed; but by the seventh section of the statutes, which regulates the appropriation of the profit, 5 per cent. on the capital is to be first distributed to the shareholders by way of interest on such capital; 5 per cent. is then to be added to the reserve fund, and the remainder is to be divided between the directors and shareholders, in the proportion of $\frac{1}{10}$th to the former and $\frac{9}{10}$ths to the latter, —the directors being of course entitled to receive their quota as shareholders in addition to the $\frac{1}{10}$th set apart for them by way of remuneration.

Of the annual accounts of the company, four have been published. The two first it will not be necessary to give in detail, but we shall most easily obtain a clear view of the nature of the company by the following comparison of the two last. The following were the liabilities of the establishment on the 31st December 1855, and 31st December 1856:—

	Dec. 31, 1855.	Dec. 31, 1856.
Capital	L.2,400,000	L.2,400,000
Deposits, current accounts	4,127,172	4,078,387
Bills payable, and sundries	34,576	13,046
Reserve fund	67,844	80,000
Total amount of profit in each year after carrying the proper sum to the reserve fund	1,073,116	601,235
	L.7,702,708	L.7,172,668

The assets of the company were,—

	Dec. 31, 1855.	Dec. 31, 1856.
Rents	L.1,602,770	L. 364,020
Debentures	1,313,784	2,123,231
Railway and other shares	2,377,364	1,195,343
	L.5,293,918	
Deduct for calls not made to 21st Dec. 1855	1,246,668	
	L.4,047,250	L.3,682,594
Investments for fixed periods in Treasury bonds, continuations and advances on shares, debentures, &c.	3,373,016	2,031,201
Premises and furniture	43,288	53,456
Balance on hand, and dividends to be received on the 31st December last	239,254	285,417
	L.7,702,808	L.6,052,668[1]

And its profit and loss account,—

	Dec. 31, 1855.	Dec. 31, 1856.
Profit on investments	L.1,042,675	L.457,463
Income from do., and interest on loans	232,155	231,193
	L.1,274,830	L.688,656
Less expenses	71,100	37,045
	L.1,203,730	L.651,611
Less depreciation of securities, &c.	80,450	41,612
	L.1,123,280	L.609,999

Note.—The difference between the expenses in the two years is principally owing to a sum of L.41,000 for interest on deposits, which, owing to a change in the mode of making up the account, does not appear in the second year. The depreciation of securities, &c., included in the first year some miscellaneous losses, to which there is nothing similar in the second year. The difference between the amount of profit here given, and that shown in the account of liabilities, has been carried to the reserve fund.

From these data we can at once determine the character of the bank. About half the funds at present at its disposal were, at the last date of which we have any information, invested in the purchase of shares, debentures, and similar securities of fluctuating value; and it is from augmentations in the value of such property that its profits are principally derived. Of the large profit of 1855, more than L.1,000,000 was so derived; and the remarkable diminution of entire income in the next year shows that the business of the company, like every other depending on purchase or sale, is very profitable in a rising market, and not by any means equally so in a falling market (like that of the latter months of 1856). The amount of profit so obtained would be deemed by English bankers very great. In 1855, 44 per cent. was realized on the capital; in 1856, 25 per cent., besides augmentations of the reserve fund in each year. Some of the large joint-stock banks in London have, it is true, on very rare occasions, made as much, or nearly as much, as 25 per cent. on their respective capitals; but then those capitals are, in proportion to their liabilities, comparatively small. The capital of the Crédit Mobilier is more than one-half its liabilities to the public; the capitals of the London and Westminster Bank, the London Joint-Stock Bank, and the Union Bank, vary from a fourteenth to an eighteenth of their respective liabilities. A comparison of the actual amounts of profit earned place the contrast in a more remarkable light. The London and Westminster Bank have made of 15 millions of money in the peculiarly profitable half year ending midsummer 1856, L.104,000, which is at the rate of L.208,000 per annum; the London Joint-Stock Bank, of 11 millions and a half, L.77,000 in the same half year, which is at the rate of L.154,000; the Union, of about the same amount of money, have made L.156,000. As will be seen by the above accounts, the income yielded by the Crédit Mobilier was in 1855 five times, and in 1856 three times as great as the highest of these, with only seven millions of money to employ profitably.

This amount of profit would generally appear to English bankers dangerously large, and their apprehensions would not be removed by the mode in which it is made. They would consider that it was dangerous to employ the money of other persons placed with them for brief periods in the purchase of the shares and bonds of miscellaneous companies, which are not readily saleable in times of difficulty, and are peculiarly fluctuating in price. The published documents and accounts of the Crédit Mobilier afford no satisfactory reply to these suspicions. They tell us

[1] The amount of assets in 1856 differs from that of the liabilities by L.120,000, because that sum (being 5 per cent. on the paid-up capital) was paid to the shareholders before the dividend meeting.

more than once that the money which they hold cannot be hastily (*brusquement*) withdrawn from them; and likewise that in its origin the company only professed to receive the deposits of companies having the privilege of limited liability, with which it could probably make special agreements as to the time at which these deposits should be repaid; but the same documents also inform us that this intention has been departed from—that other money has been received, and they omit to inform us on what terms. It is much to be regretted that these authoritative expositions—which, like most of the reports of French financiers, are exceedingly elaborate, and, according to English notions, wordy—should leave the possibility of a doubt on a point so essential, and expose the company to the discrediting suspicion of employing in investments that cannot be immediately realized, money which may at once be withdrawn. We have obtained, however, from what we believe to be very reliable authority in Paris, the following particulars, which very much tend to diminish the importance which we should otherwise attach to this consideration:—We learn, first, that the Crédit Mobilier holds deposits, repayable either at call, or at five, ten, or thirty days' notice; and that the term of notice is determined by the amount of the deposit; the amount at call being limited in each case to sums not exceeding L.1000. Secondly, that though these are the terms of notice, yet in practice the company has not availed itself of its right to require such notice. Thirdly, that the deposits consist chiefly of monies belonging to railway companies, whose works are in progress, and that, as in every case at least one of the directors of these railway companies belongs to the council of the Crédit Mobilier, the latter has always in practice notice of the time when the money will be asked for. Fourthly, that the deposits, other than the monies of such railway companies, are only from L.50,000 to L.60,000. Fifthly, that a uniform rate of interest at 2½ per cent. is given by the Crédit Mobilier for all such monies. If these details are, as we believe them to be, exact, the money held by the Crédit Mobilier is money over which they have a far greater control than other bankers have over the money which is left with them. The connection of the Crédit Mobilier with the companies who deposit such money is, in all likelihood, so close as practically to allay all apprehension of these deposits being demanded from feelings of apprehension; and the time at which they will be required for the works of the company to whom they belong must be known with great exactness. The Crédit Mobilier is in the position of a banker who receives large deposits from his personal friends; so long as they are his friends, he can be sure of their not being very hastily withdrawn from him. It is evident, however, that the scale of the operations of the Crédit Mobilier must be correspondingly restricted. There cannot be any very great amount of money in a position so peculiar as these deposits. As a general remark, no banker can have any very large number of personal friends that leave money with him; similarly, the amount of money in the hands of public companies very closely connected with the Crédit Mobilier must be of an amount strictly limited. Accordingly, as will be seen from the above accounts, the deposits did not increase during the year 1856, when the company was in the height of prosperity, its shares very high in price, and its dividend more than 40 per cent.; and we can hardly expect that they will increase hereafter, when circumstances are less favourable.

So far, therefore, as the employment of the funds left in deposit with the Crédit Mobilier is concerned, we have no reason to believe that it can accomplish the magnificent designs with which it was founded. The funds derived from that source are, and must continue, too small to revolutionize industry, or to consolidate in one common stock the shares of different companies. The original design, as appears from the above citation from the statutes, was, that the Crédit Mobilier should derive additional funds by the issue of bonds, the smaller of which should pass as currency, and the larger be held by capitalists who were desirous of investing their money at a fixed rate of interest. Neither of these operations has as yet been found practicable. The imperial government has not permitted the issue of any such bonds, and the resources of the company have been therefore less than they were expected to be. We may, however, much question whether, even without the prohibition of the government, the scheme would have realized the expectations of its framers. The smaller drafts which were to be issued as currency would have been inferior in a material point to the notes of the Bank of France, which now constitute the French circulation of paper. The tendency of commercial improvement is to confine the function of credit-currency more and more to documents payable on demand. There used to be a very extensive circulation of bills in Lancashire, but it has yielded gradually to the superior convenience of the Bank of England note. *Cæteris paribus*, it is obvious that a note payable on demand is better adapted for circulation among many persons than one payable at a distant date. Each holder of the former feels that he can test its value whenever he pleases; holders of the latter cannot do so until the day on which it becomes due arrive. There are, we believe, legal difficulties in France, as well as in England, attaching to overdue negotiable instruments which render all notes and bills payable at a fixed time inapplicable as currency after that time. We cannot, therefore, anticipate that the drafts of the Crédit Mobilier will be able to compete as currency with the notes of the Bank of France, which have the additional advantage of being now in use. If, however, the Crédit Mobilier could succeed in maintaining its drafts in circulation, we should see no objection to its so doing. They would have the ordinary advantage of paper money; if they displaced other forms of circulating credit, we may assume that the public, in giving that preference, was not acting without some reason. If a portion of metallic money were displaced, the French nation would to that extent benefit by an economy of capital. While, therefore, we cannot expect, we do not dread that the Crédit Moblier will circulate its drafts as a currency. A different objection applies to the bonds which were to be purchased as fixed investments by capitalists, like railway debentures, and the bonds of the Crédit Foncier. The first requisite of such bonds is a specific security. That of railway debentures is the revenue of a line of railway of which accounts are constantly published; and that of the Crédit Foncier is the landed property on which the funds of the society are advanced. The property on which the bondholder is to rely, is in both cases very evident to him. This is not so with the property of the Crédit Mobilier. We do not in the least know the contents of its *porte feuille*,—which shares it holds and which it has disposed of, and which it has never purchased. By the distinctive design of the Crédit Mobilier, the property belonging to it cannot be so stable in value, or so generally intelligible in character, as the property of the Crédit Foncier. No shares in bonds or moveable property of a country can ever be so fixed in price, or so well understood by the mass of men, as the acreage of the country in which they live. It is possible that a long course of good management and success may enable the Crédit Mobilier to raise *some* money on the security of shares and bonds whose names are not known to the public; but the progress of such an operation must be slow, and its range very limited.

We cannot therefore anticipate for the Crédit Mobilier the enormous and beneficial influence which its promoters announced and perhaps anticipated that it would have.

This also appears to be the opinion of the public. The shares, which, when L.10 only was paid on them, were worth L.70, are now, with L.20 paid, worth less than L.30; and their price has been for some months past (we write on the 20th of December 1857) steadily dropping. At the same time, however, we cannot expect from it the great evils which its extreme opponents have predicted. The limitation of its means tells on one side of the argument as well as on the other. It may seem, indeed, that the L.4,000,000 of deposits held by the company are a considerable sum for Bourse operations, and would be adequate to the requirements of a first-rate speculator. But the same circumstance which gives the company a peculiar control over these deposits, likewise controls the company, we have no doubt, in their employment. The railway companies who leave their money with the Crédit Mobilier expect the latter to take shares. The funds of the bank are doubtless largely invested in the undertakings carried on by its depositors; and it is only the amount not so invested which can remain applicable to common speculation. The denunciations of M. Berryer are therefore subject to important deductions, as well as the eulogium of M. Pereire. If we regard the company as a great railway bank, holding railway monies on peculiar terms, and investing much of its funds in the purchase of railway property, we obtain a view of its operations too distinct to warrant extreme apprehension or great hope. It is mainly from political considerations that a bank of such limited resources has obtained a European reputation.

(For further information as to the Crédit Mobilier, we may refer to two very able articles by M. Facade in the *Revue des Deux Mondes* for 15th May and 1st June 1856; and Tooke's *History of Prices*, vol. vi., pp. 104–130. For the ultimate data for these accounts of the company, as well as of our own, the reader may consult its published reports and accounts.) (W. B—T.)

MOCHA, or MOKHA, a city and seaport of Arabia, in the province of Yemen, is situated on the Red Sea, about 40 miles N.N.W. of the Straits of Bab-el-Mandeb; Lat. 13. 20. N., Long. 43. 20. E. The town is built on the edge of a sandy plain, near the shore of a bay formed by two low promontories, on which are built forts for the protection of the harbour. The city, when viewed from the sea, presents a striking and beautiful appearance, as the houses along the shore, which are the best in the place, are high, well built, and white-washed; while in the background several mosques are conspicuous, one of which is of great size. On a nearer approach, however, Mocha is by no means so attractive; for its appearance is mean, and it is disfigured by ruinous buildings and dirty streets. The city is surrounded by walls, but the fortifications are not of great strength. The principal building is the residence of the *dola*, or governor. The bay is accessible to vessels drawing 10 or 12 feet of water, but those of a larger size are obliged to anchor in the roads outside the bay. The principal article of export is coffee, for which Mocha is famous. The plant does not grow in the immediate neighbourhood of the town, which is a barren desert, but among the forests and hills of the interior, whence the beans are conveyed and sold to the Mocha merchants. Before the beginning of the present century the great demand for coffee in Europe contributed greatly to the wealth and prosperity of Mocha. Since then, however, the cultivation of coffee in the West Indies, and its exportation from thence at a cheaper rate, have affected the coffee trade of this port. The quantity annually exported is estimated at more than 10,000 tons. The principal other exports of Mocha are,—dates, gum of various sorts, frankincense, myrrh, balm, gold-dust, ivory, sharks' fins, rhinoceros' horns and hides, aloes, &c.; and the principal imports are rice, iron, hardware, &c. The trade of Mocha is chiefly in the hands of Banian Indians. Pop. 7000.

MODEL, in a general sense, signifies an original pattern, proposed for any one to copy or imitate.

This word is particularly used, in building, to signify an artificial pattern in wood, stone, plaster, or other matter, of some intended structure, with all its parts and proportions; being intended to give an idea of the effect it will have in its proper dimensions, and to serve as a guide in its execution. In all great buildings, it is much the surest way to make a model in relief, and not to trust to a bare design or draught. Models are also used for the building of ships, and for many other purposes.

In academies for painting and sculpture, the term *model* is given to a naked figure disposed in any particular posture, to assist the artist while executing a figure in a similar attitude.

Models in imitation of any natural or artificial substance are most usually made by means of moulds composed of plaster of Paris. The particular manner of making models, or *casts*, as they are also called, depends on the form of the subject to be taken. The process is easy where the parts are elevated only in a slight degree, or where they form only a right or obtuse angle with the principal surface from which they project; but where the parts project in smaller angles, or form curves inclined towards the principal surface, the work becomes more difficult. Bodies that are soft, however, may often be freed from the mould, even although they possess the latter shape. When a model is to be taken, the surface of the original is first to be greased, in order to prevent the plaster from sticking to it; but if the substance itself be slippery, as is the case with the internal parts of the human body, this need not be done. When necessary, it may be covered over with linseed oil by means of a painter's brush. The original is then to be placed on a smooth table, previously greased or covered with a cloth, to prevent the plaster from sticking to it; then the original is surrounded with a frame or ridge of glaziers' putty, at such a distance from it as will admit the plaster to rest upon the table on all sides of the subject for about an inch, or as much as is sufficient to give the proper degree of strength to the mould. The liquid plaster is then to be poured as uniformly as possible over the whole substance, until it is everywhere covered to such a thickness as the requisite strength of the mould, increasing with the size, may require. The whole must then be suffered to remain in this condition until the plaster has attained its hardness. When the frame is taken away, the mould may be inverted, and the subject removed from it; and when the plaster is thoroughly dry, let it be well seasoned. The mould being thus formed and seasoned, it must next be prepared for the cast by greasing the inside of it with a mixture of olive oil and lard in equal parts. It may now be filled to the brim with fine fluid plaster, and the thickness further increased by the addition of coarse plaster, to form a strong basis or support for the cast where this support is requisite, as is particularly the case where the thin and membranous parts of the body are to be represented. After the plaster is poured into the mould, it must be suffered to stand until it has acquired the greatest degree of hardness it will receive, after which the mould must be removed; but this will be attended with some difficulty when the shape of the subject is unfavourable, and in some cases the mould must be separated by means of a small mallet and chisel. If by these instruments any parts of the model should be broken off, they may be cemented by making the two surfaces to be applied to each other quite wet, interposing betwixt them a little liquid plaster, and then smoothing the joint after being thoroughly dry. Any small holes which may be made in the mould can be filled up with liquid plaster, after the sides have been thoroughly wetted, and smoothed over with the edge of a knife. In many cases it is altogether impracticable to prepare a mould of one piece for a whole

subject; and therefore it must be considered how this can be effected in such a manner as to divide the mould into the fewest pieces. This may be done by making every piece cover as much of the pattern as possible, without surrounding such projecting parts, or running into such hollows, as would not admit a separation of the mould. To make a mould upon a hard and dry substance, the surface must in the first place be rubbed smoothly over with the mixture of oil and lard above mentioned. Such hollows as require internal pieces are then to be filled up with fluid plaster, and whilst it continues in this state, a wire loop must be introduced into it, by which, when hardened, it can be pulled off.

After the mould is completely formed, it requires to be dried either naturally or by a gentle artificial heat, and then seasoned. This being done, nothing more is requisite to form the model than to pour into it the finest liquid plaster of Paris. After a layer of this, about half an inch in thickness, has been formed all round the mould, the coarser kind may be used to fill it up entirely, or to give to the model the thickness required. Besides the models which are taken from inanimate bodies, casts of the living face are frequently made, and this art has been brought to great perfection.

The method of making models in plaster of Paris is undoubtedly the easiest way of obtaining them. When models, however, are made of large objects, they must be constructed by the hand with some soft substance, as wax, clay, putty, &c.; and it being necessary to keep all the proportions mathematically exact, the construction of a single cast of this kind is a work of great labour and expense.

MODENA, Duchy of, an independent sovereign state in the north of Italy, extending from the Po to the Mediterranean, from 43. 56. 45. to 44. 58. of N. Lat., and from 9. 15. to 10. 53. of E. Long. The portion lying on the sea is very small, and has no ports or harbours. It is bounded on the N. by Lombardy and the Papal States, on the E. by the Papal States and Tuscany, on the S. by Tuscany, Sardinia, and the Mediterranean, and on the W. by Sardinia and the duchy of Parma. Its greatest length, from Portovecchio, its northern frontier on the province of Mantua, to the outlet of the torrent Parmignola, on the Sardinian frontier, is 84½ miles; and its greatest width, from the pass of Calama, on the Tuscan and Papal frontier, to the right bank of the Enza, on the frontier of Parma, is 37 miles. It has an area of 2371 square miles, of which 598,120 acres are of flat, and 890,880 acres of mountainous country. In 1855 it contained 606,139 inhabitants.

The S.W. part of the duchy is traversed from N.W. to S.E. by the main ridge of the Apennines, of which the highest peaks are Monte Cimone, 7084 feet above the level of the sea; Monte Cruna, 6762 feet; Monte Succiso, 6630 feet; and Camporaghena, 6542 feet. It contains many small lakes among the mountains, and is watered by the Magra and the Serchio, which fall into the Mediterranean. The N.E. part, which forms a portion of the great basin of the Po, is a level plain sloping very gradually from the Apennines, and watered by numerous small streams, which finally unite in the Secchia and Panaro, and empty themselves into that river. This part is intersected by numerous canals formed chiefly for the purpose of irrigation.

The soil of the N.E. or flat part of the duchy is generally fertile, and the system of cultivation very much resembles that already fully described in this work under the head Lombardy, except that olive trees are more numerous here than in the north. The vine is extensively cultivated about Reggio and Modena, and produces a strong, rough wine, a large quantity of which is exported to Lombardy. The high district of Garfagnana is entirely devoted to dairy pasture. Olive trees, vines, and orchards form the cultivation of the small district on the sea-shore. Silk, of which the greatest quantity is sent to foreign markets in a raw state, wheat, maize, hemp, and flax, are the other principal objects of culture; the two latter articles are coarsely manufactured for domestic consumption. Agriculture is chiefly carried on on the *métayer* system, and forms the principal pursuit of the larger portion of the population; for land being greatly subdivided, farms are generally very small. In the upland districts chestnuts form the principal food of the peasantry; while in the plain, *polenta*, or porridge made of Indian corn meal, is chiefly used.

In 1848 the acreage of the soil was distributed in the following manner:—734,810 acres were occupied by arable lands, meadows, &c.; 8996 by olive trees; 121,376 by chestnut trees; 3655 by vineyards; 121,815 by woods; 366,241 by buildings, roads, &c.; and 133,033 by waste land; giving a total of 1,489,926 acres. The value of the agricultural produce of 1854 was estimated at 88,611,986 Italian lire, or L.3,544,499, which, divided by the number of inhabitants in the same year, would give a produce of 146·19 lire, or L.5, 16s. a head.

The following are the detailed values of various articles of produce in 1854:—Wheat, L.823,855; Indian corn L.504,185; rice, L.66,774; other grain, L.116,701; chestnuts, L.185,450; oil, L.231,722; wine, L.1,031,594; cheese, wool, leather, &c., L.112,000; silk, fruit, &c., L.260,000. The number of live stock in the same year was,—cattle, 221,330; horses, mules, &c., 27,260; swine, 91,740; sheep, 341,200.

The *Stati Estensi*, as the duchy is officially styled in Italian, are divided into six provinces and seventy-two communities. The government is entirely in the hands of the Duke, who is assisted by several ministers and a council of state. The judicature consists of two supreme courts at Modena and Massa, and two inferior ones at Modena and Reggio. The code of laws is the same as that of Austria. Roman Catholicism is the established religion, and the hierarchy consists of an archbishop and four bishops. The educational institutions of Modena consist of a lyceum at the capital, and colleges for law and medicine at Modena, Mirandola, and Reggio; but the education of the people is at the lowest ebb. The military force consists of 3500 regular troops and three regiments of militia, amounting to a total of 14,656 men.

In 1855 the population was classified as follows:—

Provinces.	Communities.	Area in acres.	Inhabitants.
Modena	13	398,720	212,440
Reggio	14	472,960	166,696
Guastallar	6	81.920	52,220
Frignano	8	263,680	59,713
Garfagnano	17	140,160	38,705
Massa Carrara	14	160,200	76,385
Total	72	1,517,640	606,159

In this number there were 227,586 proprietors; 337,507 belonging to the agricultural class; 2648 following liberal professions; 109,500 day-labourers and servants; 40,075 tradesmen; 15,723 merchants; 11,577 shepherds; 3623 operatives; 3586 priests and monks; and 19,076 beggars!

A custom-house union with Austria was stipulated in 1849; but the commerce of the state is not considerable. In 1855 the exports amounted to L.312,447; of which Carrara marble, L.48,000; cattle and swine, L.120,000; wine, brandy, vinegar, &c., L.5600; silk, cheese, skins, grain, &c., L.138,800. The imports, chiefly colonial commodities and articles of luxury, amounted to L.224,731. In 1851 the annual revenue of the state was L.336,545, and the expenditure L.349,125; leaving a deficit of L.12,380, which was made up partly by extraordinary taxes, and partly by the revenue derived from a large patrimonial estate of the Duke near Treviso, formerly in the possession of the Obizzi, a branch of the House of Este. There is no funded debt. In 1851 Modena was united with Austria by telegraphic

Modena.

lines; and on the 1st January 1852 the metrical decimal system was adopted instead of the ancient weights and measures of the country.

History.

The sovereign of the state, who is an Austrian archduke, bears the title of His Royal Highness the Duke of Modena, Reggio, Mirandola, Guastalla, Massa, and Carrara. Through the female line he is descended from the House of Este, one of the most ancient families in Europe. Adalbert, a powerful marquis who lived towards the end of the ninth century, is the earliest ancestor to whom the learned Muratori was able upon documents to trace this family. Both Muratori and Leibnitz supposed him descended from the dukes and marquises of Tuscany; but as the latter lived *lege ripuaria*, and Adalbert, on the contrary, lived *lege Longobardica*, it is more likely that he descended from some great Longobard family. His grandson Oberto married a sister of a Marquis Ugo, who brought him as dower the castle of Este situated at the foot of the Euganean Hills, from which henceforth the family took their name. Alberto Azzo II., Oberto's grandson, married twice. By his first wife, Cunizza or Cunegunda, a sister of Guelph III., Count of Altdorf in Swabia, he had a son Guelph, who, at his uncle's death, without issue, in 1054, was acknowledged heir to that family's estates. He became Duke of Bavaria and founder of the House of Brunswick, and consequently of the present reigning family of Great Britain. Folco, another son of Alberto Azzo II. by his second wife Garisenda, a daughter of Herbert, Count of Maine, was the founder of the Italian branch, from which the dukes of Ferrara and Modena sprung. Alberto Azzo II. died, nearly one hundred years old, in 1097, and seven centuries afterwards, in 1776, William Henry, Duke of Gloucester, his direct descendant, erected to him a statue in the Prato della Valle at Padua.

Most of the present *Stati Estensi* formed in the eleventh century part of the vast possessions of Countess Matilda, the daughter of Bonifazio, Marquis of Tuscany. After her death in 1115, they came into the power of the Emperor Henry V., who descended into Italy and made himself master of her states. At his death in 1125 Modena acquired a certain independence, and soon afterwards engaged in constant warfare against its neighbour, Bologna. In 1249 the Modenese suffered a great defeat from the Bolognese at Fossalta, and their leader Enzo, son of the Emperor Frederic II., was made prisoner. After many years of civil faction, they invited Obizzo II. of Este, lord of Ferrara, who was proclaimed lord of Modena in 1289. At the beginning of the fourteenth century, however, Modena rid itself of its new master; but after thirty years of revolutions, in 1336, fell again into the power of Obizzo III. of Este; while, in 1409, Nicolo III. of Este having conquered Reggio, the district of Garfagnana surrendered to him without a contest. His son Borso in 1452 received the title of Duke of Modena and Reggio from the Emperor Frederic III., but continued to reside at Ferrara.

In the sixteenth century the Duke Alfonso I., the fourth husband of the famous Lucrezia Borgia, the daughter of Pope Alexander VI., having joined the League of Cambray against Venice, Pope Julius II., who deserted the League, took away from him Modena, Reggio, and Carpi. Modena was soon given up to the Emperor Maximilian, from whom, in 1514, it was bought back for 40,000 ducats by Leo X. Under Clement VII., however, in 1527, Alfonso I. having advanced upon the town, the inhabitants, tired of the papal sway, proclaimed him their master; whereupon the Emperor Charles V. declared that Modena, Reggio, and Carpi, belonged as imperial fiefs to Alfonso.

Under the reigns of Alfonso I. and of his two successors, Ercole II. and Alfonso II., letters and arts flourished at Ferrara, as well as at Modena and Reggio. It was Alfonso I. who, in 1522, appointed Ludovico Ariosto, the greatest romantic poet of Italy, governor of Garfagnana, and Alfonso II. was the hero of Torquato Tasso.

Modena.

At the death of Alfonso II., without male issue, in 1597, the eldest branch of the House of Este having become extinct, Alfonso, by his will, nominated his cousin Cesare d'Este as his successor. Cesare, who was a natural grandson of Alfonso I., was recognised as Duke of Modena, Reggio, and Carpi, by the Emperor Rudolph II.; but Pope Clement VIII. would not recognise him as Duke of Ferrara, and carried against him both temporal and spiritual arms. At length, by a treaty signed at Faenza on the 12th January 1598, Ferrara was taken from Cesare and incorporated in the States of the Church, while Modena from that time became the capital and ordinary residence of the House of Este.

Cesare died in 1628, and was succeeded by his son Alfonso III., who, after a year, having lost his wife, Isabella of Savoy, abdicated the throne in favour of his eldest son Francis, and became a Capuchin friar, under the name of Father John Baptist of Modena.

Francis I. patronized for a time the poets Tassoni, Graziani, and Testi, and began to build the ducal palace. His grandson Francis II. continued the palace, and founded the university and the library. At his death, without children, in 1694, the duchy came to his uncle, Cardinal Rinaldo d'Este, a son of Francis I., who gave up the cardinal's hat, and married Charlotte Felicia of Brunswick. Thus the two branches of the Este family, which had been separated since the eleventh century, were again united.

During the war of the Austrian succession, 1740–48, Modena and Reggio were occupied in turn by the French and imperial armies; but by the peace of Aix-la-Chapelle in 1748, they were restored to Rinaldo's son, Francis III., who died in 1780. His son and successor, Ercole Rinaldo III., who in 1741 had married Maria Theresa Cybo Malaspina, the last offspring of her family, and heiress of the duchies of Massa and Carrara, being driven out of Modena in 1796 by the French invasion, appointed a regency, and retired to Venice. His estates were then formed into a province of the Cisalpine republic, and by the treaty of Campoformio in 1797, he was to receive as indemnification a principality in the Breisgau. Ercole Rinaldo, however, would not accept the Swabian state, and died an exile at Treviso in 1803, leaving an only daughter, Maria Beatrice d'Este. Besides her claim to the paternal estates, Maria Beatrice was, in virtue of her mother, Duchess of Massa and Carrara; and in 1771 had been married to the Archduke Ferdinand of Austria, a son of the Empress Maria Theresa, and a brother of the Emperor Joseph II. and of Leopold II. of Tuscany.

In 1805 Modena and Reggio formed part of the kingdom of Italy, which replaced the Cisalpine republic. Massa and Carrara, by a decree of Napoleon of March 30, 1806, were united to Lucca, which had been erected into a duchy and given to Prince Felix I. and Eliza Baciocchi.

After the fall of Napoleon, by the treaty of Fontainbleau, April 10, 1814, ratified by the treaty of Vienna in 1815, the former states of the House of Este were given to Francis, eldest son of Ferdinand of Austria; Lunigiana, Massa, and Carrara, were restored to his mother, Maria Beatrice of Este, and at her death in November 1829 were inherited by Francis, and joined to the *Stati Estensi*.

The extinction of the male line of the House of Este was a misfortune to the duchy. The princes of that family, with all their faults, always had more or less patronized letters and arts; and as they had to rely on the support of their subjects, they could not act constantly in direct opposition to their wishes and interests. The new prince, who took the name of Francis IV., had no congeniality of feelings with his subjects, looked upon them as a conquered

race, and was nowise solicitous to gain their affections, as he knew that he could always rely for support on the whole strength of the Austrian empire.

The bad effects of the change appeared prominently in 1821, after the fall of the Sardinian and Neapolitan constitutions. Though in the duchy there had been no insurrection, yet many persons, on a suspicion of belonging to secret societies, were imprisoned, hastily tried, and sent to the galleys, and even to the scaffold. It was on that occasion that the present distinguished chief librarian of the British Museum, Mr Panizzi, was obliged to flee for safety from his country, where he was executed in effigy.

The French revolution of 1830 gave fresh encouragement to the liberal party throughout Italy. (See Italy.) Francis IV., either from fear, or with the hope of enlarging his territory, promoted with arms and money the liberal movement, which first broke out at Modena on the 3d of February 1831. But a large Austrian army having advanced and put down the insurrection in Central Italy without any interference on the part of France, Francis returned to Modena; and to make amends for his coquetting with the liberals, distinguished himself by numerous and cruel state trials, which carried misery and dismay into every family. Among the first victims sent to the scaffold was Ciro Menotti, a young man who had been on the most friendly terms with the Duke, and had led the Modenese movement at his instigation. The remaining years of Francis's life were equally marked by reaction and political prosecutions. It was under his protection that a Jesuitical journal, *La Voce della Verità*, was started at Modena, which became so violent in its attacks upon England, that at length Lord Holland, then the British plenipotentiary in Tuscany and the duchies, was obliged to interfere.

Francis IV. died in 1846, and was succeeded by his son, Francis Ferdinand V., the present Duke, who at first adopted a less oppressive course of government. In October 1847 he added to his estates the districts of Gallicano, Montignoso, and Fivizzano, which were given up by Tuscany on receiving the duchy of Lucca, according to a treaty of November 1844; and in January 1848 he also added the small duchy of Guastalla, and a district on the right bank of the Enza, which were received in exchange for the smaller districts of Villafranca, Castevoli, Treschietto, and Mulazzo, from Carlo Ludovico Borbone, who, having surrendered Lucca to Tuscany at the death of the Empress Maria Lousia in December 1847, had become Duke of Parma.

The liberal agitation of 1847 drove Francis Ferdinand V. into a course of stringent measures and persecutions. He had an Austrian detachment to garrison Brescello, and by an offensive and defensive treaty of February 1848, both he and the Duke of Parma empowered Austria to occupy their estates in times of danger. After the insurrection of Lombardy, the Austrians having found it necessary to withdraw, Francis took refuge in the fortress of Mantua, and the *Stati Estensi* by universal suffrage joined Sardinia. On the defeat of the Sardinian army in August 1848, Francis returned to Modena, which, however, on the resumption of hostilities, he again left and retired to the fortress of Brescello. He returned to his capital in May 1849, after the final defeat of Charles Albert, and ever since has followed a comparatively mild and more conciliatory policy.

Modena (ancient *Mutina*), the capital of the above duchy, is situated in 44. 38. 52. N. Lat., and 10. 26. 5. E. Long., between the Rivers Secchia and Panaro, on the banks of a canal which connects it with both these rivers. In ancient times Mutina was an important town of Gallia Cispadana, situated on the Via Æmilia. It was probably founded by the Etruscans, and afterwards fell into the hands of the Romans in 218 B.C., who, thirty-five years later, established a colony here, after annexing the country belonging to the Boians, in which it was situated. Civic rights were soon accorded to the inhabitants, and the great Via Æmelia constructed in order to develop the resources of the district. In 117 B.C., however, the settlers were disturbed by an incursion of the Ligurians, who for a short time held possession of the town. They were ultimately expelled by Consul Claudius, who inflicted a severe chastisement on the intruders. The next mention we have of Mutina is during the civil war, when in 78 B.C. it was held by M. Brutus against the victorious Pompey. Its most memorable occurrence in history, however, was during the *bellum Mutinense*, in 43 B.C., when it sustained a siege of about four months against the troops of Mark Antony. After the rupture of the latter with Octavius, he established a close blockade of Mutina, then garrisoned by Decimus Brutus. The forces of Antony held Bononia as well as Parma and Regium; while the main army, under his own leadership, kept up the siege of Mutina. For the relief of the latter the Senate had sent Consuls Hirtius and Pansa, besides the young Octavian. As Pansa was marching up to the support of his colleague with some newly-raised legions, he was attacked by Antony on the Bononian road, about eight miles from the besieged town. A severe action ensued, when the consul was mortally wounded; but Hirtius, taking the opportunity to attack the rear of Antony's army, forced him to retire to his camp before Mutina. The successful consul, however, was slain some days after, in a second battle near the town, which, nevertheless, had the effect of obliging his antagonist to raise the siege. In later years the town was besieged and taken by Constantine in 312 A.D., during his war with Maxentius; while after the decline of the empire it suffered severely from the barbaric invasions, and in 452 was laid waste by Attila. After the Longobard conquest it became the frontier city of their kingdom towards Ravenna; yet it gradually fell into such a state of decay, that in the tenth century it was almost totally deserted, and its site had in part become a morass. Most of the ancient buildings were allowed to go to decay, and ultimately became buried in the soil. From this abject state Mutina began to recover in the eleventh century, under the government of Countess Matilda, and gradually rose again to such prosperity, that in the fourteenth century it was already a very flourishing and opulent city.

The modern town is surrounded with walls, and defended by bastions and a citadel, which, though much enlarged and strengthened by the late Duke Francis IV. since 1830, is not capable of much defence. The city is well built, with a broad street running between two opposite gates. The houses are handsome, and many of them furnished with piazzas, or covered porticos, on the ground-floor. The ducal palace, which was begun by Francis I. in the seventeenth century, from the designs of Avanzini, and finished by the present Duke, Francis Ferdinand V., is a fine marble building, with several courts, open staircases, galleries, &c.; and still contains a large collection of paintings, though the best of them were sold in the last century, and form now the chief gems of the Dresden Gallery. In a wing of the palace is a collection of more than 25,000 coins and medals, and a museum of ancient sarcophagi, inscriptions, and curious mediæval sculptures. In the same wing is also the *Biblioteca Estense*, or library, of 90,000 volumes and 3000 MSS., founded at the end of the seventeenth century by Francis II. Muratori, Zacharia, and Tiraboschi, three of the most learned men of Italy in the last century, were successively its librarians. The *Duomo*, or cathedral, begun by the Countess Matilda in 1099, is a very fine building, in what is called the Lombard style of architecture. Its bell-tower, or *Ghirlandina*, as it is named, from the bronze garland which surrounds the weathercock, is lined with marble, and attains a height of 315 feet. The worm-eaten *Secchia*, or wooden bucket, which, taken by the Modenese

from the Bolognese at the affray of Rapolino, November 15, 1325, formed the subject of Tassoni's well-known poem, *La Secchia Rapita*, was at the time solemnly deposited, and is still kept in the basement of this tower. There are within the city more than fifty churches, of which twenty-six formerly belonged to religious orders. The new theatre, the opera-house, and the barracks are the other most remarkable edifices. The university, which once was flourishing, has been closed for several years; and public education is now chiefly in the hands of the Jesuits, who are perhaps more flourishing at Modena than in any other Italian city. There is a Royal Academy of Arts, Sciences, and Letters, a Scientific Society, a Veterinary College, and college for the nobles; but there is little trade of any kind, and the inhabitants chiefly depend on agriculture and on the expenditure of the court for their subsistence.

Cardinal Sadoleto, the secretary of Leo X., Ludovico Castelvetro, the historian Sigonio, the poets Molza and Tassoni, and many other literary men, were born at Modena. Pop. (1855) 32,000. (***)

MODERN, MODRA, or MADRA, a town of Hungary, county of Presburg, is situated at the foot of the Carpathian Mountains, 16 miles N.N.E. of Presburg. The town is well built and walled, with three gates, adjoining each of which is a suburb. It has a Benedictine monastery and church; Roman Catholic, Lutheran, Calvinistic, and Bohemian churches; and a governor's house and town-house. There are woollen manufactories; and some trade is carried on here. Pop. 6000.

MODICA, anciently *Motyca*, a town of Sicily, capital of a district of the same name, in the province of Syracuse, on the Scieli, 31 miles W.S.W. of Syracuse. The town, which stands amongst steep and rugged hills, is generally ill built, though it has a large square and some fine buildings. The principal edifices are the palace of the Dukes of Berwick-Alba, a castle, several churches, convents, schools, hospitals, and a town-hall. Cotton-spinning and the rearing of cattle are carried on; and there is a considerable trade, especially with Malta. Not far from the town is the valley of Ipsica, which is remarkable for numerous caves hollowed out of the rocks. Pop. 22,000.

MODULATION, in *Music*, is a word which in our language is susceptible of several distinct significations. It frequently means no more than an air, or a number of musical sounds properly connected and arranged. Thus it answers to what is sometimes understood by the word *tune*, and likewise expresses the French word *chant*. But the precise and technical acceptation to which it ought to be confined, is the art of composing melody or harmony agreeably to the laws prescribed by any particular key, rather than of changing the key, or of regularly and legitimately passing from one key to another. (See MUSIC, sec. *Modulation*.)

MODUM, a village and parish of Norway, in the province of Aggershuus, is situated on the Drammen, 25 miles W. of Christiania. In the neighbourhood there are extensive cobalt mines, and manufactories of smalt. Pop. 4500.

MÖEN, an island of Denmark, in the Baltic, S.E. of Zeeland, Lat. (of lighthouse on S.E. point) 54. 57. N., Long. 12. 37. E. It has a length of 18 miles, an extreme breadth of 13, and an area of 87 square miles. It is separated from Zeeland by the Ulf Sound, and from Falster on the S. by the Gröen Sound. The scenery of this island is highly picturesque and beautiful. From the one end to the other, along the E. coast, there extends a range of hills, many of the summits of which are richly wooded, whilst others are quite bare. The highest altitude to which these hills rise is only 460 feet, and the rest of the island is low, flat, and fertile. There are numerous glens and ravines, through which brooks and torrents flow in all directions from the hills. Möen has no rivers of any size, but there are a few small yet deep lakes. The chief town is Steege, on the N.W. coast, which has a good harbour. Pop. of island, 13,200.

MŒRIS. See EGYPT.

MŒSIA, a Roman province in Europe, was bounded on the N. by the Danubius (*Danube*), on the E. by the Euxine, on the S. by Mount Hæmus, and on the W. by the Drinus (*Drin*) and the Savus (*Save*). According to Strabo, it was originally peopled by emigrants from Thrace. It was first invaded by the Romans in 75 B.C.; but not until the reign of Augustus was it finally subdued, and reduced to the form of a Roman province. A line of fortresses was then planted for its defence along the southern bank of the Danube. The principal of these were afterwards known as Singidunum (*Belgrade*), Viminacium, and Axiopolis. In the interior were the towns of Marcianopolis, Sardica, and Naissus (*Nissa*). About the time of Trajan's reign, Mœsia was divided into two provinces—Mœsia Superior on the E., and Mœsia Inferior on the W., of the River Ciabrus (*Zebru*). In the reign of Decius the Goths secured a footing in the province, and were only induced to retire by a bribe from the succeeding emperor, Trebonianus Gallus. Numbers of them, however, afterwards returned, and settled down permanently. Their descendants were the Mæso-Goths, for whom Ulphilas translated the Scriptures about the middle of the fourth century. In the seventh century invading hordes of Bulgarians and Sclavonians founded the kingdoms of Bulgaria and Servia, which now comprise the territory of the ancient Mœsia.

MOFFAT, a market-town of Scotland, in Dumfriesshire, is situated near the Annan, 19 miles N.N.E. of Dumfries. It is much resorted to as a watering-place on account of its mineral springs, of which there are three in the vicinity; viz., Moffat Well, 1¼ mile from the town; Hartfell Spa, at the distance of 5, and Girpell, of 2 miles. The first, however, discovered in 1633, is the only one frequented by visitors. Its water has a disagreeable taste and a strong sulphureous smell. The town contains Established, Free, and United Presbyterian churches; baths, assembly-rooms, a market-house, reading-room, and library. The market-day is Friday, and fairs are held three times a year. Pop. (1851) 1413.

MOGADOR, MOGODOR, or SUIRAH, a seaport-town of Morocco, situated on the Atlantic, 125 miles W.S.W. of Morocco, Lat. 31. 50. N., Long. 9. 20. W. It is built on a rocky eminence, surrounded by low sandy ground which at high-water is overflowed by the sea, leaving the town in an insulated position. The town, which is of an irregular form, consists of two parts, one of which, called the Citadel, is inhabited by Moors, while the other is occupied by Jews. Mogador is walled and fortified; but its defences, which are the work of Genoese engineers, are of no great strength. The streets are straight but narrow; and the houses are large and flat-roofed, but present a somewhat gloomy appearance. The principal buildings are the mosques, some of which are very handsome, the palace of the pasha, custom-house, arsenal, &c. The harbour of Mogador is formed by an island of the same name, which lies about a third of a mile to the S. of the town; and although it is much exposed, it is considered the best harbour on the coast. It might, however, be much improved. The city is supplied with water by an aqueduct, built by the present emperor, which conveys water from a river at the distance of a mile and a half to several tanks in different parts of the town. The trade of Mogador is considerable, and is chiefly in the hands of the Jews. The principal articles of export are wool, gum, wax, hides, skins, almonds, honey, ostrich feathers, ivory, gold-dust, &c.; the imports are iron, hardware, glass, woollens, linens, cottons, sugar, pepper, &c. The value of the exports in 1855 was L.284,078, and that of the imports L.167,718. Mogador

was founded by the Emperor Leedy Mahomet in 1760, as the commercial capital of his empire. It was bombarded in 1844 by a French fleet under the Prince de Joinville, on which occasion it suffered severely. Pop. estimated at 16,000, of whom 4000 are Jews.

MOGHILEV, or MOHILEV, a government of Russia in Europe, bounded on the N. by that of Vitepsk, E. and S. by those of Smolensk and Tchernigov, and W. by that of Minsk. It lies between 53. 5. and 55. 10. N. Lat., and between 28. 50. and 32. 40. E. Long., having a length of 210 miles, a breadth of 112, and an area of 18,724 square miles. The northern part of the government is traversed by a low range of hills, which separate the streams flowing north from those which take a southern direction; but the greater part of the surface is flat, and there are few lakes or marshes. The principal river in the government is the Dnieper, which enters Moghilev from the N.E., and after flowing through the centre of the district, forms its boundary on the S.W. Of the tributaries of the Dnieper in this district, the most important are the Swinaja, the Bolotinka, and the Sodscha, on the left; and the Druez on the right. The climate is mild and dry; and the soil, which is fertile, is equally suitable for cultivation and for pasture. A great part of the surface is covered with oak and pine woods, which furnish excellent timber for ship-building, especially for masts. Along the banks of the rivers there are extensive and rich meadows, on which large flocks and herds are fed. Iron ore is found in great abundance, but it is only worked to a limited extent, the inhabitants being employed principally in pastoral and agricultural pursuits. The quantity of corn raised annually amounts to nearly 23,080,000 bushels. Rye, barley, oats, wheat, buckwheat, hemp, flax, and hops, are the principal crops grown; and the quantity of these so exceeds the demand as to leave a considerable amount for exportation. The horses and cattle are of an inferior breed; but the sheep have been much improved by crossing with those of Saxony. The manufactures are insignificant, and are chiefly in the hands of Jews. A considerable trade is carried on in grain, hemp, flax, leather, honey, wax, &c. The government is divided into twelve districts; and the principal towns are Moghilev the capital, and Mstislavl. The inhabitants are chiefly Russniaks, or Little Russians, and there are also many Jews and gypsies. The language spoken in Moghilev is a mixture of Polish and Russian. Pop. (1846) 931,300.

MOGHILEV, or *Mohilev*, capital of the above government, is situated on the E. bank of the Dnieper, 85 miles S.W. of Smolensk, and 110 E. by S. of Minsk. The town consists of four quarters, one of which, the Kremlin or citadel, is built on a hill. Two other quarters form the main body of the city, and are surrounded by ramparts; and the fourth quarter consists of a suburb. The houses are well built, partly of wood and partly of stone. Many of the streets are broad and well paved; and in the centre there is a large open space of an octagonal shape, surrounded by handsome stone buildings, one of which is the archbishop's palace. The town contains twenty churches, of which the greater number are Greek, but five are Roman Catholic and one Lutheran. Moghilev has also four convents, two theological colleges, two schools, and several benevolent institutions. The chief manufactures of the town are those of ironware, leather, and tobacco; and a considerable trade is carried on with Riga, Königsberg, Dantzic, and Odessa, in hemp, glass, leather, hides, corn, oil, wax, honey, &c. Raw salt is imported. The town is ancient, but the date of its foundation is not known. It is the seat of a Greek archbishop and of the Roman Catholic primate of Russia and Poland. Many of the nobility reside here. Pop. (1851) 16,558.

MOGI-DAS-CRUZES, a town of Brazil, province of São Paulo, about 4 miles from the Tiete and 40 E.N.E. from São Paulo. The town is chiefly built of mud, and contains four churches, a convent, and two schools. It has manufactures of woollen cloth, and a considerable trade in coffee, rum, sugar, and cotton. Pop. (of the district) about 9000.

MOGOO, a seaport of Laristan in Persia, which has one of the most secure roadsteads in the Persian Gulf. It is formed by Cape Bostana to the eastward, and by Point Certes to the west. It is capable of containing the largest fleets, and the entrances are about 10 miles asunder. It is 80 miles south of Lar.

MOGRIDGE, GEORGE, better known as "Old Humphrey," a popular magazine writer, was the son of a canal agent, and was born in February 1787 at Ashted, a suburb of Birmingham. He was educated at a boarding-school at Boarcote, near Bromsgrove, where he imbibed that love for the sights and sounds of the country which became so strong a feature in his character. After serving as an apprentice for several years, he was taken in 1811 into partnership with his elder brother, a wholesale dealer in japanware in Birmingham. Meanwhile his leisure hours had been enthusiastically spent in reading the poets, in contributing small articles in prose or verse to local newspapers, and in rambling through the most pleasant spots of English scenery. Not many years afterwards his brother's death left him to conduct the business alone. His total incapacity for mercantile affairs soon brought him to bankruptcy, and reduced his family to destitution. He now resolved to trust to literature for a livelihood, and settled down in an obscure and solitary lodging on the Kingsland road near London. There, harassed by extreme poverty, yet comforted by a deep and cheerful piety, he continued for several years to ply his facile pen unceasingly, and to produce volume after volume of simple life-like sketches and genial home-truths. At length, in January 1833, *Old Humphrey's Observations* began to appear in the Tract Society's magazine, the *Weekly Visitor*. The fond fidelity with which they transcribed the familiar sights and objects of the street and the rural by-path was the principal secret of their fame. But this charm was greatly heightened by their simple, garrulous style, their child-like humour, their practical wisdom, and their tone of human sympathy and of genuine and genial piety. In a short time "Old Humphrey" had attained the position of a moral teacher in the bosom of many a family throughout the land. His papers continued to be issued periodically for several years, until a selection of them was large enough to fill six volumes. These were published under the distinctive titles of *Old Humphrey's Addresses, Observations, Friendly Appeals, Half-Hours, Thoughts for the Thoughtful,* and *Pithy Papers.* Mogridge continued to write to the last, and died at Hastings in 1854, leaving his family nothing but his Christian example and the honour of his works. His life was published by the Rev. Charles Williams, London, 1856.

MOGULS. See ASIA and HINDUSTAN.

MOHACS, a town of Hungary, county of Baranya, on the western arm of the Danube, 25 miles E.S.E. of Fünfkirchen. It contains a castle; Roman Catholic, Greek, and Protestant churches; a handsome episcopal palace; a monastery; school; and county buildings. The commerce is considerable, and it has a quay on the Danube, whence wine, corn, wood, coal, &c., are despatched to Vienna. The steamers on the Danube also call here. Five fairs are held annually at Mohacs, and are very much frequented. In the neighbourhood of the town two famous battles were fought: the first in 1526, when the Turks, under Solyman the Magnificent, defeated the Hungarians with great loss; and the other in 1687, when the Turks in their turn were defeated by the imperialists under the Duke of Lorraine. Pop. 10,050.

MOHAMMAD ALEE. See EGYPT.

Mohammedanism.

MOHAMMEDANISM. An account of a religion which has exercised, and still exercises, so great an influence over a large portion of the human race, appears to demand the consideration of the following topics:—1. The history and character of its founder. 2. The probable causes of his success. 3. The Koran. 4. Other elements and characteristics of Mohammedanism. 5. Its social and political features. 6. Its principal sects. 7. Its literature, science, and art. 8. Its relation to heathenism. 9. Its relation to Christianity. 10. Its present condition and probable future.

Reference to various sources of fuller information under these different heads will, it may be hoped, enable the reader to fill up the outline here presented of the origin, progress, and character of Mohammedanism.

1. *History and Character of Mohammed.*—Mohammed, son of Abdallah and Amina, and grandson of Abdelmottalib, was born at Mecca in August 570 A.D. Gibbon inclines to a year earlier, but high authorities are against him. He was of the noble family of Hashem, of the tribe of the Koreish, confessedly the first and most honourable in Arabia. As his father Abdallah died shortly before the birth, the grandfather Abdelmottalib rejoiced greatly over the event, and at a feast held seven days after bestowed on his infant heir the name of Mohammed, or *The Glorified.* Later traditions told how, when the infant was born, the palace of the King of Persia was shaken by an earthquake, and the sacred fire of the Magi extinguished. Mohammed was nursed by a woman named Halima, and then by a black slave called Oumm-Ayman. Towards both, and especially towards the latter, he always displayed much gratitude and attachment.

At the age of six he lost his mother Amina. She was unable to leave him any property beyond five camels and the slave Oumm-Ayman. His grandfather Abdelmottalib (in some English works, Abdol-Motalleb) took him under his protection for three years, when he also died; and the lad, now nine years old, passed (A.D. 579) into the hands of his paternal uncles, one of whom, Abu Taleb, acted as his friend and guardian. Mohammed is believed to have been present at two battles fought between the tribe of the Hawâzin and the Koreish in 585 and 586, in both of which the Koreish were defeated, though they subsequently regained the advantage. About this time Abu Taleb took his nephew in his company on a mercantile expedition into Syria. The youth had attained his thirteenth year, and is said to have begun to attract attention, and give promise of future eminence. As in the case of many other famous men, however, it is difficult to decide how far such traditions result from the reflected glory of after life. Although endowed with a native penetration such as Thucydides in a famous passage ascribes to Themistocles, Mohammed was deficient in the elements of education: it is doubtful whether he could even read and write. So ignorant was he of the Arab rules of versification, that he seldom quoted a verse without some misarrangement of its words. In apparent allusion to these circumstances, we find him in one of the most celebrated chapters of the Koran declaring, "We have not taught Mohammed the art of poetry, nor is it expedient for him to be a poet" (chap. xxxvi.); as in a previous chapter, the seventh, he entitles himself "the illiterate prophet." There appears, however, no reason to doubt that by the age of twenty-five he had acquired a most honourable reputation among his fellow-countrymen. His readiness, his nobleness of conduct according to the Arabian standard, his good faith and aversion to anything dishonourable, won for him at this period the surname of *El-Amîn*, the trustworthy.

An important epoch in his life now arrived. His reputation for honesty and ability induced a wealthy and high-born widow, named Kadijah, to employ him as her mercantile agent. His great success led to the offer on Kadijah's part of her hand. Although between thirty and forty years of age, she had still several suitors. This match placed Mohammed in a position conformable to his origin. The change did not, however, unduly elate him. He showed delicacy in the employment of her property; and during her lifetime had no other wife. Of the six children of this union two sons died in infancy; the daughters lived to embrace their father's creed, and were married to disciples. One only, however, Fatima, outlived him, and became by her marriage with the famous Ali the ancestress of an illustrious family. The burst of feeling attributed to Mohammed, years after Kadijah's death, is well known. When a later wife, Ayesha, was claiming superiority on the score of youth, he is reported to have said, "There never can be a better! She believed in me when men despised me; she relieved my wants when I was poor and persecuted by the world."

Mohammed was twenty-five years old when he espoused Kadijah. We pass over his arbitration of a contest between rival branches of the Koreish, as to the honour of moving the famous black stone in the national temple at Mecca (the Kaaba), which this tribe, as its guardians, were (A.D. 605) reconstructing. His office on this occasion, however honourable, appears to have been accidental. But in the following year Mohammed, now thirty-six years of age, had the satisfaction of being able in some degree to repay the kindness of his uncle Abu Taleb, by taking charge of a young cousin Ali, already alluded to as one of the most zealous and famous of his future disciples. He likewise tried to console himself for the loss of his sons by Kadijah, by the adoption into his family of a young man named Zayd, son of Hâritha.

Mohammed's want of anything like regular education has been noticed. He appears, however, to have gained much information while on his travels as a merchant, and probably still more from intercourse with his wife's cousin Waraca, son of Naufal, the most learned Arab of his day. We incline to agree with Hallam, Taylor, Döllinger, and others, who think that Mohammed had no real acquaintance with the New Testament; but he gained a knowledge, though a vague and imperfect one, of the principal Jewish and Christian dogmas, of the Scripture history, of the contents of some of the apocryphal gospels, and of the Talmud. He was naturally well versed in the traditions and legends of his own country; and added to a resolute will and considerable strength of imagination a wonderful power of expression. His love of solitude was very great. He would wander, it is said, in the gorges and valleys around Mecca, and every year retired during the month of Ramazan to a neighbouring hill, Mount Hirâ. There he spent his time in prayer, and fed any poor who asked of him an alms.

We now come to the date (A.D. 611) when Mohammed, being in his forty-first year, asserts that he received his mission. About this time Britain is witnessing the foundation of a Christian church in London, now known as Westminster Abbey; Boniface IV. is pope at Rome; and the Anglo-Saxons, Jutes, and many more tribes in northern Germany, are adopting the faith of Christianity. The Greek empire is being ravaged by Persians and Avars; but Heraclius is preparing for resistance, and in the very year of the Hegira (A.D. 622) will start upon his glorious and successful expedition against Persia, and gain a signal victory for the cross.

The first passage said to be revealed is that which now stands as the commencement of the 96th *sura* (or chapter) of the Koran. "Read, in the name of thy Lord who hath created all things; who hath created man of congealed blood. Read, by thy most beneficent Lord; who hath taught the use of the pen; who teacheth man that which he knoweth not." He told Kadijah that the angel Gabriel had taught

him these words, and she at once accepted him as the prophet of the nation. Her cousin Waraca, now aged, and who died shortly afterwards, received the information in such a way as to confirm Kadijah in her belief. Ali, then eleven years of age, was the second convert. The new religion was termed by Mohammed *Iman* (belief), and *Islam* (resignation to the will of God); whence the adjective Moslem believer, and the corrupt form Mussulman. He shortly after made a new and valuable proselyte in Abu-Beker, a man of high consideration and remarkable for the beauty of his person. But a check followed; at a reunion of his cousins the announcement of his mission was received with coldness and incredulity; and when, not satisfied with teaching the unity of the Godhead and his own apostleship, he declared his intention of overthrowing idolatry and bringing his countrymen back to the religion of Abraham, indignation burst forth on all sides. It was proposed to silence him; and none were more vehement in their opposition than the other families of his own tribe, the Koreish. Abu-Taleb, though not a convert, continued to protect his nephew.

For the next few years Mohammed's life was passed in a state of persecution and insult which extended itself to his few disciples. Once, indeed, his adversaries made offers of wealth or leadership if he would cease from his endeavours; but he replied by the recitation of that chapter of the Koran which now stands as the 41st; a really sublime effusion, in which he reminds his hearers of the destruction of the city and tribe of Ad for idolatry; a legend known to English readers by the first book of Southey's *Thalaba*. The reply to this appeal was the very natural request that Mohammed would work miracles as a proof of his divine mission. This embarrassing demand is more than once alluded to in the Koran. His answer was, that he was sent to preach truth, not to work miracles; and that his opponents would not be convinced even if miracles were vouchsafed. Nevertheless, as if conscious of his weakness on this side, he in time proclaimed his famous night journey to heaven, known as *Isra*, when the angel Gabriel took him on the animal Borac to enjoy an interview with patriarchs, prophets, and the Almighty himself. This brought on him a storm of ridicule, and some of his disciples abjured his teaching. Abu-Beker stopped others from departure by professing his own entire belief in Mohammed's narrative.

In the eleventh year of his mission (A.D. 621) some new converts took oaths of fidelity, known as the oaths of Acaba, the hill on which they were taken. But fresh plots among the Koreish alarmed him; and in A.D. 622 he took the step of flying from Mecca to Medina, then known as Yathrib. This flight, known as the Hidjra, and in Europe as the Hegira, was, 17 years later, fixed as the great Moslem epoch by the Caliph Omar. Here he took up arms against the Koreish, and within two years (on the 13th of January 624) won the famous victory of Bedr. In the Koran (chap. iii.), he maintains that angelic aid was granted in this battle. Mohammed behaved generously to his prisoners, but made some of them teach his converts how to read and write. In the same year he was defeated at Ohod; but as this battle was lost by disobedience to his orders, Mohammed's reputation did not suffer. He resolved henceforth to give no quarter to the idolaters. About this time he had dealings with the Jews. A few accepted him as a prophet; but his claim of descent from Ishmael, and his partial admission of the claims of Jesus, repelled the majority. They became bitter enemies, and Mohammed caused at least one of their leading men, Khalid, to be assassinated.

In the meantime Mohammed had largely increased the number of his wives: he had in all fifteen, besides Kadijah. It was probably in the year 626 that he married Zeynab, daughter of Djahch. This was contrary to Arab usage, for she was the wife of his adopted son Zayd; and no willingness on the part of the husband, who at once divorced Zeynab, nor on the lady's own part, could annul this difficulty. But a resource was at hand. In the 33d chapter of the Koran was given a permission to the Moslem to marry the wives of their adopted sons, these sons being in future called by the names of their actual fathers.

In A.D. 628, the 6th year of the Hegira, he began to send letters to sovereign princes, not only in Arabia, but beyond its limits. They were sealed with a silver signet containing in three lines the words, MOHAMMED—APOSTLE—OF GOD. Persia, Abyssinia, and Egypt were the first recipients. This is a new and marked feature in the history of Islamism.

In the following year he made some of his most distinguished converts,—Othman, Amr, and Khaled; but essaying his power against the Eastern Roman empire, his troops were defeated by Theodore, lieutenant of Heraclius. He was not present at this battle. Soon after, he gave great offence to his wives by continuing to cohabit with a Coptic slave, Maria, whom he had freed on the birth of a son. A fresh chapter (the 66th) of the Koran righted this matter also, but not without difficulty.

Eight years after his flight he was strong enough to gain possession of Mecca (January A.D. 630). Mounted on his camel, he rode seven times round the Kaaba, then having on its roof 360 idols. He had every one of these destroyed before his face, saying the while, "*The truth is come; let falsehood disappear*" (Koran, chap. xvii.) That day was perhaps the grandest of Mohammed's life.

But by this time he had fully adopted the principle of enforcing his creed by arms, instead of mere persuasion. We have not space to dwell on his victory over the Hawâzin at Honayn: his precepts will fall under later sections. In 632 his health began to decline. He had always been subject to fits of epilepsy. This was long supposed to be a Christian calumny, and is so treated by Gibbon and others; but the researches of Weil have proved its truth. On the 7th of June 632, the sixty-third year of his age, Mohammed died of fever, his favourite wife, Ayesha, supporting his head.

In person Mohammed was of middle stature, with dark eyes, a ruddy complexion, and a fair and graceful neck. He wore a thick beard. His life was most simple: dates and water often his only food, and his house sometimes without fire for a month together. His manner, as well as his appearance, was fascinating, his conversation lively and not destitute of "that taste for humour which (as Dr Arnold remarks) great men are seldom without." He was fond of setting off the beauty of his person to the best advantage.

It must be owned that, apart from the Koran, there is a lack of contemporary written evidence for the life of Mohammed. Abulfeda lived in the fourteenth century; and Al Jannabi is also late, and a mere writer of legends. Later investigation has brought out the writings of Ibn Khaldoun, also of the fourteenth century, and of Tabari, who lived in the third century of the Hegira; and it is satisfactory to find that these authors do not apparently clash with what was already known. Dean Prideaux's Life (4th edit., London, 1708) is unduly hostile, and the *Vie de Mahomet*, by the Comte de Boulainvilliers, untrustworthy from the opposite cause. Gagnier's (Amsterdam, 1748) was the best of the last century. The account of Mohammed prefixed to Ockley's work seems fair, and more to be relied on than the main body of his book (*History of the Saracens*, 3d edit., Cambridge, 1757). Gibbon's famous fiftieth chapter is full and splendid; though Hallam, in an excellent discussion of the subject (*Middle Ages*, chap. vi.), rightly reminds us of the frail nature of a portion of the evidence. Dean Milman (*Latin Christianity*, bk. iv., chap. 1) gives a candid and masterly summary of the case.

He agrees with a distinguished French orientalist, M. Renan, in praising the copious work of Dr Weil (*Mohammed der Prophet, sein Leben und seine Lehre*, Stuttgart, 1843). Among minor works may be honourably mentioned *Lives of Mahomet and his Successors*, by Washington Irving, New York and London, 1850; and the Life published by the London Religious Tract Society. But the book to which we are here most indebted, and which can hardly be praised too highly, is the *Essai sur l'Histoire des Arabes*, &c., par A. P. Caussin de Perceval (Paris, Didot, 1847-48). Both M. Renan (*Revue des Deux Mondes*, tome xii., 1851) and Lieutenant Burton (*Pilgrimage to El Medina and Mecca*, London, Longman, 1855) sanction this admiration. M. Renan, it may be observed, cautions us against lending attention to Turkish or Persian, as distinct from Arab, accounts.

It remains to speak of Mohammed's character. Men's views have been largely influenced by preconceived notions. Thus, *e.g.*, Voltaire, disliking religious fervour of any kind whatever, detested the memory of Mahomet (we adopt for the moment the French and English corruption of Mohammed's name), and has done his utmost to vilify him both in verse and prose. His tragedy of *Mahomet* is utterly unsupported by history. Of his arguments we may speak presently. Other writers have been favourable from indifference or hostility to Christianity, as Boulainvilliers, and possibly, in some degree, Sale and Gagnier. Among those who are too favourable we should be inclined to class Mr Carlyle (*Heroes and Hero-Worship*) and Mr E. A. Freeman, in his *Lectures on the History of the Saracens*. But if undue favour be now the chief danger, it has arisen from the reaction caused by the harsh treatment of Bibliander, Hottinger, Maracci, and Prideaux, from the sixteenth to the eighteenth century. Caussin de Perceval and Milman are very fair. But perhaps the most equitable and philosophic treatise is the short essay (50 pp.) of Möhler (*Ueber das Verhältniss des Islams zum Evangelium*), published in 1830, and re-edited by Döllinger in 1839 (Regensburg). A very correct English translation, by the Rev. J. Menge, has been issued at Calcutta (Ostell & Lepage, 1847).

The controversy concerning Mohammed's character turns mainly upon these two points: Was he a mere imposter? Was he, prophetic claims apart, a bad and immoral man? The believers in his entire or partial imposture allege the syncretistic character of his creed, and its bitter hostility to Christianity; the stains of voluptuousness and revenge which disfigure his character; and, above all, the supposed revelations about the cases of Maria and Zeynab. But none of these arguments are decisive. That his creed is largely borrowed from Judaism and Christianity does not prove that he was not honest in selecting what appeared to him to be truth. He never pretended to be teaching a new religion. The enmity to Christianity is a more serious feature. It certainly, in our judgment, convicts Mohammedanism of containing a seed of evil and bitterness through its false claims; but it followed logically, as we shall see hereafter, from the delusion of Mohammed in imagining himself the prophet of the human race, and delusion need not be hypocrisy. Of Mohammed's revengeful spirit and voluptuousness it must be said that we reason unfairly when we judge of them by a Christian standard. The assassination of his Jewish enemies was a fearful crime; but it neither shocked himself nor his companions, for Arabian morality, unhappily, did not condemn it. For a full discussion of the case of Zeynab and Maria, we must refer the reader to Möhler's Essay. Certain it is, that Mohammed's passions offended those around him as little as his revengefulness; he could boast of his physical powers, and record those things which are his shame, without a blush. But Möhler's remarks on this subject deserve the deepest consideration: "I maintain, that if one admits the possibility of any man's being able to give out his own individual religious impressions, ideas, and thoughts, without suspicion, for divine inspirations, I cannot perceive the impossibility of his considering God also to be the author of all his other inward impulses." The learned writer then refers to religious rites practised in ancient Babylon (Herodotus, i. 199), and in many other countries, as a proof that men *may* come to regard the basest deeds as allowable, and even divinely authorized; and while fully admitting how much the above transactions lower Mohammed's character, and lend a plausibility to Voltaire's inventions and Goethe's imitations of them, he not unnaturally argues that Mohammed may still have acted with good faith, and would never have immortalized these events by the publication of the two chapters of the Koran, if he had been conscious of wickedness. No Moslem ever appears to have found any difficulty or inconsistency with Mohammed's prophetic character in these circumstances. (*Möhler*, ed. Doll., pp. 367-8.)

On the whole, then, while we regard Mohammed as a false prophet, whose teaching and character (amidst much that is good and true) contains most unchristian and antichristian elements; while we consider his intellect to have been in many respects narrow and limited; while we leave to the Judge of all men the solution of the problem of his heart, with its admixture of lust, revenge, shamelessness, and apparent love of spiritual rule, strangely combined with its loftier qualities, we are unable to regard him as a bad *Arab* or a mere imposter. Of the Koran we shall speak presently. But on the whole, looking at the natural workings of an ardent imagination, exalted by meditation and solitude at a time when his countrymen were in an unsettled religious state; the conviction wrought upon those nearest to him, as Kadijah, Omar, and Abu-Beker; his endurance for twelve years of every species of insult and persecution; his steady rejection of every offer of wealth and chieftainship, made on the condition of his desisting from his endeavours; the simplicity of his mode of life to the very last;—we cannot accept the views of Voltaire, or of Prideaux and Maracci, but must so far side with Möhler, Caussin, Carlyle, Irving, and others, as to believe in the general sincerity of Mohammed, and his faith in himself and his own mission.

2. *The Probable Causes of Mohammed's Success.*—Some Mohammedan, and more especially Turkish, historians decline to investigate secondary causes of events, content to assert that such was the will of Providence. We are tempted to follow their example with respect to the question here at issue, so inadequate do the reasons usually assigned appear to us. Still, some of them may be true so far as they go, and it is right to mention these.

Arabia, Mohammed's native country, had enjoyed remarkable freedom. Even Gibbon admits that no conquest had been more than local or temporary. Hence arose great freedom of thought. The Arabs were a Semitic race, partly descended from the son of Eber, variously called Kahtan, Yectan, Jocktan (Gen. x. 25-30); partly from Ishmael, the son of Abraham by Hagar. Whether the Koreish were from Ishmael or from Joktan has been hotly disputed. Mr Forster, author of *Mahometanism Unveiled*, is strenuous for Mohammed's descent from Ishmael; and Caussin de Perceval seems inclined to support him. Dr Sprenger, one of the most recent biographers, takes the other side; as do Gibbon, Lieutenant Burton, and others. We do not attach great importance to this point. Mr Forster is probably biassed in one direction, as Gibbon is assuredly in the other; but all would probably admit, firstly, that the entire nation displays similar characteristics to the Ishmaelites in their love of fighting and plunder, varied by a taste for commerce (compare Gen. xvi. 12, and xxxvii. 25-28, with Judges viii. 24); and secondly, that Mohammed

himself claimed descent from Ishmael, and acted upon his belief. The ancient religion of Arabia has been proved to have been a strict Monotheism (Caussin, Renan, Hallam); and in maintaining that he was recalling his countrymen to their old creed, and appealing to the example of Abraham, he named one whose memory was honoured alike by Joktanite and Ishmaelite, Jew and Christian. The Arab is allowed, both physically and intellectually, to be a fine specimen of the human race, and it is to their natural qualities, their courage and energy, that many attribute their success in imposing their creed on other nations.

At the time of Mohammed's appearance there were Christian tribes, Jewish tribes, and pagan tribes. But Christianity seems to have been but imperfectly accepted even by those who professed it, and almost every imaginable form of heresy was rife in the Arabian Peninsula. A vague syncretism was very common, and there was a yearning for something more simple, definite, and dogmatic. Four of the Koreish (Caussin) had already tried to amend matters. Of these four, three ultimately became Christians; but the fourth, Zayd, son of Amr, was quite a precursor of Mohammed in his attack upon idolatry and proclamation of the Divine unity.

Some will at once attribute Mohammed's success to the use of the sword and the permitted indulgence of voluptuousness. As regards the compulsion by war, we answer with Mr Carlyle, that before you convert with the sword you must first get your sword. However much the creed of Islam may have been forced upon unwilling nations after Mohammed's death, there was certainly no violence employed in the first instance. On the contrary, physical force was in the outset against Mohammed. The supposed attraction of a sensual paradise, and permitted indulgence in this life, as a cause of success, has been sanctioned by Gibbon, who (it may be observed) inclines to think Mohammed hypocritical in his later days. But we quite agree with Mr Hallam and Mr Maurice (*Middle Ages; Lectures on the Religions of the World*, London, 1848, 2d edition) in thinking that the influence of such motives has been much exaggerated. Mohammed did not introduce polygamy; he found it in existence, and restricted it. He condemned all adulterous and incestuous connections; forbade wine, usury, games of hazard, superstitious divination by arrows, the sadly common sin of destroying female infants, and all war between tribes which had become Mussulman. When we add to this the fasts, the pilgrimages, and the regular prayers and ablutions enjoined by him, it will be hard to prove that the adoption of the new creed was thought to be an acquirement of more license either of thought or action. M. Caussin's narrative seems to us to establish the direct contrary (*Histoire*, &c., tom. ii., pp. 402-3, 604). This point, with others, is also discussed in a pamphlet by the present writer (*Mahometanism*, London, Mozley, 1856.)

There remain the following probable causes of success:—The state of Arabia at the time of Mohammed's appearance—the actual amount of truth taught by him—the principles acquired directly or indirectly from Christianity—the points of contact with the past, and the religions then obtaining in his country—the remarkable elegance and purity of the Arabic diction of the Koran, and its applicability to law and the practical business of life—the native vigour of the author's mind, and the apparent need, to human eyes, of some great scourge upon idolatry. These causes may all have contributed to the result; but we cannot pretend that they seem to us to afford a complete and satisfactory explanation of the triumphant progress of Islamism in its early stages, still less of its extraordinary permanence in an almost unchanged state to the present day. With one more reflection we quit this branch of the subject. Those who consider Mohammed to be a conscious deceiver place one more difficulty in the way of accounting for his success. "How, indeed, is it possible," asks Möhler, "that a religious fire, wild though it were, which in so astonishingly short a period set all Asia in flames, could proceed from one in whom the kindling material had no real existence?" Unless, which remains to be seen, Mormonism should prove an exception, we cannot call to mind an instance of any lasting religious effect being produced by a teacher who did not believe, however delusively, in the truth of his own mission and doctrine.

3. *The Koran.*—Neither with reference to the Koran, nor to the other claims of Mohammed, do we think it necessary to enter upon any formal refutation. Enough for us to observe, that the proper proofs of a Divine revelation are miracles and prophecy, and that Islamism possesses neither the one nor the other. There does not exist one authenticated account of a miracle wrought by Mohammed (indeed the Koran admits that he had no such power); nor is there one real prophecy, unless we call the threat against the overthrow of Persia prophetic, in which case we must extend the title to any warrior or statesman who makes a happy political guess. Thus Burke prognosticated, in the early stage of the French revolution, the advent of some military chieftain who should seize the reigns of power; and Napoleon foresaw the likelihood of a union between France and England to prevent the designs of Russia upon Constantinople. Other weak points of this false religion will appear as we proceed. At present we will only ask with Pascal, in his famous *Pensées*, what one mystery Mohammed revealed which was previously unknown? what miracle he wrought? and where this last prophet of the world was himself foretold? We pass on to a few brief notices of the Koran.

This work is divided into 114 chapters. They are of very unequal length, some of the longer ones being equal to at least ten or twelve of the shortest. It was revealed at intervals, and not collected into one body until after its author's death, when Abu-Beker acted as editor, and gathering together its portions (some written on skins, palm leaves, and blade-bones, and some few treasured up in the memory of disciples), placed as a rule the longest chapters first and the shorter at the end. This remarkably simple but not very philosophic plan of arrangement lends no aid to our comprehension of the doctrines of Islamism.

Its leading features are,—the assertion of the unity of God and the apostleship of Mohammed (which are the two great dogmas of Islam); its denunciations of idolatry and recital of legends illustrative of the Divine wrath against that great sin; its recognition of previous prophets, as Adam, Noah, Abraham, Moses, and *Jesus*, as also *Ishmael* and other minor ones, all forerunners of Mohammed; its accounts of angels, Gabriel and Michael, Azrael the angel of death, and Israfil, who is to sound the trumpet at the last day; of the fallen angels and their prince Eblis (Satan); of the Genii, a class of beings inferior to the angels; of heaven, hell, and the partition between called Al Araf; and of final judgment to come. The fall of Eblis and the fall of Adam; the flood of Noah and the life of Abraham; Sodom and Gomorrah; Isaac and Jacob; the guilt of Pharaoh and the plagues of Egypt; the rod of Aaron, the acts of Moses, the golden calf, the manna and the quails; Samuel and Saul; David and Goliath; Job, Jonah, and Solomon;—all these find their place in its pages, though sometimes in a very distorted guise. When we add to these certain evangelic ideas and precepts to be spoken of hereafter, and consider to what dimension the Koran would shrink if deprived of all that can fairly be traced to Holy Scripture, we feel the justice of Möhler's *dictum*, that "without Moses and the prophets and Christ, Mohammed is simply inconceivable; for the essential purport

of the Koran is derived from the Old and New Testaments." Respecting our Lord and Saviour, Mohammed teaches that, though only a man, he was miraculously born (chap. iii.), and that he wrought numberless miracles; and, apparently from a belief that it was unworthy of Christ's dignity to be put to death, he denies (chap. iv. *et alibi*) the reality of his crucifixion, asserting with the Gnostics, that another was put to death for him. Denying the doctrine of the Holy Trinity (which he quite misunderstood), the incarnation, and the atonement, he yet calls Christ the Word of God, the Spirit from God, announces His second advent and triumph over Antichrist, and teaches the doctrine of the Millennium. But these acknowledgments appear intended to exalt the dignity of Mohammed himself and the excellency of the Koran. Its own greatness is loftily proclaimed throughout the book; unbelievers are challenged to produce ten pages like it, and orthodox Mohammedans declare its substance to be eternal and uncreated.

It must not be overlooked that Mohammed felt deeply that the advent of such a teacher as he claimed to be *ought* to have been foretold. Hence the Koran, while recognising the Divine authority of the Pentateuch, Psalms, and Gospel, frequently (chaps. ii. and iii.) charges Jews and Christians with corruption of their own sacred books, and the withdrawal of passages which foretold him. His followers have since claimed certain texts, of which the most curious are,—Deuteronomy xxxiii. 2, where (in defiance alike of context and geography) Mount Sinai, Seir, and Paran, are wrested into respective predictions of Judaism, Christianity, and Mohammedanism; and Isaiah xxi. 7, where the Vulgate rendering, *Ascensorem asini et ascensorem cameli*, is made to refer firstly to the Prophet of the Gospel, and then to the Prophet of the Koran. A third passage is St John xvi. 7, apparently alluded to in the 61st chapter of the Koran, the promised Paraclete being interpreted to mean Mohammed (just as the followers of Manes had referred it to him); a blasphemous view, though not intentionally such. Mohammed, confounding and identifying the Holy Spirit with the angel Gabriel utterly mistook the drift of this prophecy.

Among popular errors must be named that of supposing the Koran to deny that women have souls. On the contrary, paradise is promised to those who believe and do aright (chaps. iii. and iv.) It must also be remarked, that the idea of paradise contained in it, though gross and carnal, is less so in the book itself than in the pages of its Moslem commentators.

Of the civil laws in the Koran relating to marriage, inheritance, slaves, contracts, murder, theft, &c., we must try to speak in subsequent sections. We may just notice its establishment of the month of fasting (Ramazan), and a weekly holiday (Friday), in memory of man's creation; its prohibition of usury and of swine's flesh; and its high commendations of the duty of prayer. Penitence is also praised, and in some cases slight and reasonable penance is enjoined.

To a European reader, even if partial to Mohammed's memory, the Koran, in a translation, is for the most part hopelessly wearisome. Even Gibbon has observed how completely the single book of Job, in a mere literary point of view, eclipses it. Its Judaic character may in part be guessed from the above sketch. With some exceptions it bears the impress of "a spirit bounded and poor," yoked to much that is local, national, and temporary, as distinguished from that which is of universal application. This might of course be in part applied to Judaism likewise; but then Judaism was but preparative, and did not pretend, like Islamism, to be a universal religion. In each case (not of course that we class the two together in any other respect) the vehicle of a Semitic language probably of itself imposes certain limits. Unsurpassed in the expression of simple and pathetic narrative, wise moral precepts, and that which is sublime and awful in devotion and denunciation, the Semitic tongues have never been the medium of any very *original* subtlety in argument and preciseness in definition. In its finer parts the Koran reminds us of prophets rather than evangelists: *e. g.*, "God! there is no god but He, the living, the self-subsisting; neither slumber nor sleep seizeth Him; to Him belongeth whatsoever is in heaven and on earth. Who is he that can intercede with Him but through his own good pleasure?" (chap. ii.) Of the purity of its Arabic, and of its effect upon the oriental mind, there seems to be but one opinion. Nor do its deficiencies, as its narrowness and lack of all mysticism, affect the sincerity of its author. We can recognise in it, with Möhler, "an original piety, a touching devotion, and a thoroughly individual religious poetry, which cannot possibly be forced or artificial;" and add too, with him, "that many millions of men feed and foster from the Koran an estimable moral and religious life; and one cannot think that they are drawing from an empty spring, from the composition of a mere deceiver."

For fuller information on the Koran, the reader is referred to the excellent translation of Sale, with its valuable notes and introduction. The first edition appeared in 1734, and has often been reprinted. It had been anticipated by a Latin translation (to which Sale acknowledges great obligations) by Maracci, professor of Arabic at Rome, published at Padua in A.D. 1698, with a very learned but too hostile *Prodromus* and *Refutatio Alcorani*. These last have the verses marked, and are consequently more convenient for reference than Sale's. On Mohammed's borrowings from Judaism Milman recommends a prize essay by Geiger, rabbi of Wiesbaden,—*Was hat Mohammed aus dem Judenthum genommen?*

4. *Other Elements and Characteristics of Mohammedanism.*—A book once received as sacred implies the existence of teachers and of commentaries. These are greatly needed in the case of the Koran, which, by the admission of Mohammedans, contains 225 contradictions (Renan, Prideaux, and Milman); *i. e.*, 225 passages which were abrogated by fresh revelations. The principle is asserted in the Koran itself:—"Whatever verse we shall abrogate or cause thee to forget, we will bring a better than it, or one like unto it" (chap. ii.)

Islamism has both teachers and commentaries. Thus, *e. g.*, in Turkey, the body of the *Ulema* (corresponding to divines and jurisconsults in Christendom) is appealed to by the Sultan respecting the right application of precepts of the Moslem faith; and their decision is known as a *fetua*. M. Ubicini (*Lettres sur la Turquie*, Paris, 1853) gives a specimen of a fetua of recent date, A.D. 1839. It is directed against the famous Méhémet Ali, then in open revolt against his sovereign. The Sultan demands whether the authors of the rebellion may not be justly regarded as impious men, who defy the precepts of the Koran, &c. The replies, signed by forty doctors of different degrees, are entirely favourable to the Sultan's view of the case, and sanction the most extreme measures.

Not less important is the supplement to the Koran, known as the *Sonna*. This mass of traditions and oral law was fixed and sanctioned about 200 years after the Hegira. The Sonna embodies certain sayings and acts of Mohammed not contained in the Koran. The wives of the founder of Islam, and the four first caliphs, were the main authorities appealed to by its editor, Al Bochari. But though carefully compiled, it is in part apocryphal, as was likely to be the case. Its general tendency is to mitigate the sternness of the Mohammedan creed, to amplify and render it somewhat less local and temporal, and adapt it to a later state of things. The Sonna does not dogmatize on the Divine nature or attributes, but bears rather upon practical life, in which, next to the Koran, it is the great source of customs. It also contains some weighty sentences on faith,

on works, and on penitence,—the last being highly lauded. It follows the Koran in its rigidity on the subject of the Divine predestination.

Of other features of Islamism, not arising directly out of the Koran or the Sonna, we can here only find room to speak of two,—its dervishes and the element of mysticism.

The Koran is decisive against asceticism; nevertheless, partly from oriental love of contemplation, partly, perhaps, in imitation of the Christian communions with which it was brought in contact, Islamism has long had its bodies of dervishes. They are apt, however, to break away from the faith and practice of the religion which they profess. It is a common notion that madmen and idiots are specially gifted, and see more of things heavenly, because deprived of earthly reason, and undisturbed by external objects. This opinion has led to great abuses, as it is no uncommon thing for a dervish to feign madness with a view to spiritual reputation, which is, again, in many cases a stepping-stone to political power, sometimes even to a throne. Thus, towards the close of the eighteenth century, Bagian obtained among the Turcomans, whose capital was Bochara, supreme authority, first in religion, then in the state; and the dynasty of the Sofi, which lasted 230 years in Persia, was founded in the same manner. Power thus acquired has a fair chance of descending, as Mohammedanism cherishes the idea of religious sanctity being hereditary. On the other hand, mere intellectual gifts have seldom won such advancement for their possessors.

Still more alien, if possible, from the original spirit of Islam is the idea of mysticism. This has been disputed or ignored, but the evidence is quite overwhelming. Ancient Arabian poetry knows nothing of mysticism; the Koran is utterly devoid of it. It has found its way into the religion through the influence of countries conquered by the Moslem, more especially of Persia, where the national poetry has ever been pervaded by a thoroughly mystical tone. This element, commonly known as Soffeism, is still conspicuous in the works of Turkish and Persian poets. But as its leading idea is that of union between the creature and the Creator,—and this in a pantheistic manner, which, like Buddhism, Brahminism, and similar creeds, tends towards the denial of the Divine personality,—Soffeism is most abhorrent to the true genius of Islamism, and is decidedly condemned by orthodox Mussulman theologians. On this last point see M. Renan, Taylor's *History of Mohammedanism*, and *Persian Literature* (by Mr Cowell) in the *Oxford Essays* for 1855. On the section in general, and on most of what follows, the reader will find much compressed information in a very masterly essay by the late Dr Döllinger,—*Muhammed's Religion nach ihrer innern Entwickelung und ihrem Einflusse auf das Leben der Völker*, Ratisbon, 1838. Its chief blemish is an occasional want of discrimination between real characteristics of Islamism and features common to other oriental religions. An Italian version has been published (Milan, G. Silvestri, 1848). This article is deeply indebted to Döllinger's essay.

5. *Its Social and Political Features.*—The social life fostered by Mohammedanism requires perhaps a more dispassionate investigation than it has yet received. It is not enough to show its inferiority to Christianity in this respect; it ought in fairness to be confronted with other false religions. F. von Schlegel, though by no means favourable to Mohammed or his religion, yet allows, in his *Philosophy of History*, that its moral code is higher than that of Buddhism. Respect for women was not unknown to the pre-Islamite Arabs, and Kadijah and Ayesha are in honourable remembrance with the followers of Mohammed. Still, however, the blight upon woman's lot, which is only removed by Christianity, presses heavily upon the weaker sex throughout all Moslem countries. Although a large proportion can only afford to keep one wife, yet polygamy, to the extent of four wives, besides concubines, being sanctioned by religion, is beyond the reach of attack. And women are certainly regarded as a subaltern class in a state of virtual servitude. Their religious education is limited to a mechanical knowledge of prayer; they are forbidden to attend the worship in the mosques; and jealousy precludes them from the visits of any religious teachers. Their paradise is supposed to be different from that of men; and a devotional life is almost unknown. There is no religious ceremony of marriage; and in this, as in her entire social *status*, the Mohammedan wife is probably in a position inferior to that which was enjoyed by an ancient Roman matron. Far more vast is, of course, the gulf between the women of Islam and of Christianity, of which all the chief communions can display such noble specimens of piety, heroism, and intelligence. The harems are but too often a stage for the development of bad passions, as envy, jealousy, and unnatural crimes. Abortion is so common as to have affected the population in some countries, as Turkey; nor is it punishable, if the master of the household have given his consent. Sons by different mothers are constantly rivals, and their jealousies have often rent in pieces the fabric of Mohammedan states. The most stable of Islamite government—the Ottoman—is supposed to have owed its endurance in great measure to the circumstance that Mahomet II. made fratricide a law in the imperial family; and the Sofi in Persia used regularly to put out the eyes of princes not destined for the succession. Nor is the influence of wives able to restrain rulers, as Christian princesses have often done, from acts of cruelty. One noble but solitary exception is recorded,—that of Zobeide, wife of the celebrated Haroun Al Raschid.

The extreme facility of divorce is an evil as great as that of polygamy. It is in some degree checked among the wealthy by the provision that the wife's dowry must be restored, and in Persia the feeling of the higher classes is said to be against it. Still the practice is fatally prevalent, and induces a low and degrading tone about all that concerns the matrimonial relation. Above all, the rebukes uttered by St Paul in the first chapter of his Epistle to the Romans (verses 26–28) are but too applicable to the moral condition of most Mohammedan countries, and more particularly of Turkey.

Another feature in the social life of Islamism is that of slavery. Whatever difference of opinion on this head may exist among Christians, few will be found to assert that the *principle* of slavery is recognised by Christianity as an enduring institution; and none will deny that the abolition of slavery in Europe is attributable to the influence of the gospel. Now, Mohammedanism recognises the principle, and this is surely so far a blot upon its character. Nevertheless, when this is once admitted, the highest commendation must be bestowed on the humanity of many of the provisions for the treatment of slaves. Mohammed from the first put slaves under the protection of his creed. He taught that they were brethren, equally created by God, and that good or ill treatment of them would seriously affect an owner's prospect of paradise. A master who chastises without cause ought to let that slave go free; liberation of slaves is at all times a good work; a female slave cannot be, without her own goodwill, separated from her child; and if she have borne a son to her master, must be set free. The most recent travellers (*e.g.*, Burton) fully confirm the reports of earlier observers. They tell us that a slave who is dissatisfied can legally compel his master to sell him. It is not merely possible, but even common, for a Mohammedan slave to rise to the highest offices. Lieutenant Burton travelled with a pacha who had been the slave of a slave, and of whom a Turkish officer remarked,—*C'est un homme de bonne famille, il a été acheté.* It is true that

the history of Islamism in the East records many insurrections of slaves; but these do not appear to have arisen from bad treatment, as was the case in ancient Rome; they have resulted rather from occasions of general turbulence and religious excitement.

A complete survey of the political features of Mohammedanism would require some account of their conquests. Our limits forbid such an attempt; and the reader must be referred to Gibbon, D'Herbelot, Ockley, Von Hammer's *Ottoman Empire*, the Histories of Mohammedanism by Mill and by Major Price, and Mr E. A. Freeman's recent *History and Conquests of the Saracens*, for fuller information. Enough for us to recall that Persia, Syria, Egypt, Africa, and Spain, were rapidly overrun by the Saracens (as the Arabs from some unexplained cause were called in the West); and that within a century after the Hegira, the caliphs had become, in the language of Gibbon, "the most potent and absolute monarchs of the globe." While, however, idolaters were exterminated, and their temples overthrown, a certain amount of civil and religious liberty might be secured, on submission and the payment of an annual tribute, "by the people of the book;" *i. e.*, those who possessed, or claimed to possess, a written revelation from Heaven, as the Jews, Christians, and Magians (or Ghebers), the fire-worshippers of Persia. We can only add that the famous victory over the Saracens, gained by Charles Martel, between Tours and Poitiers in A.D. 732, alone, humanly speaking, saved European Christendom from utter ruin; that the most flourishing period of Moslem rule in Spain was under Abderrahman in the tenth century, and the conquest of Hindustan by Mahmood was nearly contemporaneous; that the Crusades lasted from 1095 to 1270; that Constantinople was captured by Mohammed II. in 1453; while, on the other hand, the great checks of the sea-fight of Lepanto, and of the defence of Vienna by Sobieski, occurred respectively in 1571 and 1683. Since that time, the Ottoman Empire has steadily declined. The formation of the kingdom of Greece in 1829, and the Anglo-French alliance in the war of 1854-56 are too recent to require notice.

It is more in accordance with the object of this article to touch upon some of the *principles* of Mohammedan rule. The patriarchal union of spiritual and regal power in one and the same person was exhibited by Mohammed and by his successors the first caliphs. So indissolubly were the two supposed to be connected, that a division of the empire among the ruler's sons (like that of Charlemagne) was held to be quite inadmissible. The caliphate, which was at first elective, soon became hereditary. But as Mussulmans scarcely seem to recognise the difference between events ordered by the Almighty and those merely permitted by Him, the doctrine that *might makes right* was soon admitted, and the claim of a successful usurper was easily recognised. One condition is indeed a *sine quâ non*, and that is, that Mohammedans *must* be governed by a co-religionist. They could not, as Christians may, submit to a heathen sovereign; indeed, all Christian princes are regarded by the Moslem as usurpers. The great monarchs, as in Turkey and Persia, are (as has been intimated) among the most absolute on earth; all property theoretically belongs to them; their conduct is considered to be beyond scrutiny, and above the ordinary laws of morality. Their power over life and death is unlimited; and though the mass of the populace are rarely touched, yet some idea of the perilous state of those about the court may be formed from the fact, that in the space of 419 years (from 1370 to 1789) Turkey saw 138 viziers, of whom a large portion fell by the hand of the executioner. Nor does such severity lower a sultan in general estimation: many of the most esteemed (*e.g.*, Soliman the Magnificent) have been among the most sanguinary in their executions. It must, however, be remarked, that no Mohammedan ruler has ever succeeded in changing, to any great or lasting extent, the religion of his subjects; and in this particular, as in so many others, they stand in marked contrast to Christian princes, as may be seen in the history of national conversions to Christianity and the epoch of the Reformation in Europe. The emperor who among Moslems approached nearest to such influence was the famous Akbar, sovereign of Delhi, contemporary with our Queen Elizabeth. But Akbar cannot be regarded as a sincere Mussulman; his belief was rather that of a rationalistic deist. On the other hand, the repression of any nascent heresy by the sword is in thorough harmony with the general spirit of Islamism; and the degree of interference with the minor details of life and worship, and with questions of doctrine, far exceeds anything known in Christendom.

The cruelty too often exhibited in Moslem legislation does not arise out of the enactments of the Koran, which is decidedly lenient in its tone. Homicide, with malice aforethought, adultery, and apostacy, are the sole crimes recognised as capital by the Koran; and in the case of adultery a fine was soon substituted. It appears more probable that cruelty has arisen from that subtle connection with lust, which has frequently been commented on by moralists. In cases of rival dynasties the severities have been tremendous on both sides. Price relates that Aba-Moslem, who established the Abbassides in the caliphate (A.D. 750), killed (besides those who perished in battle) 100,000 persons to consolidate the new dynasty; and the death of the famous Hossein, son of Ali, was revenged by the execution of 48,000 men. It is acutely remarked by Döllinger, that scarcely ever did a Christian prince on his deathbed recommend a crime, or even an execution; whereas among Mohammedan rulers such an event is by no means uncommon, —so much less hold upon the conscience does Islamism possess than Christianity, though both tell of another world and a judgment to come.

It is remarkable that upon the whole the Moslem dynasties have been among the most unstable in the world. With the exception of the Abbassides, the Sofi in Persia, and the rulers of the family of Osman in Turkey, the changes have been rapid and extreme. The hereditary principle is generally less likely to be strong in countries where polygamy is sanctioned. In Persia during nine centuries (*i.e.*, from the ninth to the eighteenth) fourteen dynasties reigned; other parts of Asia and Africa have undergone the same lot; and when it is considered that these changes have almost always been accomplished by violence, some idea may be formed of the contrast between the majority of Mohammedan thrones and those of Christendom.

For the social and political life of Islamism the works of travellers in Arabia, Turkey, Persia, &c., may be referred to with advantage. It will be sufficient to allude to such travellers as Burckhardt, Niebuhr the Elder, Malcolm, Chardin, Morier, Burnes, Fraser, Ouseley, &c., as having rendered important contributions to our knowledge. Among recent works we may specify Mr Lane's edition of the *Arabian Nights*, with its valuable notes, and Lieut. Burton's *Pilgrimage to El Medinah and Mecca*. We must also mention with high praise the spirited sketches of the Princesse de Belgiojoso, contributed to the *Revue des Deux Mondes* during the years 1855 and 1856; also the learned Dr Pocock's *Specimen Historiæ Arabum* (Oxon. 1806), to which Sale and Gibbon acknowledge their great obligations.

6. *Principal Sects.*—Almost immediately after the death of Mohammed a great dispute arose among his followers as to his successor. A strong party were in favour of Ali, already mentioned as Mohammed's son-in-law by his marriage with Fatima. But he was not chosen until after a lapse of twenty-three years, during which time the throne

had been occupied by Abu-Beker, Omar, and Othman. Nevertheless a tradition that the first three caliphs were usurpers, and that Ali had been grievously wronged, has prevailed to the present day among a large proportion of Mohammedans, and hence the primary ground of dissension between the Sonnites and the Shiites; the latter being the partisans of Ali, while the Sonnites accept the legitimacy of the first three caliphs. Other points of difference ensued. The Shiites place Ali at least on a level with Mohammed (a view which we suspect had reached Dante, judging from the twenty-eighth canto of the *Inferno*, lines 31, 32); the Sonnites imagine a vast interval between Mohammed and every one else. Some have supposed the Shiites to reject the Sonna entirely; but this appears to be a mistake. They refuse, indeed, to accept such parts as come from Abu-Beker, Omar, and Othman, or any other enemies of Ali, but they accept the rest, and moreover admit other traditions which are not recognised by the Sonnites.

Thus far this great schism appears to be of a purely personal and historical character. Even to this day, as Lieut. Burton witnessed, the Persian pilgrims to Medina will almost endanger their lives by muttering curses at the tombs of the three usurping caliphs (as the Shiites consider them) and weeping over that of Fatima. Still it is hardly possible that such rivalry and opposition could have lasted had the legitimacy of the succession been the sole point in dispute. The *kind* of regard given by the Persians to the twelve Imams, or descendants of Ali, involves a more real difference of doctrine; and, on the whole, it is reasonable to believe that a sort of under-current of the old Persian creed of Magianism (including some ideas of *mediation*) runs through the Shiite teaching. The strength of the Shiites lies in Persia; of the Sonnites in Turkey and its dependencies. In times of apathy they have been known for a brief season to dwell together, but in general they detest and anathematize each other as worse than Jews or Christians. We must profess our conviction that no impartial observer, whether regarding the case historically or doctrinally, can hesitate to conclude in favour of the Sonnites as the more orthodox Mohammedans. Gibbon, Taylor, and Burton all tend to confirm this view.

The Sonnites are again subdivided into four sects,—Hanefites, Malefites, Shafeites, and Houbalites,—named after their respective founders. These, however, all regard each other as orthodox in fundamental points. The remaining sects (to which we can do little more than allude, for a mere list of their names would occupy a large space) have arisen chiefly out of controversies on the Divine attributes, or on predestination (a very fertile source of schisms); on Antinomianism; on the rewards and punishments of the life to come; on the Mahadi or Medhi, the twelfth Imam looked for by the Persians as about to return as the overthrower of Degial or Antichrist in the latter days; and on mysticism. Inclinations towards Buddhism, and even towards Manicheism, have also given rise to fresh sects.

Perhaps the most important, certainly the most energetic, of recent sects have been the Wahabees, who arose towards the end of the tenth century. Their founder, Abdel Wahab, was a reformer who sought to bring back Islamism to its pristine condition under Mahomet and Omar. The Wahabees have been not unjustly called the Puritans of Mohammedanism. They protested against a practice which had gradually crept in of venerating Mohammed and other Moslem saints as intercessors; and tried to restore the rules of the Koran in many of the details of life. So great was their success, that for a time Mecca and Medina fell into their hands. They were ultimately put down by the Pasha of Egypt, but their principles are not extinct.

There has been no limit to the wildness and immorality of some of the Mohammedan sectaries; and the circumstance that Mohammed appealed to the sword has caused a constant recurrence to this *ultima ratio* on the part of any newly-formed school, and no less so on that of their opponents. The great schism between Sonnites and Shiites materially weakened, if it did not overthrow the caliphate; and for a time favoured the progress of the Crusaders; and Abdallah Ben-Tammurt, founder of the sect of the Mowahhedini in Africa (A.D. 1116), is said to have destroyed 70,000 persons. This is by no means a solitary instance; and in quitting the subjects of the sects, we can only express our astonishment at the gross ignorance of Spinoza, who asserted that the Mohammedan communion had known no schisms. Our chief authorities on this part of the subject are Sale, Döllinger, Gibbon, and Burton.

7. *Literature, Science, and Art.*—The Arabs before the time of Mohammed (or, as they term it, in the days of ignorance) excelled in poetry and oratory. Their seven prize-poems suspended (Moallakat) in the Kaaba, have been translated by Sir W. Jones, and display much spirit and beauty. But there is little reason to suppose that Mohammed was in any way a patron of general knowledge or of letters. Praises of science from his lips have indeed been quoted, but not until the dynasty of the Abbassides had begun to patronize letters; and their genuineness is extremely suspicious. His one act of interference in these matters was essentially anti-scientific. Shortly before his death he reinstated the vague old lunar calendar of Arabia (*Caussin*, iii., pp. 302, 303), and forbade the insertion of the triennial intercalary month by which it had been improved. The famous story respecting the second Caliph Omar, and the destruction of the library at Alexandria has indeed been called in question; but it does not appear to be intrinsically improbable, or at variance with the character of the early Mohammedans. As, however, their rule became more settled, a change came over them, and literature was abundantly patronized in Spain, and by the caliphs of Bagdad, more especially Haroun Al Raschid, the hero of the *Thousand and One Nights*, and Almamun. Nor can we deny that European Christendom is indebted to their labours. The nine numerals which effected so great a revolution in arithmetic were introduced by them. *Al*-gebra and *Al*-chemy both betray by their prefix the quarter from which Europe received them; nor is it possible to study a catalogue of the stars without being struck at the large proportion which, by the retention of Arabic names, testify to their successful cultivation of astronomy. Sismondi (*de la Littérature du Midi de l'Europe*) thinks that their poets influenced the taste of the Troubadours. Their commentaries on Aristotle, though often militating with their orthodoxy as Mohammedans, produced a great effect upon the mind of Europe. Even Dante names Averroes; and our great countryman Roger Bacon displays a most extensive acquaintance with the Arabian authors, particularly with Avicenna. Such men as Averroes and Avicenna deserve respectful mention in these pages, for they have not inaptly been termed *encyclopedists*, from the range and variety of the subjects treated by them. Medicine, though a less strong point than logic and metaphysics, was also cultivated by the Saracens. We must also take into account the Persian *literati*, especially the poets who have flourished since the introduction of Islamism, and the Turkish moralists and writers on jurisprudence. Nor must we fail to acknowledge the intellectual improvement caused in Africa, where the village possessing a Marabout or Mussulman teacher is always found to be far in advance of its neighbours in all the elements of civilization.

Of art we can say but little, for it is almost a blank in the realms of the Moslem. The prohibitions of the Koran against images are fatal to its culture; though a single exception, that of architecture, must be granted to the Spanish Arabs. A high authority, Mr Owen Jones, regards their

architecture as the legitimate offspring of the Koran, nor do the remarks of Lieutenant Burton appear to us to overthrow this supposition. But in any case, there can be but one opinion as regards the singular and original character of beauty which distinguishes the remains of the Alhambra.

Still, after all, it must be said that the Arabian genius was receptive rather than originative; it handed on the torch of learning, but it did not give the quickening spark; its creative powers cannot be compared with those of Greece, nor its jurisprudence (shut up in the Koran) with that of Rome; while in algebra, &c., the Hindus are decidedly superior. Their science is a mass of borrowings from Euclid, Ptolemy, Aristotle, Galen, &c. In Persia the greatest poets were all actually or virtually pre-Islamite.

The research into Mohammedan literature is still incomplete. Mill's *Mohammedanism* (London, 1817), chap. vi.; Berington's *Literary History of Middle Ages* (London, 1814); and the literary portion of Mr Sharon Turner's *History of England* (vol. i., chap. v.), all afford information. M. Ubicini has a neat *resumé* of Ottoman literature (vol. i., let. x.); Mr Cowell's Essay on Persian Literature has been alluded to; Condé, *Historia de la Dominacion de los Arabes en España*, did much by first calling attention to the writings of the Moors in Spain, and though violently attacked for deficiencies in knowledge of Arabic, yet cannot be robbed of this praise. Much might have been expected from the distinguished historian of the Ottoman Empire, Von Hammer (subsequently Count Von Hammer-Purgstall), who before his death had commenced a work entitled, *Literaturgeschichte der Araber, Von ihrem Beginne bis zu Ende des 12 Jahrhunderts der Hidschre*, Wien, 1856.

8. *Its relation to Heathenism.*—The most impartial thinkers generally allot to Islamism a kind of half-way place between paganism and Christianity; somewhat as, in popular legend, the coffin of Mohammed was supposed to be suspended by loadstones between heaven and earth. If, in employing the term paganism, we think primarily of the religion of Greece and Rome, it must be allowed that the teaching of the Arabian is a great advance. Classic paganism was in constant danger of allowing its votaries either, with Epicurus, to deny any real Providence (a doctrine which practically amounts to atheism), or to fall into pantheism, and thus deny the divine personality and the enduring individuality of the soul. Above all, its polytheistic idolatry appears from Holy Scripture to have involved communication with evil spirits. (See Deut. xxxii. 16, 17; Ps. cvi. 37, 38; 1 Cor. x. 18–20.) Now, Mohammedanism, both by words and deeds, protests most vigorously against all these errors—Epicurism, pantheism, and idolatry. If, as we have seen, its dervishes have displayed a tendency towards pantheism, this is an intrusive element, and alien from the essential character of the religion. Far from encouraging the cloud of doubt which hangs around the question of Providence in classic writings (as, *e.g.*, even those of Cicero), Mohammedans so thoroughly recognise the Almighty as the great originator of all things, as almost to shrink in their histories from the investigation of secondary causes. And as regards idolatry, that great day of Mohammed's life when he destroyed the idols of "The Square House," or Kaaba, at Mecca, was again and again reenacted by his disciples,—most strikingly, perhaps, in their famous conquest of Hindustan, where the idolatrous temples had become the haunts of the most appalling wickedness.

Nor is the superiority of Islamism to paganism confined to mere negations of error. On the contrary, it teaches positively and clearly much that paganism had lost, or was teaching but very vaguely. The unity of God, eternity and judgment to come, fixed rules of right and wrong, the existence of real revelations, the value of repentance,—borrowed these truths may be from Judaism and Christianity, but however obtained, they are unmistakeably announced by Islamism. It appears, moreover, to be comparatively free from the self-righteous notions taught by other eastern creeds, as Hinduism,—for even Mohammed himself is held by orthodox Islamite theologians to have been admitted into Paradise through Divine mercy only, and not for his presumed good deeds. Lastly, it is conspicuous above all merely human forms of religion, for the sense of brotherhood with which it inspires its votaries. Mohammed appears to have deliberately aimed at this result, and his success has been truly wonderful. With the exception of caliph or sultan, all Mussulmans are regarded as spiritually equal; nor, indeed, is there any temporal superiority, except such as may arise incidentally from the possession of wealth or office,—a precarious superiority in the East, and one which the events of a single day may entirely reverse. Every Moslem is supposed, by spiritual filiation, to be grafted into the great Arab race,—a truly noble idea, beyond the teaching of Judaism, because reflected from the light of that faith for which Judaism was only a preparation. Hence his creed is, far more than his country or his race, the one object for which a Mussulman is prepared to labour and to fight.

Still, it must not be supposed that Islamism is, from every point of view, superior to the other false religions which it confronts. There are certain needs in the human heart which other creeds have at least attempted to satisfy, but for which Mohammed has nothing to offer. Pantheism, erroneous as it is, yet expresses the deep yearnings of men's spirit for union with his Maker. Even idolatry, with all its deep sinfulness, recognises the want of something to interpose between our fallen nature and the purity of an offended God. Magianism, Buddhism, and other forms admitting mysticism, find food for these wants: Islamism is essentially bare and arid, and leaves the gulf between man and his Maker in all its vastness. Even sacrifice cannot be considered as part of the essence of Mohammedanism. It is only (with some rare exceptions) performed on the occasion of a pilgrimage, and may be neglected even then on the condition of observing an additional ten days' fasting in the course of the year.

9. *Its relation to Christianity.*—Among the most striking inconsistencies of the Koran is the contrariety of its tone in different parts with reference to Christianity. In the second chapter Jews, Christians, and Sabians are all placed upon a level, and assured of salvation if obedient to the law of their respective creeds; but in the chapter which immediately follows, according to the existing arrangement, we are told that "whoever followeth any other religion than Islam, it shall not be accepted of him, and in the next life he shall be of those who perish." It would not be possible here to dwell upon the different modes of solving this difficulty which have been attempted; we can only, with the *Quarterly Review* (No. 136, September 1841), express our entire acceptance of the theory of Möhler, that Mohammed commenced his career merely as the prophet of Arabia, and gradually persuaded himself that he was the destined prophet of the world. So long as he regarded himself as the teacher of his own countrymen alone, he was willing to consider Christianity as a religion of co-ordinate authority with that which he taught; but when, extending his sphere of thought and action, he claimed the universe as the scene of his mission, he was compelled to represent Christianity as subordinate to the creed of Islam. Now, however sincere Mohammed may have been in his delusion, the part of a universal instead of a merely national instructor involved far larger demands (if the expression may be permitted) upon his creed and character. But of this he does not seem to have been at all conscious. It behoves us, however, to consider some of the leading points of distinction.

That a national religion should be inseparably bound up with the state appears natural, and is perhaps almost inevitable. It is certainly part of the normal condition of Judaism when flourishing. But a religion which is to be the heritage of all mankind must be capable indeed of coalescing with any rational form of government, but no less capable, if need be, of standing in the completest isolation from the state. Now, Mohammed's religion includes in itself the idea of a universal monarchy. This condition alone must necessitate the failure of all its attempts to become a religion of the universe; and even in Mohammedan countries, though originally an element of strength, it tends to produce ultimate decay. Without entering into details, it is obvious that strict adherence to the Koran, as the law of the state, must impede many reforms which in a political aspect may become highly necessary.

Again, while we admit that Christianity has at times employed the sword as an instrument of defence, or even a means of conversion, still the instances have been comparatively rare and exceptional; but in the case of Islamism the exception is the other way; its votaries almost avow that too long peace endangers its vigour and vitality. And thus Mohammedanism has no real claim to be a religion of love: it cannot even imagine that union of special favour to its own with benevolence to all, which is one of the first lessons of Christianity.

But, above all, did Mohammed fail to comprehend the lofty requirements needed for a teacher of humanity at large. A good Arab he may have been, according to the miserably imperfect standard of his age and country; nevertheless he was a man blood-stained and lust-stained, and, moreover, unrepentant of these sins, because unconscious of their shame. But the prophet of the universe must soar far above all merely conventional morality; he must satisfy *all* the really religious needs of the human heart, and such needs can find their satisfaction in nothing else save the mystery of an Incarnate God, alike the teacher and the redeemer of the world. Mohammed's celebrated declaration, "There is no God but God, and Mohammed is the apostle of God," combined a solemn and vital truth with a hopeless and tremendous falsehood. Against superstitions worse than his own that truth held its way triumphantly, but before Christianity it was sure in the long run to pale and wither. It has its warriors, but hardly martyrs; and polygamy must be fatal to its universality, for polgyamy can never satisfy the needs of woman's heart.

And while with Dante (*l. c.*), Jones, Leibnitz, De Maistre, and others, we may admit that the amount of truth contained in Islamism renders it more like a heresy than an absolutely false religion, yet we submit that, as regards its view of the person and office of Christ our Lord, and its doctrine of a unity of person (not of substance merely) in the Godhead, there is a greater gulf between Mohammedanism and Christianity than is always, or perhaps usually, admitted. Moreover, the doctrine of the Divine unity and omnipotence becomes unspeakably different when viewed apart from, or in connection with, the idea of an all-perfect Mediator. It is apparently the unsoftened awfulness of that doctrine in its loneness that causes the deep melancholy observed in so many of the more earnest Mohammedans. And even as regards predestination, on which so many Christians appear theoretically to agree with the Moslem, it could, we feel assured, be shown that Mohammedan submission under reverses is, with all its acknowledged merit, something very different from Christian resignation, and far less noble and ennobling.

Lastly, in its lack of any one good thing in which Christianity has not anticipated it; in its constrained spirit and absence of any real sympathy with progress and the highest forms of civilization; in its spiritual and intellectual poverty and limitation to oriental or African regions,—Islamism betrays the limited and finite conceptions of a merely human author, and stands in marked antithesis with the faith of Christ.

On these points there is something to be gained from White's *Bampton Lectures*, Oxford, A.D. 1784; also from *Lectures on the History of the Turks in its relation to Christianity*, Dublin, 1854. The author of the last named writes, however, it must be observed, with a Roman Catholic object in view.

10. *Its present Condition and probable Future.*—The creed of Islam is still very widely spread. It is professed throughout the Turkish empire, Persia, Arabia, Russian and Independent Tartary, Madagascar, parts of the eastern coast, and the interior of Africa, by a large part of the population of Hindustan, and in the islands of the Eastern Archipelago. The Malay tribes appear to take an active part in spreading Mohammedanism; and all Christian missionaries (though frequently acknowledging the improvement thus wrought among idolatrous populations) agree in deploring the extreme difficulty of converting Moslems to the faith of the gospel. At the Cape a few cases have occurred of professing Christians lapsing into Islamism; but some have happily been reclaimed. In China, the prohibition of swine's flesh is said, with every appearance of probability, to militate against the reception of the Koran. The number of Mohammedans has been variously stated from 100,000,000 to 140,000,000. We should suppose the smaller number to be nearest the truth; but it is difficult to speak with confidence, as an accurate census is almost unknown in eastern countries.

A religion so influential must have had its special task assigned to it by Providence, though we can only faintly guess at its nature. Its protest against many pagan errors, more especially idolatry, has been already touched upon. We may add that Islamism was probably one of the greatest checks to the progress of a much worse form of error than itself, which arose in the bosom of the church of the seventh century, namely, the species of Manichæism known as Paulicianism (*vide* Gibbon, chap. 54), which "violated the unity of God, the first article of natural and revealed religion." And it may yet possibly, as Forster and Möhler suggest, prove a preparative for Christianity in Africa, by moulding the hearts and minds of races as yet too stubborn for the mild yoke of the gospel. That He who overrules evil to good may vouchsafe such a result must surely be the devout prayer of every Christian.

Viewed externally, Mohammedanism appears to have long since reached its culminating point. In Mesopotamia, in Cyprus, in Candia, the Moslem population is not half what it was at the commencement of the eighteenth century. Persia is covered with ruins; Turkey, once the dread of Christendom, is utterly effete, and only exists through the powerful and armed intervention of France and England; Cairo has only a shadow of its once flourishing hospitals, schools, and libraries; Alexandria 15 instead of 100 mosques ever open; even Mecca itself displays ruined buildings, and the number of pilgrims is continually decreasing. (See Döllinger's concluding chapter.)

Still, however, does this creed sway the hearts of its votaries. In this respect there is as yet no clear proof of diminished power. In the present year (1857) the rising against British rule in India is most probably traceable to Moslem influence, though the Hindoo element may have combined to produce its awful and unheard-of atrocities. May that outburst prove but the prelude to its fall, and to the future triumph of Christianity. (J. G. C.)

MOHAMMERAH, a town of Persia, about 40 miles from the mouth of the Euphrates, is situated on the left side of that river at its point of bifurcation before entering the Persian Gulf. The position of this town affords great advantages in a commercial point of view, as it communicates by means of an artificial channel with the Karun, and thereby with the fertile regions of Khuzistan to the N.E., while by the Euphrates it is connected with Basrah, Hillah, and Baghdad on the one hand, and with the sea on the other. The merchants of Mohammerah are intelligent and enterprising men; and the place will soon, it is probable, become one of the most important towns on the Euphrates. The climate, however, is excessively hot, and owing to the moist and marshy nature of the country, extremely unhealthy. A colony was founded near the site of the modern Mohammerah by Alexander the Great, under the name of Alexandria; and the adjacent district was called by him Pellæum, after his native city of Pella. This town having been destroyed by a flood, was restored by Antiochus Epiphanes, and named by him Antiochia. It was afterwards taken possession of by an Arab chief called Spasines, from whom it obtained the name of Charax Spasinu, and the district that of Charncene. It was evidently at that time much nearer to the sea than at present, a circumstance which confirms the opinions of several recent travellers in this region, that the delta of the Euphrates is encroaching on the sea with unusual rapidity. Mohammerah was long an object of contention between Turkey and Persia, until it was finally ruled by a commission, instituted by the two governments in recent years, that it should adhere to Persia. During the British-Persian war of 1857 the town was bombarded and taken by the British under Sir James Outram on the 26th of March, but shortly after evacuated by them according to the treaty between the two governments signed at Paris. The frontier between the two countries, according to law, is, that the land watered by the Euphrates, excepting that about Mohammerah, should belong to Turkey, and that watered by the Karun to Persia.

MOHILEV. See MOGHILEV.

MOHILL, a market-town and parish of Ireland, county of Leitrim, situated at the foot of a hill, 9½ miles E. by S. of Carrick-on-Shannon, and 92½ miles N.W. by W. of Dublin. The town has a parish church, Roman Catholic and Methodist chapels, a dispensary, hospital, and workhouse. Some trade is carried on in corn, butter, and pigs, and numerous fairs are held. Pop. (1851) 1223.

MOIR, DAVID MACBETH, was born at Musselburgh in Mid-Lothian on the 5th of July 1798. He received his elementary education at the grammar school of his native town, and was, at the age of thirteen, apprenticed for a term of four years to Dr Stewart, a medical practitioner there. At the conclusion of his apprenticeship he completed his medical course at the University of Edinburgh, and received his diploma of surgeon in 1816. Moir had originally intended to enter the army, but the recent peace not offering much encouragement in that quarter, he returned home and spent his leisure in literary pursuits. During his laborious apprenticeship he had found time to cultivate those pursuits in which he afterwards gained a name, and had even made his first appearance as an author in some of the local magazines as early as 1812. Towards the close of the year in which he left college he put forth a small anonymous publication entitled *The Bombardment of Algiers, and other Poems*, which was not characterized either by originality or power. In 1817 the young surgeon joined Dr Brown as a partner in an extensive and laborious medical practice in the town of Musselburgh and its neighbourhood. While Moir entered upon the duties of his profession with great zeal, he nevertheless succeeded in snatching occasional moments to gratify his unquenchable thirst for literary studies. He had already been a frequent contributor in prose and verse to the *Scots Magazine* and to Constable's *Edinburgh Magazine*, when he made his *debût* in the pages of *Blackwood* as an occasional prose essayist, but especially as a writer of grave and comic verse. The clever effusions of *The Eve of St Jerry, The Auncient Waggonere*, &c., are now known to have been written by Moir, although these, as well as many others of his jocose pieces, were generally ascribed to Maginn. His serious verses bore the signature Δ, which gave origin to his literary cognomen of "Delta." This connection with Blackwood ceased only with his death. In 1823 Moir made the acquaintance of John Galt the novelist, who had come to reside in his neighbourhood; and so intimate did their friendship become, that when Galt was called suddenly off to America before completing his *Last of the Lairds*, the novelist commissioned Moir to write the concluding chapters of that work. *The Legend of Genevieve, with other Tales and Poems*, were collected from the various magazines in which they had originally appeared, and published, with additions, in a separate volume in 1824. This work, while generally well received by the press, met with but a very limited sale. In 1824 Moir commenced to publish in the pages of *Blackwood* his novel of *The Autobiography of Mansie Wauch*, a work which delineated with much quaint humour and quiet power some of the most subtle peculiarities of the Scotch character, and which gained for its author very considerable reputation. Moir was warmly pressed at this time by his friends in Edinburgh to remove to the Scottish metropolis, where he had at once the prospect of a more lucrative practice and a more extensive circle of literary friends. The scenes of his early days, however, had a strong hold on the poet, and he regarded the poor among whom he had laboured so long as having peculiar claims upon him. He accordingly resolved to abide by his provincial practice, which entailed so very great drudgery, that for more than ten successive years Moir never slept a single night beyond the scene of his labours. He married in 1829, and published two years afterwards his *Outlines of the Ancient History of Medicine, being a view of the progress of the Healing Art among the Egyptians, Greeks, Romans, and Arabians*; a work which was well received by the members of his own profession. On the visitation of the cholera in 1832, Moir put forth extraordinary exertions to check the progress of that virulent and mortal disease; and as secretary of the Board of Health at Musselburgh, gave to the public his *Practical Observations on Malignant Cholera*, and *Proofs of the Contagion of Malignant Cholera*. These pamphlets met with great success, and were recognised, even by those who differed from them, as very masterly productions. In the autumn of 1832 Delta attended the meeting of the British Association at Oxford, and afterwards visited London, where he met Coleridge and other men of literary note. On the death of his friend Dr Macnish in 1837, Moir collected together the fugitive pieces of "the Modern Pythagorean," and published them with a Life of the author. A few years later he was called to perform a similar service to the memory of his lamented friend Galt. Early in 1843 Delta circulated privately, and then published, his *Domestic Verses*, which contained some touching pieces full of true tenderness and beauty. In the summer of 1846 he met with a severe accident by being thrown from a carriage, which confined him for months and rendered him lame for life. Moir had always taken a special interest in antiquarian studies, and on the publication of the new edition of *The Statistical Account of Scotland*, he supplied an interesting paper for that work on the antiquities of his native parish of Inveresk. In 1851 he delivered a course of six lectures at the Edinburgh Philosophical Institution, which were afterwards published, *On the Poetical Literature of the*

Past Half Century; and during the summer of the same year appeared *The Lament of Selim,*—Delta's last contribution to *Blackwood's Magazine,* a journal to which, from first to last, he had furnished no fewer than 370 articles in prose and verse. His health having given way in June 1851, he sought relief in a change of scene, and after visiting the land of Burns, he passed on to the town of Dumfries, where he died on the 6th of July of the same year.

Delta, without possessing much original power as a poet, was always fluent, generally graceful, and often singularly sweet and pathetic. He was one of the most amiable and benevolent of men, and was held in great esteem wherever he was known. A selection of his poetical works, in 2 vols., was published, with a Memoir of the author by Thomas Aird, in 1852; and a new and complete edition of his works, in 1 vol., edited by Aird, appeared in 1857.

MOISSAC, a town of France, department of Tarn-et-Garonne, is pleasantly situated on the Tarn, here crossed by a handsome bridge, in an extensive valley surrounded by hills covered with wood and vineyards, 15 miles W.N.W. of Montauban, and 97 miles S.E. of Bordeaux. The streets are narrow, crooked, steep, and ill paved, but the houses are well and substantially built. Moissac contains some remains of an ancient abbey, founded in the seventh century, consisting of cloisters, several pointed arches, and the old gateway, which is adorned with bold and fantastic sculpture. The old abbey itself, however, has disappeared, and its site is occupied by a modern edifice of no great elegance. The town contains a large flour-mill, tribunals of first instance and of commerce, and a communal college. There is a considerable trade in flour, oil, wine, linen, wool, &c. Pop. (1851) 10,655.

MOITTE, JEAN GUILLAUME, an eminent sculptor, was the son of a well-known engraver, and was born in Paris in 1747. So marked was his talent at a very early age, that the sculptor Pigalle, who was then at the head of his profession, requested to have him for a pupil. In a short time young Moitte fully justified this high opinion. His statue of "David carrying the head of Goliath" gained for him the grand prize in sculpture, and the privilege of studying at the French Academy in Rome. Accordingly he proceeded to Italy in 1768, and set himself with great enthusiasm to the study of the architectural fragments of old Rome, and the masterpieces of the great sculptors of ancient Greece. His progress was rapid, and it was then that he began to evince that correctness of design, beauty of proportion, variety of expression, and happy choice of draperies, which became so conspicuous in his subsequent works. Compelled by ill health to return to his native city in 1773, Moitte began to execute several great national works. Among these were the bas-reliefs of several of the barriers of Paris, the colossal figures representing the provinces of Bretagne and Normandy, the statue of Cassini, the bas-reliefs in the Louvre, of Moses, Numa, and the Historic Muse, and an equestrian statue in bronze of Bonaparte. About this time he was decorated by the emperor with the cross of the Legion of Honour. Moitte died in May 1810.

MOIVRE, A. DE. See DEMOIVRE.

MOKRIN, a village of Hungary, in the county of Toronthal, 42 miles W.N.W. of Temesvar. It has a Greek church; and some trade in corn, flax, hemp, cattle, sheep, and swine. Pop. about 5500.

MOLA, or MOLA DI BARI, a seaport-town of Naples, in the province of Bari, situated on a low point of land on the Adriatic, 13 miles S.E. of Bari. The town consists of an old and new portion; the former of which contains a castle, and is surrounded by walls and ditches, but is meanly built, with narrow and irregular streets. The new part of the town, however, which extends along the shore, is better laid out, and has three creeks for the accommodation of small vessels. The harbour is insecure; but the roadstead, though unprotected, has good anchorage. A considerable coasting trade is carried on in oil, cotton, and carrots. Pop. 8400.

MOLAI, MOLAY, or MOLÉ, JACQUES DE, the last grand-master of the Templars, was born of a noble family in Burgundy, and entered his order about 1265. In a short time his bravery against the Infidels raised him to note. He succeeded William de Beaujeau as grand-master of the Templars, and was present at the recovery of Jerusalem in 1299. Subsequent reverses compelled him in 1305 to retreat to Cyprus to recruit his forces. It was then that he was recalled to France for the alleged purpose of assisting in effecting a union between his own order and that of the Knights Hospitallers; but the real object was different. Philip the Fair, with the connivance of Pope Clement V., had resolved to fill his empty exchequer with the great wealth of the Templars, even at the cost of their complete destruction. At the same time he knew that public opinion, offended at their dissoluteness and excessive pride, would easily be reconciled to their downfall. Accordingly, after soothing down all suspicion by a series of notable favours which he bestowed on Molai, he suddenly, on the 13th of October 1307, caused the whole order throughout France to be arrested, and their effects to be seized. On the same day he took up his abode in the luxurious palace of the Temple at Paris. The Templars were tried before inquisitors on the charges of heresy and immorality. On being subjected to the torture of the rack, some chose to die rather than criminate themselves unjustly, while others confessed themselves guilty of the crimes alleged. Among the latter was the grand-master Molai. However, when brought soon afterwards before the papal commissioners, he retracted his confession, and demanded the liberty of pleading his cause before the supreme pontiff himself. But the pope had already satisfied his mind on the subject, and accordingly he abolished the order of the Temple in 1312. Meanwhile Molai was lying in prison at Paris. At length, in 1314, he was tried along with three other Templers, and as he still persisted in retracting his former confession, was condemned to be burnt alive. He protested with his last breath the innocence of himself and of his order.

MOLASSES, or MELASSES (in Portuguese *Mel de assucar* or *Melâço,* from *mellatium,* a low Latin derivative of *mel,* honey, signifying, according to Nonius, *must* concentrated to half its bulk), is the sirup or mother-water that is separated from the crystals or grains of raw sugar in the course of manufacture. It drips from those crystals like honey from the comb, a circumstance to which it no doubt owes its name, and especially to its likeness to honey in taste, consistency, general appearance, and uses. The name is sometimes given to *treacle,* which, as distinguished from molasses, is the sirup separated from the lowest boiling in refineries of sugar, or from the "bastard" sugar obtained in sugar-houses by boiling imported molasses. In France and elsewhere treacle and molasses bear indiscriminately the name *melasse;* in Germany that of *syrup.*

Molasses varies according to the colour, strength, and treatment of the sugar which yields it. Fine bright sugar yields fine bright molasses; weak sugar, viscid or weak molasses. Muscovado or unclayed sugar yields thick or heavy molasses; clayed sugar thin, but, when kept from becoming acid, strong molasses. By strong molasses is meant molasses capable of producing a large per-centage of granulated sugar. The heaviest molasses, though containing less water, and therefore a greater per-centage of saccharine matter, is not generally the strongest, its thickness being often connected with the presence of much grape-sugar and impurities. The best molasses is obtained in the earlier periods of the crop season, and before rains set in.

Molasses is usually of a dark-brown colour. St Croix,

Barbadoes, and Porto Rico, produce the finest, of that yellow or amber colour which is preferred. The progress of improvement in the making of sugar, for which there is still ample scope, may be expected to improve the colour, as well as reduce the proportion yielded, of this the less profitable extract from cane-juice.

Molasses is shipped in tight casks (called in this country *puncheons;* in Cuba and America, *hogsheads*), containing from 9 to 15 cwt. each. The bungs are left out to give free vent to the fermentation to which it, particularly if strong and fresh, is subject on the voyage. Iron tanks have been used, but only to a very limited extent. The deposit of sugar which frequently settles at the bottom of the casks during the voyage is called *foot*.

Although molasses is produced wherever sugar is made, the only parts of the world which export it in any considerable quantity are the West India Islands, of which Cuba alone in 1856 contributed 226,000 casks, mostly of large size, or two-thirds of the whole commerce in the article. Brazil, Mauritius, the British East Indies, Java, and the Philippines, which collectively supply about a third of the world's sugar, do not ship any quantity worth notice; yet they might do so profitably, notwithstanding length of voyage, if better means were devised to prevent waste and acidity.

Much molasses is converted into *rum* on the estates. Jamaica distils all its molasses. A great deal of what is sent to the United States of America, and (when grain is dear, or inferior molasses, chiefly clayed from Cuba, is cheap) some also of what is sent to the United Kingdom, finds its way to the distilleries, producing from 6½ to 7 or 8 gallons of proof spirits per cwt., unexceptionable in quality. Sugar is supposed to yield 11 to 11½ gallons per cwt. In the city of Boston alone, the chief seat of this branch of the trade, the quantity distilled was, for the years 1854-5-6, near 50,000 casks a year. The returns for the United Kingdom show 134,682 cwts. so used in 1856.

The laws of the United Kingdom prohibit the use of molasses in breweries, in order to maintain the duty on malt at its present high rate. For domestic brewing this material is allowed and is suitable, but it is not so used. There are several other ways in which it might be serviceable, but it is not used, because it is not sold here in retail; common treacle, which has a better consistency, and is also cheaper, or refiners' "golden sirup" (a finer sort of treacle), being kept by the grocers in preference. In the United States and British America molasses is largely used as an article of diet in its natural state. Molasses or treacle from beet-root sugar, an extract necessarily obtained in large quantities in the beet sugar-works of Europe, has an unpleasant vegetable flavour, and is employed for feeding cattle and for making alcohol and acetic acid.

The principal consumers in the United Kingdom are the refiners of Greenock, Liverpool, London, and Leith, who, by operations not yet benefited by modern science so much as may be hoped for, obtain from it a dark, or, as the case may be, a yellow sugar, resembling West India muscovado, the residue being treacle. Of 82,000 casks imported into the United Kingdom in 1856, half came to the seaports of Clyde, 25,000 to Liverpool, and 15,000 to London.

The magnitude of the molasses trade is further shown by the following figures:—The United States imported in each of the years 1854-5-6 above 25,000,000 gallons, or about 2,500,000 cwt., besides consuming its own growth, which in these years amounted to not much less. In the same years this kingdom imported an average quantity of 950,000 cwts. The remarkable progress of this trade is shown by comparing the imports into the kingdom in the years 1820-30-40, when they were only 39,991, 250,648, and 432,220 cwts. The increase is due to the greater indifference with which the planters regard the making of rum, to the enlargement of the sugar-boiling business in the chief northern ports of Britain, to the removal of the prohibitory duty, and to the vast extension of the growth of the cane, especially in the highly prosperous slave-labour Spanish colony of Cuba. It is worthy of notice that this "sweet" is used almost exclusively by the English-speaking countries of the world,—Great Britain, and the states and colonies to which she has given birth.

The present duty on molasses is 5s. per cwt., and the price, exclusive of duty, has ranged for some years between 7s. and 20s. per cwt., or about half the price in bond of the lowest sorts of sugar. In this country it is sold by weight; in the United States and the colonies by measure (the old gallon). An imperial gallon weighs from 13 to 14 lb. The specific gravity of molasses from muscovado sugar is about 1·370, and from clayed sugar 1·356.

A trade has lately arisen between Cuba and the United States in *melado*, which is cane-juice concentrated, or sugar with the molasses remaining unseparated from the crystallized portion. (See SUGAR.) (R. A. M.)

MOLD, a parliamentary borough and market-town of Wales, county of Flint, pleasantly situated in a fertile valley near the right bank of the Alen, 13 miles W. from Chester. The town is irregularly built, chiefly of brick. The principal buildings are,—the parish church, a large and handsome edifice of the fifteenth century, with an embattled tower, richly carved; and the county-hall, a fine building, which cost L.3000. There are also places of worship belonging to the Methodists, Independents, and Baptists; national and other schools; a market-house, and a savings-bank. The parish contains extensive coal pits, and mines of lead and iron, as well as some manufactories of earthenware, bricks, and cotton. Bailey Hill, a little to the N. of the town, was in the twelfth and thirteenth centuries crowned by a fortress, which was the scene of many sanguinary fights between the English and Welsh during the border warfare. It was captured by the latter under Owen Gwynedd in 1145, was retaken by the English some time after, but again came into the hands of the Welsh in 1201. In its churchyard is the humble grave of Richard Wilson, the celebrated landscape-painter. Mold combines with Caergwyle, Caerwys, Flint, Holywell, Overton, Rhuddlan, and St Asaph, in returning a member to Parliament. Pop. (1851) 3432.

MOLDAU, a river of Bohemia, rising in the Bohemian Forest, on the frontiers of Bavaria, and flowing in a S.E. direction as far as Rosenberg. It then turns to the N., and continues generally in this direction till it joins the Elbe at Melnik, after a course of 230 miles. The most important tributaries of the Moldau are the Luschnitz and the Sazava on the right, and the Wattava and the Beraun on the left. The principal towns on its banks are Rosenberg, Budweis, and Prague. In the lower part of its course the Moldau is a large river, and contributes more water to the Elbe than the Upper Elbe itself. It abounds in fish, and is navigable to Prague for vessels of 60 tons, to Budweis for barges of 10 or 15 tons, and to Rosenberg for smaller craft.

MOLDAVIA, one of the two Danubian Principalities under the sovereignty of Turkey, is bounded on the N. and E. by the Russian province of Bessarabia and the Black Sea, S. by the principality of Wallachia, along with the Danube and the Kilia branch of that river, which separate it from Turkey, and W. by the Austrian provinces of Transylvania and Bukowina; lying between N. Lat. 45. 15. and 48. 13., and E. Long. 25. 10. and 30. 13. It has a length of about 200 miles from N. to S., an average breadth of about 100, and contains an area of about 19,932 square miles. The Carpathians form the natural boundary on the W., and separate it from Transylvania. These mountains rise to the height of from 3000 to 5000 feet above the sea, and send off numerous branches to the eastward, gradually diminishing in height as they approach the banks of

Moldavia. the Sereth, which traverses the country from N. to S. The general surface of the country, excepting the part occupied by the marsh-lands at the mouth of the Danube, slopes from W. to E., and terminates in an undulating plain of considerable extent. The principal rivers of Moldavia are the Sereth and the Pruth; the former rises among the highlands of Bukowina, flows first E. and then S., and finally falls into the Danube after a course of about 270 miles. The Pruth rises in the same region as the Sereth, flows S.S.E., and falls into the Danube at Reni after a meandering course of 360 miles. It forms the north-eastern boundary of Moldavia, and is navigable for three-fourths of its length. The other important rivers are the Bistritz, Birlat, Moldava, Tatros, and Tazlen, all of which flow southward, and fall into the Sereth. The soil of the country is rather stony in the E., but gradually improves in fertility as it approaches the rivers; and the greater part is abundantly productive, amply rewarding the labour which is applied to it, notwithstanding the excessive heat of the summers, and the intense cold of the winters. The corn is excellent, especially the summer or hard wheat. The wine is good, and produced in abundance. Excellent cattle are fattened in the meadows; and good flax, hemp, honey, wax, and all kinds of fruits, are most abundant. The mineral resources of Moldavia are very great; but little advantage is taken of their abundance. Rock-salt, saltpetre, and bitumen, are the principal minerals, and these are found chiefly in the Carpathian Mountains and towards the N. of the principality; while small quantities of gold-dust have been obtained from some of the rivers. Great numbers of horses, cattle, sheep, goats, and hogs are reared in the meadows and forests of Moldavia; and some of the boyars or noblemen have studs of no fewer than 400 or 600 mares. The climate of Moldavia is exposed to severe cold in winter and excessive heat during summer. Rain falls in large quantities in the months of June and September; but the weather in October and November is very mild. The vicinity of the marshes which occupy that section of the state between the Pruth and the Black Sea is, however, very unhealthy, especially during the hot season. The inhabitants live in a wretched manner in earthen huts, without windows or chimneys, and sometimes underground. The manufactures are few and rude in kind. But this want is fully compensated by the great advantages for importation and exportation afforded by the Danube, now open to all nations.

The three ports of Moldavia are Galatz, Ismail, and Reni, all on the Danube; but the first is by far the most important. In the year 1855, when the operations of the Russo-Turkish war were transferred from the Danube to the Crimea, and the trade of that river was thus enabled to resume its usual importance, the number of shipping and tonnage entering and clearing at Galatz amounted to a total of 1698 vessels, with 417,584 of aggregate tonnage. The following table shows the value of the imports and exports of Galatz from and to the various countries in 1855, as well as the amount and value of the chief articles imported and exported during the same year:—

Value of Imports from—	
Britain	L.253,240
France	152,400
Turkey	141,840
Holland	38,480
Other countries	38,920
Total	624,880

Value of Exports to—	
Greece	L.668,920
Austria	193,280
Holland	112,280
Sweden	78,480
Tuscany	31,680
Other countries	109,720
Total	1,194,360

Chief Imports.	Quantity.	Value.	Chief Exports.	Quantity	Value.
Sugar	8,472,351 lb.	L.230,320	Wheat	342,163 qrs.	L.676,840
Coffee	1,271,492 „	82,720	Maize	453,776 „	396,040
Oil	1,938,211 „	52,720	Rye	63,698 „	88,900
Dried fruit	2,127,907 „	28,600	...	...	...
Rum	2,703 bar.	18,920	...	...	...
Manufactures—Cotton, &c.	7,162,365	126,400	...	...	...

The population of Moldavia is almost identical in kind with that of the neighbouring principality of Wallachia, and seems to belong to the same race as the ancient Dacians, who inhabited this region from the earliest times. The Moldavians, indeed, differ very little from their ancestors in appearance, costume, and manner of life, and they still bear the name of Roumuni or Romans, while their dialect is a corruption of Latin with Slavonic, Turkish, and Tartar words. There are four classes of people in Moldavia, viz.:—1. The boyars or nobility, and the clergy, who are exempted from taxation; 2. The privileged classes, such as the academic corporation at Jassy, but who are liable to taxation; 3. The villagers; and 4. The gypsies, who have no civil rights, and, till a recent period, were in a state of slavery either to the government or to private individuals. They have now, however, been released from servitude; those belonging to the government having been emancipated several years earlier than the slaves of the nobles, who received their liberty only in 1853. The established religion of Moldavia is that of the Greek church, superintended by a metropolitan and a vicar. The capital is Jassy; and the principality is divided into Upper and Lower Moldavia, and subdivided into districts, of which the former contains six, and the latter eight, as follows:— Moldavia.

Upper Moldavia.

Districts.	Chief Towns.	Pop. (1850).
1. Doroboi	Mihaileni	80,222
2. Botoshani	Botoshani	146,361
3. Sucslava	Faltichani	71,044
4. Nyemtzoo	Piatra	90,219
5. Roman	Roman	80,677
6. Jassy	Jassy	128,566

Lower Moldavia.

Districts.	Chief Towns.	Pop. (1850).
1. Vaslooi	Vaslooi	84,703
2. Falchey	Koosh.	78,722
3. Tutova.	Birlat	83,674
4. Tecutsi	Tecutsi	86,505
5. Bakow	Bakow	132,244
6. Pootna.	Fokshani	124,217
7. Kovarlooi	Galatz	67,293
8. Moldavian Bessarabia (ceded 1856)	Ismail	42,600
	Total	1,297,047

The principality of Moldovia occupies part of the region known in ancient times by the name of DACIA (which see). In the later times of the Byzantine Empire it was overrun by several barbarous tribes, and the inhabitants were driven across the Carpathian Mountains, where they remained until the thirteenth century, when a small colony, under a chieftain called Bogdan, re-established themselves in their country, which received from their leader the name of Bogdania, by which it is still known among the Turks and natives. This prince and his son gradually extended their power over the whole of Moldavia. The princes of Moldavia were at that time called *voyvodes*, or military leaders; a name which was afterwards changed by the Turks to that of *hospodars*, which is still retained. In the thirteenth century Moldavia was frequently disturbed by civil war, occasioned by rival claimants for the crown, and these dissensions rose to such a height that the country was divided into two parts, one of which acknowledged the sovereignty of Poland, and the other that of Hungary. A union was, however, soon after effected, and Moldavia became subject to Hungary, paying at the same time a tribute to the Poles. In 1536 Moldavia came under the protection of the Sultan. For a considerable time after this period it was the scene of constant wars between the Poles and Turks, until the claims of the former to the sovereignty of the state were finally abandoned in 1621, and peace concluded between Turkey and Poland. But notwithstanding the authority of the Sultan was now unquestioned, the boyars still continued to elect their own voyvodes, a proceeding which caused numerous disputes between them and the

Moldavia. Porte. In 1710 Demetrius II., voyvode of Moldavia, entered into negotiations with Peter the Great of Russia, by which the latter undertook to force the Turks to restore the principality to its former independence. On the failure of the Russian attempts, and the retreat of Peter, who was accompanied by Demetrius, the Sultan deprived the Moldavians altogether of the privilege of electing their princes. These were thenceforth nominated by the Porte direct, and received their modern title of *hospodars*. In 1738, during the war of Austria and Russia against Turkey, Moldavia was invaded by a Russian force under Münnich, and occupied for two years, but was evacuated after the peace of Belgrade. In 1769 it was again occupied by the Russians, and in consequence of the victories gained by them over the Turks, became for a short time subject to the Czar. It was, however, restored to Turkey by the peace of Kutchuk Kainaryi in 1774. Three years later, Bukowina, which had before formed a part of Moldavia, was ceded to Austria. In 1789 this unfortunate principality was again the scene of contest between Russia and Turkey, until the peace of Jassy in 1792, when the Russian frontier was fixed by the Dniester. In the war of 1807-12 Moldavia again fell into the hands of the Russians, who, by the treaty of Bucharest, acquired possession of Bessarabia, and thus extended their frontier to the Pruth. At the commencement of the Greek war in 1820 an insurrection broke out in the Danubian Principalities, but was suppressed by the Turks, who then occupied with an army the two principalities until the year 1826. It was then agreed by an article in the treaty of Ackermann, that the hospodars of Moldavia should be elected by the boyars out of their own number for a period of seven years. In 1828 another war between Turkey and Russia broke out; and Moldavia was occupied by the Russians without opposition until peace was established by the treaty of Adrianople in 1829. By this treaty it was stipulated that all the Turks should leave Moldavia, which was thenceforth to be under the protection of Russia. The hospodars were now to be elected for life, and their power was limited by a divan, consisting of ten boyars, and an assembly of deputies from the boyars, the clergy, the academic corporation, and the landowners, which was to meet annually. An annual tribute is paid to the Porte of three millions of piastres, or somewhat more than L.27,000, and an additional tribute is paid at the accession of each new hospodar. The Moldavians were also bound to pay to the Porte a yearly sum as a compensation for the surrender by the latter of the fortifications N. of the Danube, and of the rights they formerly possessed. The principality was governed by the Russian general Kisseleff from 1832 to 1834, when the constitution was approved by the Porte; and in the same year Michel Stourdza was elected hospodar. A conspiracy was formed in 1840 to unite the principalities of Moldavia and Wallachia into one state, but without success. In 1848 the influence of revolutionary sentiments was felt in Moldavia; the people of Jassy demanded a new constitution, and, although the hospodar successfully resisted this movement, he laid down his authority in the same year. In 1849 the treaty of Balta Liman was concluded between Russia and Turkey, in accordance with which the hospodars were to be nominated by the Russian and Turkish courts for a period of seven years; and in June of that year Gregory Ghika was appointed hospodar. In 1853 a Russian army entered and seized possession of Moldavia and Wallachia, and the hospodars of the Principalities retired. After attempting in vain to cross the Danube in Wallachia, the Russians, in the spring of 1854 crossed that river at Galatz, and seized the fortresses in the Dobrudscha. They then proceeded to lay siege to Silistria, but this town was so vigorously defended that they were obliged to raise the siege, and the British and French troops having arrived at Varna, the Russian army evacuated the Principalities in the autumn of 1854. The hospodars then returned to their respective governments, and the Principalities were occupied by an Austrian army. At the conference of Vienna in March 1855 a proposal was made by Baron Bourqueney, the French plenipotentiary, to unite the two principalities under a foreign prince, subject to the sovereignty of Turkey; but the discussion of this proposal was deferred until the opinion of the Porte was known. By the treaty of Paris in 1856, a portion of Bessarabia was reunited to Moldavia, so that the Russian territory had no longer any communication with the Danube. At the same time the protectorate of Russia over the Principalities was abolished, and the continuance of all their rights and immunities was guaranteed by the European powers. The future organization of the Principalities was to be decided according to the wishes of the majority of the people. The treaty of Balta Liman, in accordance with which the hospodar Gregory Ghika governed Moldavia, being annulled, and at the same time the term of seven years for which he was appointed having expired, that prince laid down his authority, and the Sultan appointed Theodore Baltche hospodar in his stead. During his reign Ghika had granted to the Moldavians the liberty of the press, and had shown himself favourable to the union of the Principalities, which was the wish of the majority of the people; but the present hospodar, as well as the Sultan, is opposed to it, and the liberty of the press has been suppressed by the Sultan. The receipts of the principality in 1853 amounted to 13,235,230 piastres or L.129,411, and the expenses to 12,456,324 piastres or L.122,320, of which the tribute to the Sultan made up 715,000 piastres or L.65,000. The army of Moldavia in the same year consisted of a force of 15,944 men. (For the more recent history, see WALLACHIA.)

Molesworth. MOLESWORTH, SIR WILLIAM, an eminent British statesman, was the lineal descendant of an old Cornish family of extensive landed property, and was born in London in 1810. In his thirteenth year he lost his father, and succeeded to the family estate and baronetcy. He studied at Cambridge, but was rusticated there for challenging his tutor to mortal combat. After spending some time at the university of Edinburgh, engaged in the study of mathematics, classics, and metaphysics, he repaired to Germany. There his attention was chiefly devoted to philology and history. He then made the usual tour of Europe, and returned to England in 1831. In the same year, before he had attained his majority, he delivered an earnest and elaborate speech in favour of parliamentary reform at a Cornish county meeting. This first appearance of his in public prepossessed the local Liberals so much in his favour, that in 1832 he was returned without opposition as one of the members of Parliament for the eastern division of Cornwall. He was re-elected by his constituents in 1835; but in 1837 so powerful had the reaction against his opinions become, that he despaired of regaining his seat. He therefore became a candidate for Leeds, and was successful. On the dissolution of 1841, the clouded prospects of his party deprived him of all hope of being returned by his former constituency, and induced him to retire without a contest from parliamentary life. Sir William Molesworth devoted the next four years to a close study of politics and social economy. In 1845 he was again on the field as a candidate for Southwark. His bold advocacy of the Maynooth grant excited formidable opposition; but his open and conscientious conduct at length won the day, and he continued to represent this constituency during the rest of his life. Ever since his entrance into Parliament Sir William Molesworth had been gradually acquiring the reputation of a clear, sound, logical, and weighty speaker. He had directed all his energies to the reformation of the colonial office, had aroused the attention of Parliament to that subject, had

explained with great ability the principles of colonial self-government, and had finally convinced statesmen and the public of the truth of his views. It was therefore with general approbation that he was appointed First Commissioner of Public Works in January 1853, and Colonial Secretary in July 1855. But this latter office he did not long enjoy. He died of a low gastric fever in October 1855.

MOLFETTA, a walled seaport town of Naples, province of Terra di Bari, on the Adriatic, 16 miles W.N.W. of Bari. The town as approached from the sea has a fine appearance, many of the houses being handsomely built of a white stone resembling marble, but its streets are narrow and dirty. The principal buildings are,—a cathedral, several churches, a college, and a castle. The chief manufactures are linen goods and saltpetre. Some ship-building is also carried on. The harbour is formed by a mole and a sandbank, which acts as a breakwater, and is well sheltered, except from the N. wind. A considerable trade is carried on in corn, oil, almonds, and other articles. In the neighbourhood of the town there are some curious oval caves, arranged in tiers, and hewn out of a limestone rock. In all these saltpetre is found; and one of them, called the Nitre Cavern, is 1400 feet in circumference and 112 in depth. Pop. 17,000.

MOLIÈRE, the assumed name of JEAN BAPTISTE POQUELIN, who was born at Paris on the 15th of January 1622. His father, Jean Poquelin, exercised the vocation of *tapissier*, and subsequently that of *tapissier valet-de-chambre* to Louis XIII. Young Poquelin, who seems to have been designed for the same trade, received originally a somewhat meagre education, and remained connected with his father's shop till he was fourteen years of age. Nothing is known respecting the boyhood of Molière till the year 1637, when his father succeeded in securing the reversion of his office for his eldest son Jean Baptiste, then in his fifteenth year. It has been customary to fill up this long blank in the early life of the great dramatist by an apocryphal story of a fond grandsire extorting occasional permission to take young Poquelin to witness the theatrical performances at the Hôtel de Bourgogne. Unfortunately, however, it turns out, on more accurate inquiry, that this benevolent old gentleman died just four years after his grandson's birth. Whether or not the slumbering genius of Molière was awakened by the indifferent specimens of the histrionic art which he beheld at the Hôtel de Bourgogne, it is at least certain that in the year 1637 he became a student at the college of Clermont, now known as that of Louis le Grand. During his five years' residence at this institution he enjoyed the private instruction of Gassendi, one of the first philosophers of his age, and numbered among his fellow-students such men as Chapelle, Bernier, Cyrano de Bergerac, Hesnaut, and Condé's brother, the Prince de Conti, afterwards known as the liberal patron of letters and the friend of Molière. His relation to Gassendi, however, is the principal matter of interest at this period. The influence exerted over the expanding genius of the future dramatist by the teaching of this illustrious man must have been at once powerful and abiding; and in the withering scorn and fearless satire with which Molière afterwards assailed the vices, and unmasked the hypocrisy of his age, one can detect the hand of a man who in his early years was a favourite pupil of a philosopher who made bold to challenge the authority of Aristotle, and to enter the lists with Descartes. If Molière distinguished himself in philosophy at the college of Clermont, he gained a name for classical learning hardly less eminent. It was here he attained to that intimate acquaintance with the Latin dramatists which he afterwards turned to so good account in his compositions for the stage.

On the completion of his collegiate course, Molière commenced the study of law, which he prosecuted with more or less regularity during the three following years. It is difficult to say whether or not Molière had resolved upon any definite plan of life previous to this time; at all events, a circumstance occurred just when he had reached his twenty-third year which proved the turning-point in his history. It so happened that one Madeleine Béjart, a provincial actress of some celebrity, visited Paris in 1645, when "a young fellow named Molière," as old Tallemant des Réaux drily informs us, finding greater attractions in this interesting lady than he had yet discovered in the dull pages of Cujas and Trebonian, renounced his legal studies, followed the charmer to the provinces, and subsequently joined her *troupe*. Thus it was that Jean Baptiste Poquelin, or as he now called himself Molière, was led, whatever may have been his previous leanings, to assume a profession which from that hour became the business of his life. During the year which inaugurated his dramatic career Molière endeavoured to establish himself at Paris in connection with the *Theâtre Illustre*, which had been originated by a society of young men of good family, who considered themselves possessed of a talent for declamation. Failing in this attempt, Molière betook himself to the provinces, and soon found himself a member of the same company with the previous object of his admiration, Madeleine Béjart. Little is known respecting his provincial life, which occupies a space of not less than twelve years (1646–1658), except what is exceedingly meagre and fragmentary. During the greater part of that time Molière was the chief of a company of strolling players who spent their time in amusing the citizens of Nantes, Vienne, Bordeaux, Lyons, Pézenas, Béziers, Grenoble, and Rouen. From the outset Molière resolved to combine the profession of actor and author, and endeavour, while he built up his fame, to secure his fortune. He accordingly assumed the function of author by converting certain Italian pieces into acting plays for his company, and which were characterized more by the faults of the Italian theatre than by the genius of Molière. His first regular production was the *Etourdi*, a comedy in five acts, which was represented at Lyons in 1653, where it met with so much success that the principal performers belonging to another *troupe* permanently attached themselves to the fortunes of Molière. His play, although it surpassed the comedies of Scarron and Scudéri, which preceded it, was nevertheless much inferior to Molière's subsequent productions. It is made up of a number of isolated incidents and intrigues, which succeed each other certainly, but display very little inherent connection. Yet, amid all these defects, it gave marked evidence, in its spirited dialogue, ready repartee, and felicitous flow of language, of very decided advancement in stage composition. This piece was afterwards "revised and polished" by Dryden into his *Sir Martin Marall*. (See Downes's *Roscius Anglicanus*, p. 38, 1789.) Reinforced by the recent valuable accession to his company, Molière repaired to Béziers, where his former class-fellow, the Prince de Conti, was holding the states of Languedoc. Here the rising player received the distinguished patronage of his noble friend, and his company was called upon to put forth all their energies to furnish entertainment to the prince, the assembly, and the city. The *Depit Amoureux* was acted here for the first time in 1656. As a whole, it is inferior to the *Etourdi;* yet it met with decided success. So greatly was the prince delighted with the genius of the dramatist, that it is said he offered to make him his secretary,—a distinction which Molière respectfully declined, remarking, "I am a tolerable author, but I should make a very bad secretary." Fortunately for the glory of the French drama, Molière had the courage to be faithful to his genius, a resolution which did as much honour to the player as the handsome offer did to the prince.

Having continued for some time his strolling performances in the south of France, Molière approached the capital, attracted by the hope of better fortune and greater

fame. After assiduous efforts he succeeded, through the influence of De Conti, in obtaining permission to give a theatrical entertainment before their majesties and the court. This was a trying position for the strolling player, but he trusted to his genius, and it proved all-sufficient. Accordingly, on the 24th day of October 1658, his company played Corneille's tragedy of *Nicomede* before this august assemblage, at a theatre erected at the guard-hall of the old Louvre. Molière, who felt that his company was inferior in tragedy to the *troupe royale* of the Hôtel de Bourgogne, who were present, came forward after the performance, and adroitly observed that he and his actors were but feeble copies of those first-rate models, and hoped that his majesty, who had graciously tolerated their rustic ways, would allow them to play one of the little comic pieces which had gained their author some reputation in the provinces. The king granted the request, and the adventurous provincials represented a one-act farce, now lost, called the *Docteur Amoureux*, with so much success that they were desired by royalty to remain at Paris, and received permission to assume the title of *Troupe de Monsieur*, the king's brother, and to play alternately with the Italian comedians at the Petit-Bourbon Theatre. So this author-actor, with his squat, ungainly figure, coarse features, and melancholy countenance, finds that his reception by the fastidious public of Paris has not been inferior to that given him by the provinces. There was a fascination in Molière's person despite all its natural defects. Every limb and muscle of that awkward figure had something to say for itself; and, as a contemporary remarked of him, "he is an actor every inch of him, from the crown of his head to the soles of his feet." How he entertained the public at the Petit-Bourbon during the succeeding year is not known. It is certain, however, that he produced his celebrated *Précieuses Ridicules* in November 1659, which had such an extraordinary success that, though the prices of admission were trebled on the second day, the piece had a run of four months. The fame of Molière and genuine French comedy began alike with this play. Its author was hailed enthusiastically from the parterre with "*Courage! courage! Molière, voilà la vraie comedie.*" If not designed as a satire upon all the ladies or *précieuses* connected with the famous Hôtel de Rambouillet, a literary circle which could boast of some of the most eminent men of the age as its supporters, this play was certainly meant to heap ridicule upon that class of *précieuses* who perverted alike good taste and correct feeling by the elaborate affectation of their talk, and the mock refinement of their sentiments. The characters and manners of this class were portrayed with extraordinary power and boldness; and it was with no small consternation that these absurd coteries found themselves thus ruthlessly impaled before the public by this comic censor, who kept all Paris laughing at their follies for four months in succession. The public now saw what was in store for them when Molière chose, as he modestly phrased it, "étudier le monde." His next piece, *Sganarelle, ou le Cocu Imaginaire*, was given to the public on the 28th of May 1660, and met with a success more than equal to its merits, having been acted forty times in succession.

The beginning of 1661 found Molière installed in his new theatre, the *Salle du Palais Royale*. Whether or not it was owing to the associations connected with the past history of this place that Molière felt induced to appear as a tragic author, he at all events produced a heroic comedy termed *Don Garcie de Navarre; ou le Prince Jaloux*, in 1661, imitated from the Italian, which proved an utter failure, and was the source of loud jubilation to his enemies. Molière withdrew it, and afterwards transferred some of its lines to the *Misanthrope*. On the 24th June 1661 he made another attempt, in his *École de Maris*, to retrieve his fallen reputation, and met with the most brilliant success. He owed the fundamental idea of this piece to Terence in his *Adelphi*, and some of the details he borrowed from Boccaccio and Lopez de Vega. During the same year he was engaged by the unfortunate Fouquet to compose a comedy for the celebrated fête which the superintendent of finance gave to Louis XIV. at Vaux, a few days before that monarch arrested and imprisoned for life the minister who entertained him. Molière had only five days to execute his task, and at the end of that time he produced *Les Fâcheux*, a piece which introduces us to the most provoking set of "bores" that ever afflicted mortal. The materials are of the slenderest, having been designed to be acted during the intervals of a ballet; but such a lecture on the follies of character and manners as it contains Molière alone could read. An event occurred on the 20th of February 1662, just two days after the appearance of *Les Fâcheux*, which was not destined to increase the happiness of the dramatist. He became united to Armande Béjart, a sister of that Madeleine Béjart, with whose charms the young lawyer Jean Baptiste Poquelin had been smitten some twenty years before. The envenomed tongue of slander laboured industriously to circulate the calumny that Molière's wife was the daughter of his former mistress; and the *chef* of the Hôtel de Bourgogne kindly improved upon the scandal by submitting to the king that Molière's death would leave his wife at once fatherless and a widow. His majesty, however, showed his appreciation of these malicious reports by condescending, in February 1664, together with Henrietta of England, Duchess of Orleans, to be the sponsors of Molière's child. Much of the loathsome scandal regarding this affair has been swept away by the unequivocal testimony of certain legal documents which had escaped detection till 1821. But the worst trial of all awaited the much-wronged dramatist, in the imprudent coquetry of his wife, which served not a little to embitter the remainder of his domestic life. He pursued his labours, however, with unmitigated ardour, although he had by this time drawn down upon himself a host of assailants. The parties whose ridiculous conceits and absurd follies he had so ruthlessly exposed, too wise to express the rankling pain which the arrows of the censor had inflicted, now set themselves up as guardians of the purity of the national morals and of the national language. His next three plays aggravated the animosity of his enemies a hundred-fold. The *École des Femmes* appeared on the 26th December 1662; the *Critique de l'École des Femmes*, an energetic defence of the former, on the 5th January 1663; and the *Impromptu de Versailles* in October 1663. In the first of these he was accused by the pseudo-religious party of Paris of turning religion into burlesque,—a class which he drove almost frantic by sending home the satire with tenfold force and power in his *Critique*. Nor did his *Impromptu* tend to conciliate his enemies. On the contrary, the cutting and merciless exposure which it contained of the envious rivals whom his genius had eclipsed, drew down upon him the *troupe* of the Hôtel de Bourgogne like a nest of hornets. His next piece, *La Princesse d'Elide*, executed at a signal from the king, who stood constantly by him, was composed in haste to garnish a splendid fête of Louis at Versailles in May 1664; and while it afforded little scope for Molière's comic powers, belonging as it did to the gorgeous and romantic drama, it nevertheless was received with great applause. It also appears that the first three acts, or rough sketch, of the celebrated *Tartuffe* were presented on the sixth day of the entertainment, and the piece was regarded by the king as "fort divertissante;" yet he saw reason to forbid its public representation. Molière's next production of the same year was *Le Marriage Forcé*, a one-act comedy, with a bold and simple plot, but full of inimitable wit and ridicule, chiefly directed against the sophists of the Sorbonne. In the *Festin de Pierre*, which came out in 1665, Molière de-

picted with extraordinary satirical power the character of an incorrigible hypocrite and libertine in Don Juan, borrowed from a Spanish story, which has furnished material for the creative genius of Molina, Mozart, and Byron. Some critics of this work went so far as to invoke the spiritual censure and the doom of the civil magistrate on the author; but the king supported him, and not only allowed his company to assume the title of *Troupe du Roi*, but also bestowed upon them a pension of seven thousand livres, in addition to the thousand livres (L.40) previously granted Molière as a crown pension. *L'Amour Médécin*, which appeared at the royal command in September 1665, was produced in five days, and was a declaration of war against a new and influential body of enemies. In this piece he directed his polished satire against the quackery and pedantry then prevalent among the medical faculty of Paris. After the lapse of nine months, an unusual term of repose for Molière's muse, caused partly by his own illness and partly by the death of the queen-mother, the 4th of June 1666 brought a day to be remembered in the annals of the drama. It was then that the *Misanthrope* was first acted at the Palais Royal. This piece is universally accounted by French critics as the most correct in point of style of all Molière's compositions, and not a few regard it as his *chef d'œuvre*. It was in this play he introduced the passage from a translation of Lucretius which he is said to have executed and afterwards committed to the flames. It was received but coldly at first by the Parisian public, and its author was compelled to heighten its attractiveness by attaching to its representation the lively farce of *La Médécin Malgré lui*, founded on an old *fabliau*, and afterwards translated into English by the celebrated novelist Henry Fielding, under the title of *The Mock Doctor*.

Passing over *Melicerte*, the *Pastorale Comique*, and *Le Sicilien*, which appeared about this time at St Germains, as slim in material and rather dull in detail, we come to the most remarkable of all Molière's performances. Hitherto it had been more the aim of his satire to chastise folly than to unmask and brand vice. Three years before we saw the rude outline of the *Tartuffe* sketched at Versailles. Scruples as to the probable reception of the piece induced the king to interdict its representation. Alterations were made in the play at the desire of royalty, and Molière used all his efforts to tone down the colouring, and remove any semblance of personal allusion. On the departure of Le Grand Monarque to pursue his conquests in Flanders, permission was obtained by Molière to represent this long suppressed *Tartuffe* at the Palais Royal. This piece accordingly made its appearance on the 5th of August 1667, and produced a most extraordinary sensation. In the depth and power of its composition it was felt to outstrip all previous attempts at comedy which France had known. It was received with the most triumphant and deafening applause; and yet twenty-four hours did not elapse before the *prémier president* interdicted a second representation, and the archbishop had exhausted his thunders of excommunication by the week's end against all who should act, read, or listen to, in public or private, the said comedy of *Tartuffe*. The Jesuits at first supposed it was a satire upon the austerity of the obnoxious Jansenists; while the latter sought their revenge in giving currency to the notion that *Le Tartuffe* was but a postscript to the *Provinciales* of Pascal. The truth is, it was not religion of any form which Molière ridiculed; it was the insincere professors of religion. Where religion is in a healthy state, the exposure of the vice of hypocrisy will always be hailed with applause rather than received with censure. Satire, although a dangerous weapon, is, when employed in good faith and honest purpose, often the only effective means of assailing a crime equally odious in the sight of God and man. Such thorough-paced hypocrites are not to be moved by ordinary means; they "are touched and shamed by ridicule alone." Yet Molière's purpose, as is too often the case, was doomed to be misunderstood; and even such men as Bossuet and Bourdaloue, fearing lest the keen blade which smote down so mercilessly the subtle hypocrite, might glance back and wound the simple, joined with not a little intemperance in the hue and cry raised against the audacious moral censor. Molière, however, fearlessly held on his way; and if the intrigues and petulence of a so-called religious faction influenced his royal patron to confirm the interdict, Molière lived to have his revenge. The fame of the *Tartuffe* soon found its way across the Channel, and by the industry and taste of the unfortunate actor Matthew Medburn, the play-goers of the British metropolis learned early to applaud the genius and admire the courage of this indomitable French comedian. (See the *Roscius Anglicanus*, p. 27.) Clamour and controversy were still raging when the *Amphitryon*, a questionable drama taken from Plautus, came out with its inexhaustible stock of keen wit and inimitable humour. Voltaire tells us, the first time he read it he tumbled off his chair, convulsed with laughter, and nearly broke his neck! This play, together with *George Dandin* and *L'Avare*, appeared during 1668. *George Dandin* was a successful exposure of the mischief done by unequal marriages, especially by the union of impoverished aristocrats with wealthy *parvenus*. The general conception of *L'Avare* was taken from Plautus, but adapted to modern society with a degree of truth and felicity which none but a Molière could command. The delineation of the miser, although one of the author's most successful attempts, was less favourably received than usual, owing, it is said, to its being written in prose. It has since, however, received ample justice. The highest compliment paid to the truth of the piece was by a miser himself, who was, it is said, so pleased with the excellent lessons of economy which it contained, that he actually paid the cost of admission to witness the performance. This play was transferred to the British stage, as *The Miser*, by Henry Fielding. Since the proscription of *Le Tartuffe*, Molière had been urgent in his endeavours to obtain for it a fair hearing. After repeated opposition and discouragement, his efforts were crowned with success, and the *Troupe du Roi* performed on the 5th February 1669 *Le Tartuffe, ou l'Imposteur*, to the great horror of the bigots, who ceased not to invoke the nether fires to consume the wicked dramatist. Passing over the clever farce of *Monsieur de Pourceugnac* (1669), and the satire on astrology of *Les Amants Magnifiques* (1670), we come to a masterpiece of comic art in *Le Bourgeois Gentilhomme*, first presented before the court at Chambord on 14th October 1670. This play, though defective in construction, continues to be one of the most popular of Molière's compositions. It exposes in an exceedingly amusing manner the ridiculous absurdities into which a man is led who would force his way into a higher sphere than his own, with no other qualification but the weight of his purse. In this relation the ignorant pomposity of Monsieur Jourdain, and the pretentious pedantry of his fashionable instructors, will continue to afford matter for genuine laughter as long as the piece is known. The *Fourberies de Scapin*, *Psyché*, and *La Comtesse d'Escarbagnas*, appeared in 1671, none of them demanding very special mention, with the exception of some exceedingly amusing pieces of dialogue in the *Fourberies*. It is in one of these that the avaricious father utters the celebrated phrase, "Que diable alla-t-il-faire dans cette galère?" with such passionate importunity and ludicrous effect. The following year brought a richer specimen of Molière's art in *Les Femmes Savantes*, acted on the 11th March 1672, consisting of a regular comedy in five acts, which has always been considered one of his most powerful productions. The object of the dramatist's ridicule on this occasion was the scientific airs and learned

dignity which the exploded coteries of the *précieuses* now affected, instead of the romantic jargon in which they had formerly indulged.

We now come to speak of the *Malade Imaginaire*, a piece possessing the melancholy interest of being Molière's last. This play appeared in February 1673, and consisted of a powerful and pungent satire upon those unworthy members of the medical faculty who were accustomed to take advantage of the unfounded apprehensions of their patients. Molière had always been of a delicate constitution, and had for many years been liable to pulmonary affections, which, during the composition of this his last work, increased greatly in violence. His friends attempted to dissuade him from appearing in the character of Argan when the piece came to be represented, as the exertion of voice and person called forth on such an occasion would tend to increase the severity of his malady. But Molière who had sacrificed personal comfort so often for the benefit of those dependent on him, could not forget even in the hour of death "those fifty people who must want their daily bread if the spectacle is put off." He had accordingly appeared as Argan, the *Malade Imaginaire*, for the fourth time; and before the conclusion of the piece, through which he had laboured with great pain, his cough overcame him, and being threatened with choking, he was carried off the stage and conveyed to his own house. The clergy were summoned, but in vain: it was the author of *Le Tartuffe* who was dying, and the last offices of religion must be withheld. Two poor Sisters of Charity, who in past days had never come to his door in vain, try to smooth the pillow of the dying man with their words of peace. His cough soon returned with increased violence, and having burst a blood-vessel, he died apparently of suffocation on the 17th of February 1673, in the fifty-second year of his age. The cunning hand is now stiff, and the inventive brain cold, yet bigotry must have its revenge. Ecclesiastical sepulture was refused the comedian's remains by Harlai, Archbishop of Paris, a man who, after a life of licentiousness, himself died of debauchery. How could the dust of a poor comedian, who wore out his life in the cause of truth and virtue, find respect at the hands of such a *Tartuffe* as this? Yet such is a specimen of Molière's most malignant foes. The interdict was revoked, however, by the private orders of the king, after tearful importunities on the part of Molière's poor unfortunate widow, who, forgetful of all her follies now, tried to atone, by her sorrowing anxiety for the honour of the dead, for the many wrongs she had done the living. It was nevertheless with great difficulty that the remains of one of the truest men France had known were ultimately got interred in the cemetery of Saint Joseph. Of Molière's three children, only one, a daughter, born in 1665, survived him. She eloped with a widower twelve years after her father's death, and died without issue in 1723.

We know nothing respecting the character of Molière that is not greatly to his honour; and those who have been loudest in their censures of the poet have failed to find a flaw in the character of the man. Numerous anecdotes of unquestionable authenticity abundantly prove him to have been an honest, generous, true-hearted man. He seems to have had a genuine love of truth, an utter scorn of whatever was false or mean, a genial, kindly nature, and a heart full of unostentatious benevolence. Baron, a distinguished pupil of Molière's, requested on one occasion some pecuniary aid from his master on behalf of an unfortunate actor whom Molière had known in the provinces. "How much does he want?" asks Molière. "Four pistoles," was the reply. "Here they are," says Molière, "and twenty besides, that I wish *you* to give him; for I want him to feel it is to you he owes his relief." Witness also his clinging to his craft lest his retirement should damage his *troupe*, when the Academy proposed to receive him on condition of his dropping the title of "actor." His well-known practice of reading his pieces while in manuscript to his shrewd old housekeeper, Laforet, affords an admirable illustration of the amiable simplicity of his character. That he continued this custom so scrupulously, from the mere desire of trying the effect of his compositions on the good dame, is not at all likely. The success of his profession placed him in a position of comparative opulence, and he was indefatigable in his acts of charity. He did not only rest satisfied with aiding the importunate; he is said to have quietly sought out objects for his liberality among needy sufferers of the humblest rank. No change of fortune could alter the original simplicity of his character. The king treated him constantly with respect, and even with familiarity; and not a few of the haughty noblemen of the court, forgetting the accidents of birth in the presence of genius, diligently sought his society. Yet amid all these flattering marks of distinction, Molière preserved the native purity of his heart and the simplicity of his manners. His hours of leisure he enjoyed in the society of the most distinguished literary men of the age; and he counted among his friends La Fontaine, Boileau, Chapelle, and Racine. In society he was very reserved, being characterized by a thoughtful modesty, which gained for him the sobriquet of "The Contemplator."

The most distinguished critics among Molière's countrymen have been unanimous in assigning him the highest place among the comic authors of France; and Voltaire does not hesitate to pronounce him the most eminent writer of comedy of any age or country. This judgment the majority of English critics have also learned to indorse; and even with the extraordinary comic powers of Shakspeare before them, feel it their duty to vindicate for Molière the very highest place of any who has ever distinguished himself in this department of literature. The comic scenes of the great English dramatist are introduced more to relieve the severity of his tragedy, than with the view to make comedy his ultimate aim; and even in the *Merry Wives of Windsor*, his nearest approach to a regular comedy, he rises at times, by the uncontrollable soaring of his genius, into a region of poetry entirely beyond that sphere where vice is satirized and folly rendered ridiculous. Molière, again, hardly ever introduces a single piece of poetical imagery to ornament his dramas. He wrote constantly to the understanding, and not to the imagination. You search in vain almost for any touch of the sublime in his compositions; and even when he becomes serious, he seldom parts company with the hardest common sense. Yet there is no comic author who has depicted character as Molière has done,—keeping steadily fixed before him the grand end of his art. His observation was so penetrating, and his glance so keen, that no veil could hide vice from his detection, or cover the foibles of men from the fire of his wit. His insight into human nature is powerful and penetrating; his delineations are characterized by great truth and simplicity; and his language stands unrivalled for force and *naïveté*. The scenes from which Molière painted represent follies of a former date; yet so profound was his knowledge of the human heart, that while apparently ridiculing an accidental folly, or branding a particular vice, he was at the same time steadily directing his satire against those outstanding follies and vices which are peculiar to man at all times and in all places. And here Molière ceases to be merely the comic writer of France. His works, like those of all men of true genius, become the property of universal humanity. His comic power was of the very highest order, and his wit of the purest kind; his laughter is always hearty, and his pleasantry always innocent. In exposing the more serious forms of vice, his satire occasionally assumes a gravity almost too staid for the ordinary

notions of comedy; for virtue, with Molière, never ceases to be sacred, and the keenest shafts of his satire are directed against its enemies. His verses, while remarkable for freedom and fluency, are said to have been polished with great care. He has been charged with deficiency in the development of his plots; with not only precipitating the *denouement*, but with bringing it about without a sufficient regard to probability. It must be admitted that Molière always takes greater interest in the unfolding of character than in following out the complicities of intrigue. Situation and incident seem always to have held a subordinate place in his estimation. His most striking situations were not his own; yet he compensated by originality of execution for what he had borrowed in design. It signified very little to Molière what was the mere form which his drama assumed; his unrivalled power in portraying individual character, and his genuine comic genius, won for him success alike in regular comedy and in *comedie-ballet*. There is perhaps no instance on record in which such a constant and determined warfare against vice and folly was sustained by means of wit and satire alone, without any assistance either from sublimity or pathos. Molière was a genuine reformer; and the author of *Tartuffe* and the author of the *Lettres d'un Provincial* take their places together as the two most valiant defenders of the truth during the seventeenth century in France.

Of the numerous editions of Molière's works which have been published, the following are the most valuable:—That of Lagrange and Vinot, Paris, 1682, in 8 vols. 12mo, and that of Didot, Paris, 4 vols. 8vo (edition Lefevre), 1854, with notes, historical and critical, and life by Lagrange, who was an actor in Molière's *troupe*. A complete translation of the comedies of Molière, printed with the original French, by James Miller and Henry Baker, appeared about 1750.

For the most valuable information respecting the life and works of Molière, see *Vie de Molière*, par M. Taschereau, new edition, Paris, 1854; *Notes Historiques sur la Vie de Molière*, par M. Bazin, Paris, 1851; also an able essay on *The Life and Genius of Molière* in the *Cambridge Essays* for 1855, by Mr C. K. Watson. (J. D—S.)

MOLINA, LOUIS, the founder of the sect of the *Molinists*, was born at Cuença in New Castile in 1535. At the age of eighteen he entered the Order of Jesus. He then studied at Coimbra, and was subsequently appointed to a theological chair at the Portuguese university of Evora. During twenty years he taught there with great success, and acquired some reputation for the lively and subtle ingenuity which he displayed in his commentaries on Thomas Aquinas, and his treatise *De Justitia et Jure*. But the work which especially rendered him famous was his *De Concordia Gratiæ et Liberi Arbitrii*, folio, Lisbon, 1588. It is an attempt to show, by a method somewhat new, how the doctrines of predestination and grace are consistent with free will. Assuming that man is free to perform or not to perform any action whatever,—that, in fact, he really works out his own destiny,—Molina yet affirms that this circumstance renders the bestowal of the grace of God neither impossible nor unnecessary. It does not render it impossible, for God never fails to bestow grace upon those who ask it with sincerity. It does not render it unnecessary, for grace, although not an efficient, is still a sufficient cause of salvation. Nor does it preclude the possibility of predestination. The omniscient God, by means of his *scientia media*, or power of knowing future contingent events, foresees how we shall employ our own free will and treat his proffered grace. Therefore, upon this foreknowledge, he can found his predestinating decrees. Such doctrines as these brought upon their author the attacks of the Dominicans, who were the faithful followers of Thomas Aquinas. The Jesuits came to the defence of one of their own order. A hot war of theses then ensued, which speedily excited Spain into a ferment, and forced Clement VIII. in 1594 to impose silence upon the clamorous combatants. But the orthodox fury of the Dominicans refused to be calmed. They insisted that the grand inquisitor Cardinal de Quiroga, Philip II. of Spain, and the pope, should each interpose his authority to check this revival of Pelagian heresies. At length in 1598 Clement referred the dispute to a council consisting of a presiding cardinal, three bishops, and seven theologians of different fraternities. For several years this court continued to hold its meetings, which, as they bore reference to the aids of grace, were called *Congregationes de Auxiliis*. Its decision was given in 1601 in favour of the Dominicans. Clement therefore prepared to pass a sentence of condemnation against the Molinists; but the Jesuits prevented him, and induced him in 1602 to summon a council under his own presidency for the reconsideration of the dispute. This council was interrupted in its deliberations by the death of Clement in 1605. It resumed its sittings, however, under the following pope, Paul V., and continued to deliberate until the controversy was, by common consent, left undecided. Meanwhile Molina had died at Madrid in 1600. The dispute between his followers and the Dominicans was afterwards merged in the great controversy between the Jesuits and the Jansenists.

MOLINOS. See MYSTICISM.

MOLISE, or SANNIO, a province of Naples, bounded on the N. by Abruzzo Citra, E. by Capitanata, S. by Principato Ultra, and W. by Terra di Lavoro; having an average length of 55 miles, a breadth of 40 miles, and an area of 1783 square miles. The province is situated on the E. slope of the Apennines, the main ridge of which traverses it from N.W. to S.E., and sends off several branches in a north-easterly direction. The surface is thus for the most part rugged and mountainous; but the valleys and the lower parts of the hills are fertile, though ill cultivated; and the higher regions afford excellent pasturage. The principal rivers of the province are the Trigno, the Biferno, and the Fortore, all of which flow from the Apennines to the Adriatic. The chief productions of the province are,—maize and other sorts of corn, pulse, rice, oil, wine, and fruits. Sheep, goats, swine, and a small number of horned cattle are reared; but the breeds are inferior. Bees are also reared in large quantities. The most important manufactures of the province are those of cutlery and firearms; the principal seats of which are Campobasso, Frosolone, Lucito, and Agnone. The inhabitants are for the most part sunk in poverty; and thefts and murders are more common here than in most other parts of Italy. The province of Molise corresponds to the lands of Larinum, of the Caraceni, and of the Pentri, in ancient times. It is now divided into three districts,—Campobasso, Isernia, and Larino, comprehending 33 arrondissements and 136 communes. Pop. (1854) 376,750.

MOLITERNO, a town of Naples, province of Basilicata, situated on the E. slope of the main ridge of the Apennines, near the source of the Agri, 10 miles N.N.E. of Lagonegro. Pop. 5000.

MOLL, a town of Belgium, province of Antwerp, on the right bank of the Moll-Nethe, 31 miles E. of Antwerp. The town contains several churches and schools, an hospital, and a prison. The principal manufactures carried on are,—brewing, distilling, dyeing, and the making of woollen stuffs, hats, leather, tobacco, and bricks. Pop. 4770.

MOLLUSCA.

Introduction.

Of the Primary Division, or Province, of the Animal Kingdom, which is the subject of the present Article, Aristotle first defined certain members, under the name "Malakia," of which "Mollusca" is a rude Latin equivalent.

The great and peculiar merit of the system of Cuvier, as exemplified in the *Règne Animal*, and especially in the last edition (1830) which came from the hands of the illustrious author, is the determination of the characters and boundaries of the molluscous province by investigations of the entire animals.[1]

Most Mollusks are protected by a shell, and the shells had monopolized the attention of most preceding classifiers. After Cuvier, "Conchology" sank to its proper position as an artificial system and a subordinate department of "Malacology." By *Malacology* is meant the science of the "Malakia," *Mollusca*, or Mollusks; as "Ichthyology" is that of the *Pisces*, or Fishes. We now, in English speak of "a mollusk" and of "mollusks," as the French of "mollusque" and "mollusques." Subsequent advances in the knowledge of *Mollusca* have been made chiefly by pursuing the anatomical methods of Cuvier, and by applying them, not only to the last or fully developed stage of the individual, but to the previous stages of its development, from the egg onwards. These embryological investigations have required the use of the microscope; and Malacology, like other branches of natural history, has benefited by the application of the higher powers of that instrument to the investigation of both the minute embryos and of the component tissues of the organs of the Mollusks.

The first important improvement in the characters and constitution of the province or sub-kingdom of Mollusca, as defined by Cuvier in 1794[2] and 1817,[3] was the elimination therefrom of the order *Cirripedia*. In 1819 Straus Durckheim, in a memoir on the Structure and Affinities of an Entomostracous Crustacean (*Daphnia*), published in the fifth volume of the *Mémoires du Muséum*, compared in detail the organization of a Cirriped (*Pentelasmis*) with that of an Entomostracan (*Limnadia*), and pointed out their close affinity; which affinity was, two years after, insisted upon and illustrated by the correspondences of structure between *Pentelasmis* and *Daphnia*, by Mr W. S. Macleay, in his *Horæ Entomologicæ*, part i., p. 308. Dr Gray accordingly omitted the *Cirripedia* from the "Systematic Arrangement of the Mollusca," which he published in the *London Medical Repository*, vol. xv., 1821, p. 229. But the capital discovery, proving the plan of structure and the essential nature of the *Cirripedia* to be "articulate," not "molluscous," was made by Mr J. V. Thompson, and was published in 1830 in the third part of his *Zoological Researches*. His observations were made on the larvæ of a small sessile barnacle (*Balanus pusillus*), which he showed to undergo a very remarkable metamorphosis. He captured their larvæ in a fine towing net, as they swam freely in the guise of a small Crustacean furnished with a flexible shell composed of two valves like those of *Daphnia*. Being preserved alive in a vessel of sea-water, these larvæ cast off their bivalve shell, attached themselves to the bottom of the vessel, and became transformed into the *Balanus pusillus* of Pennant. Whilst the young animal possesses the natatory limbs and the power of locomotion, it has a pair of compound eyes, which gradually become obliterated, as in the case of the crustaceous *Cymothoë*, in the final transmutation to a fixed and sessile state. Other phenomena detailed by Mr Thompson left no doubt that the homogangliate type of the nervous system of the *Cirripedia*, first made known by Cuvier,[4] most truly indicated the primary group or province of the animal kingdom to which that singular class of shell-clad animals belonged.

Burmeister, who corroborated the discovery of Thompson, formally proposed, in his work on the Cirripeds, published in 1834, to transfer them to the Articulate province, and to place them as a particular tribe in the class *Crustacea*.

De Blainville had indeed included the Cirripeds with the Chitons in a distinct sub-class called "Malentozoaires," under which name they are described, as the order *Nématopodes*, in the work on Mollusca called *Malacologie*, which was published as such in 1825. But the obvious want of anatomical knowledge, or indifference to evidence from organization, which the association of the Cirripeds with the multivalve Gastropods displayed, prevents the attachment of any importance to the innovating ideas and sweeping changes of malacological nomenclature proposed by this naturalist.

For the same reason, no influence on the modification of molluscous classification was exercised by the suppression of Cuvier's order *Pteropoda*, and the intercalation of the genera of that order between *Helix* and *Fissurella* amongst the Gastropods of Cuvier, in the *Manuel de la Malacologie* of 1825 above cited. Even as late as 1837 Professor Milne Edwards, in his *Elémens de Zoologie*, adopts the constitution and relative position of the *Pteropoda* assigned to them by Cuvier in the last edition of the *Règne Animal;* and their position is preserved unchanged in the second volume of the *Zoologie de la Bonite*, published by M. Souleyet in 1852.

But before noticing the chief modifications of the Cuvierian system in reference to minor groups within the limits of the Molluscous province, it may be remarked, with reference to those limits, that had Cuvier placed due reliance on the character of the nervous system which had previously guided him in his primary arrangement of the animal kingdom, he might have been led by his discovery, in 1815, of the homogangliate type of that system, in both sessile and pedunculate barnacles, to the reform subsequently worked out by Straus Durckheim and others.

The modification of two of Cuvier's provinces by the subtraction of the class *Cirripedia* from one, and the addition of these soft inarticulate conchiferous animals to the other, induced Professor Owen, in the Synopsis of his course of Lectures delivered at St Bartholomew's Hospital, and published in 1835, to propose the term *Heterogangliata* for the so-curtailed Mollusca, and *Homogangliata* for the pro-

[1] See *Mémoires pour servir à l'Histoire et à l'Anatomie des Mollusques*, 4to, 1817; a volume which consists of a series of papers published chiefly in the *Annales* and *Mémoires du Muséum d'Histoire Naturelle*, from the year 1792 to the date of their collection into that volume.

[2] "Seconde mémoire sur l'organisation et les rapports des animaux à sang blanc, dans lequel on traite de la structure des Mollusques et de leur division en ordres" (*Magazine Encyclopédique*, t. ii., an. iii. (1794).

[3] *Le Règne Animal distribué d'après son organisation*, 8vo, 1817.

[4] "Mémoire sur les Animaux des Anatifes et des Balanes, et sur leur Anatomie" (*Mémoires du Muséum*, tom. ii., 1815).

Introduction.

portionally expanded Articulata,—terms expressive of the leading modifications of the nervous system characterizing those provinces respectively. The term *Mollusca* is used in the present article, as by most recent authors, in the sense of the *Heterogangliata* as above defined.

Characters of the Mollusca.

The *Mollusca* are here meant to include the animals with one ganglion or more below the entry to the alimentary canal, whence nervous chords radiate to form a collar round that entry, and to supply other organs of the body; nervous ganglions being superadded, as the species ascend in complexity of structure, above the gullet, representing a brain, and in different parts of the body, but commonly in a more or less scattered or unsymmetrical manner, and never along a pair of symmetrical sub-abdominal median chords.

In the highest molluscous class (Cephalopods) muscles may originate from an internal cartilage; in other Mollusks they are attached to the skin or to the shell which may be developed in that otherwise soft substance. The shell is hardened chiefly by carbonate of lime, and consists either of one piece or two pieces, called "valves;" rarely of more than two, or with accessory parts. The blood is colourless, or not red; the heart is distinct, muscular, and propels the blood through a system of arteries and veins, the latter having more or less the form of irregular sinuses or lacunæ. The respiratory cavity, with the exception of one family (Ascidians, which therefore ought rather to be transferred to the molluscoid Zoophytes), receives or opens near the anus. The intestine is usually bent or reflected forward to effect that relation. The *Mollusca* may be either diœcious or hermaphrodite. The molluscoid Zoophytes are parthenogenetic.

The foregoing characters of the Molluscous province are natural, if the Ascidians and ascidioid Polypes are excluded. Admitting these as the lowest confines of the province, its definition must be qualified by large exceptions.

Boundaries of the Mollusca.

Cuvier, in publishing the collected results of his anatomical investigations of the *Mollusca*, remarks in the preface:—"Here may be seen to what point some among them approach the vertebrate animals, and one may convince himself that it is no longer possible to leave them, as Linnæus did, in the lowest class of the animal kingdom confounded with the tentaculiferous Polypes and other as simple Zoophytes."[1]

Savigny[2] was the first to show that such linking on of the molluscous to the polype type of structure was not so impossible in nature; this he did by his discovery of the organization of the compound Ascidians which had previously been classed with Zoophytes.

Audouin and Milne Edwards,[3] Ehrenberg,[4] Thompson,[5] and Arthur Farre,[6]—the last-named author more especially,—have demonstrated the resemblances in organization between the compound Polypes with ciliated tentacles and the compound Ascidians.

These results of anatomical investigation, carried out into forms of a lower grade than the Mollusks dissected by Cuvier, together with subsequent embryological observations demonstrating certain developmental characters which the nudibrachiate and ciliobrachiate Polypes have in common with the Ascidians and higher Mollusks, have led some modern naturalists to return to the Linnæan views of classification, and to group together, for example, under the term "Allovitelliens" the *Mollusca* and *Radiata* of Cuvier.[7]

The truth is, that with regard to any great primary group of animals, as with a tree, it is much more easy to define the summit than the base; nay, although the labour in quest of the beginning be like that of following out all the hidden ramifications of the tree's root, it will fail to end in as definite results, and the lower boundary of the *Mollusca*, as of the *Articulata*, must still be defined by an arbitrary line.

One has no difficulty in regard to the highly organized Cephalopods, in concluding that we have reached the topmost branches of the molluscous tree. We cannot connect them with the *Sagitta* or *Amphioxus*, nor glide on from them to any low embryonoid form of vertebrate life; but, in descending from the cephalopodous summit we are led, through the Nautilus, the siphonated Univalves, and the naked Gastropods, to minute forms of the latter in which all traces of shell, of foot, of liver, and of gills, have disappeared, and in which the alimentary canal, dispersing ramifications throughout the body, combines digestive, hepatic, and excretory functions, as in some *Entozoa* (fig. 1, *e*, *e*),

Fig. 1.
Fasciola gigantea.

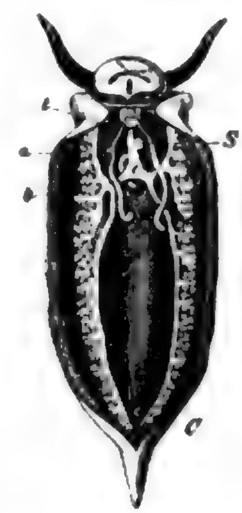


Fig. 2.
Calliopea Souleyetii.

and in some fresh-water worms, with a ventral disc *d*, called *Planariæ*, to which the marine *Apneusta* (fig. 2) are more closely allied than to any of the Pteropodous, Lamellibranchiate, Palliobranchiate, or Tunicate types of the *Mollusca*. Thus one of the roots of the Mollusca appears to be lost in the Turbellarian and Trematode families of Abranchiate Vermes.

The *Brachiopoda*, by the more intimate organic union of their shell and mantle, and by their ciliated, fringed,

[1] "On y verra à quel point plusieurs d'entre eux se rapprochent des animaux vertébres, et l'on se convaincra qu'il n'est plus possible de les laisser, comme l'avait fait Linnæus, dans la dernière classe du règne animal, confondu avec les polypes à bras et d'autres zoophytes aussi simples." (*Histoire des Mollusques*, &c., 4to, 1817, Avertissement, p. v.)

[2] Mémoire sur les Animaux Composés (*Mém. de l'Acad. des Sciences*, Paris, 1817); *Mémoires sur les Animaux sans Vertèbres*, 8vo, 1816–18.

[3] *Rapport fait à l'Académie des Sciences*, Paris; and *Annales des Sciences Naturelles*, 1828.

[4] *Symbolæ Physicæ*, 1828–1831 (*Bryozoa*).

[5] "On *Polyzoa*, a new animal discovered as an inhabitant of some Zoophytes," in *Zoological Researches*, 1830.

[6] "Observations on the Minute Structure of Ciliobrachiate Polypes" (*Philosophical Transactions*, 1847).

[7] "Il nous semble que la division de Linnée est encore la plus naturelle. Elle est en effet le plus en harmonie avec le developpement." "Chez les vers de Linnée, dont Cuvier a fait les Mollusques et les Radiaires, le vitellus ne rentre par le dos ni par le ventre; on pourrait les désigner sous le nom de *Allovitelliens* ou *Allocotyledones*. Les *Allovitelliens* comprennent la classe des Mollusques, des Polypes, des Echinodermes, &c." (Van Beneden, *Embryogenie des Bryozoaires*, 4to, 1845, p. 7.)

Introduction.

bent or spiral arms, compared by Siebold to those of *Alcyonella*, conduct to certain forms of *Bryozoa*, to which they are more closely allied than is the *Salpa* or *Ascidia*. The progress to the latter form of Mollusk may be traced upwards as follows:—

Amongst the varied forms of microscopic beings called *Infusoria* and *Polygastria* is one (fig. 3, *A*) shaped like a bell, attached by a contractile apical peduncle to a foreign body, with the base of the body provided with vibratile cilia, effecting the respiratory currents of the surrounding water, and drawing the food towards the mouth, which, with the vent, open upon the same ciliated extremity of the body. The ciliated border is retractile. This organism propagates, among other modes, by buds (fig. 3, *B*), which become detached, and for a time swim freely as "ciliated gemmules (fig. 3, *C*).

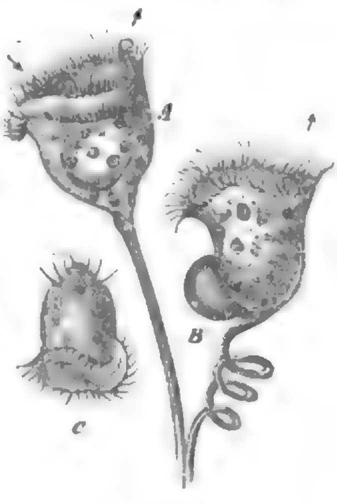


Fig. 3.
Vorticella convallaria.

In another minute aquatic organism, with a similar form and pedunculate attachment (fig. 4), there is a certain advance in development, with concomitant distinction of parts. The vibratile cilia are supported on tentacular prolongations *g* of the free base of the bell-shaped body *A*. The cavity *ed* receiving and acting on the food, is now distinct from the proper walls of the body, and can be traced, as a canal, extending from the mouth *e* to the vent *d*, both of which, however, open, as in the *Vorticella*, within the ciliated circle. The contractile fibres *m*, which retract the ciliated borders, are manifest.

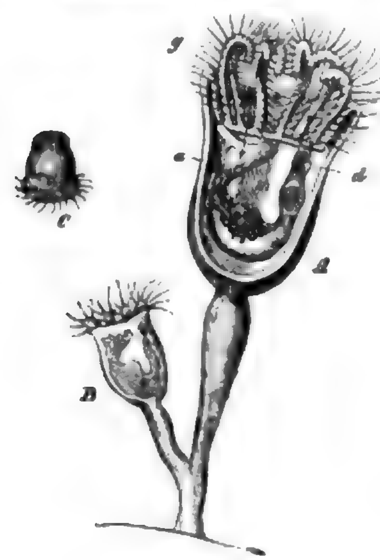


Fig. 4.
Pedicellina.

The organisms showing this advance of structure are called *Bryozoa* and "ciliobrachiate Polypes." They propagate by buds *B*, and by free-swimming ciliated gemmules *C*. The generic form here illustrated is called *Pedicellina* (fig. 4).

A third type, or what, in regard to general development, might be called a third stage (fig. 5), is manifested by a group of small aquatic animals called Ascidians, for the most part compound, and in some species pedunculate, as in the two preceding stages; the peduncle being attached to the apex or end of the body opposite to that on which the mouth and vent open. But in the present more advanced type the walls of the body are so developed as to surround separately the oral (*g*) and anal (*f*) apertures; rudiments of ciliated tentacles *g'* are confined to the oral inlet, and the cilia, which answer in function to those of *Pedicellina* and *Vorticella*, are developed from a capacious sac *cc*, with transverse rows of holes, at the lower part of which the alimentary canal begins; this canal *d* returns upon itself, as in the former more simple types, and terminates at *k*, below the anal aperture of the body *f*. A rythmically contracting or pulsating body exists in all the three grades of structure above cited. In the Ascidian type the heart *n* manifestly circulates a nutritive fluid through two channels, marked by arrows in fig. 5, which convey it in opposite directions along the stem, which thus organically unites the different individuals supported by its branches.

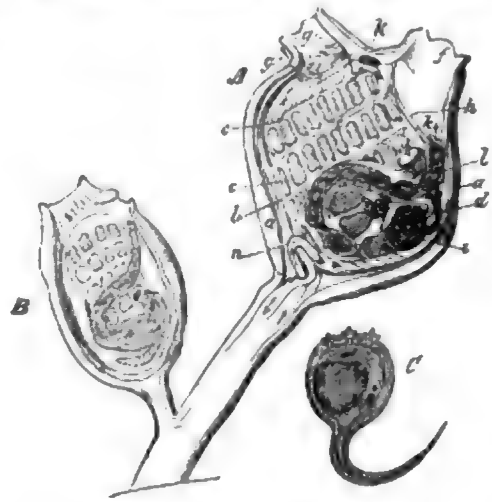


Fig. 5.
Perophora Listeri.

The Ascidians propagate by buds (*B*) and by eggs, the latter excluding free-swimming larvæ *C*, shaped like the tadpole of the frog. This well-marked developmental distinction has not received from some naturalists the importance it merits in the question of associating the *Bryozoa* with the *Tunicata*.

As to their relations to the true *Mollusca*, some classifiers draw the line between the first and second steps of development; others between the second and third. One physiologist[1] assigns developmental or embryonic facts in support of an incorporation of all *Zoophytes* with the *Mollusca*; another physiologist[2] would associate the rhizobranchiate and ciliobranchiate *Acalephæ* with the Salpæ and other acephalous *Mollusca*. The philosopher who may, in the range of his studies of animated nature, include the highest phenomena of life—the psychical—will be apt to believe that the systematist who is really least qualified will denounce most dogmatically every partition which does not tally with his own notions of the proper boundary line.

It is here proposed to submit that the *Mollusca*, for the

[1] Van Beneden, *loc. cit.*

[2] De Blainville, *Considérations sur les Animaux et leur Classification*, 8vo, 1840, p. 31.

ends of definition and description, should be understood to commence, in the ascending order, with those forms in which the respiratory organs or cavity are in relation rather with the vent than with the mouth. The oral relation with the ciliated or tentaculiferous circle prevails from the *Vorticella* and *Hydra* to the *Ascidia* and *Terebratula* inclusive; but the bend of the intestine in *Discina* and *Lingula* indicates the tendency to the usual molluscous relation of the vent in the *Brachiopoda*.

In deference, however, to the expectation of most readers, and with the conviction, when the progressive series of developments to different modifications of the molluscous type have been traced and illustrated, of the essential unimportance and artificiality of any line defining the lower boundaries of the heterogangliate province, the present article will include, with the anal-breathing classes, the *Tunicata* and *Brachiopoda*, although these are rather "Molluscoid" than *Mollusca*.

Classes. Subdivisions of Mollusca.

Having premised so much as to the definition and extent of the molluscous or heterogangliate province, the subject of its partitions, and of their relative value in the scale of organization, is next in order.

In tracing the progressive complication of animal structures from the simplest forms, we soon find ourselves travelling along two distinct routes, the additional complexities adjusting themselves according to two general types of organization, which are, however, so gradually assumed, that the lower boundary must in both cases be arbitrarily defined.

In the great province of the *Articulata* the advance of structure is most conspicuous in the organs peculiar to animal life, and is manifested in the powers of locomotion, and in the instincts which are so various and wonderful in the insect class.

In the *Mollusca* the developmental energies seem to have been expended chiefly in the perfection of the vegetal series of organs, or those concerned in the immediate preservation of the individual and the species.

The *Mollusca* are so called on account of the soft unjointed nature of their external integument. The scattered centres of the nervous system, disposed according to the heterogangliate type of that dominant system of organs, is often accompanied with an unsymmetrical form of the entire body, which, in compensation for the low condition of the perceptive energies, is protected in most of the species by one or more dense calcareous plates, called shells.

All true Mollusca have a complete alimentary canal, with mouth, stomach, intestine, and vent; and they are provided with circulating and respiratory organs.

In a large proportion of the lower organized Mollusca there is no head and no brain or superœsophageal ganglion. The inlet for the food is simply a pharynx, or beginning of the œsophagus, without jaws, tongue, or mouth, properly so called. All other *Mollusca* are provided with a head, which generally supports feelers, or soft tentacula, eyes, and a mouth armed with parts for mechanically operating on the food.

The molluscous province may thus be primarily divided into *Acephala* and *Encephala*.

The Acephalous Mollusca are all aquatic, and are divided into classes according to the modifications of their integument, or of their gills.

The *Tunicata* are those which are inclosed by an elastic cellulose uncalcified integument. They breathe either by a muscular ciliated pharyngeal sac, or by a riband-shaped gill stretched across the common visceral cavity. John Hunter, who had anatomized the typical forms of this class, and had recognised the homology of their flexible case to the shells of the bivalves, to which Mollusks he saw that Banks's "Dagyza," and the "squirters" of our own shores, were most nearly allied, grouped together the *Salpa* and *Ascidiæ*, as they are now called, into a natural family, which he termed "Soft-shelled."[1] This family is the same as that afterwards described and called "shell-less *Acephala*" by Cuvier, and *Tunicata* by Lamarck. All the other *Acephala* have a bivalve shell.

The *Brachiopoda* have two long spiral arms developed from the sides of the mouth, and respire chiefly by means of their vascular integument or "mantle." One valve of the shell is applied to the back, and the other to the belly, of the animal, which is attached by its shell, or by a pedicle, to some foreign body.

The *Lamellibranchiata* are bivalve conchiferous Mollusks, which respire by gills in the form of vascular plates of membrane attached to the inner surface of the mantle. One valve is applied to the right side, the other to the left side, of the animal. The common oyster and mussel are examples of this best-known class of Acephalous Mollusks.

The Encephalous Mollusca are divided into classes according to the modifications of the locomotive organs.

The *Pteropoda* swim by two wing-like muscular expansions, extended outwards from the sides of the fore part of the body.

The *Gasteropoda* creep by means of a muscular disc attached to a greater or less extent of the under part of the body.

The *Cephalopoda* have all or part of their locomotive organs attached to the head, whence they radiate in the form of muscular arms or tentacula.

In the last class only do we find, in the present series of animals, an internal skeleton, combined in some with a shell. In the rest of the Mollusca the hard parts, where present, are external. But the integument in certain species of the Encephalous classes, and in most of the Cephalopoda, is uncalcified and flexible.

The chief modification of the Cuvierian system, in regard to the sequence or relative position of the classes of the *Mollusca*, has been made in the Encephalous division, and consists in the transference of the *Pteropoda* from above to below the *Gasteropoda*.

The grounds for this change, which, as already shown, was not accepted up to 1852, rest mainly upon a demonstrated nearer affinity of structure of the Cephalopods to the Gastropods, and on the resemblance of the mature form of the Pteropods to the larval stage of certain Gastropods.

The first step in the work requisite to establish the necessity of this innovation upon the Cuvierian system will be found in the following passage from Owen's *Memoir on the Pearly Nautilus*:[2]—

"The interesting character which the *Nautilus* sustains as an osculant form between *Cephalopoda* and *Gasteropoda*, will perhaps be considered to have been sufficiently manifested by the instances of affinities already cited; but it is rendered still more evident on a consideration of the nervous system. The forms, proportions, and disposition of the principal masses of this system appeared, indeed, at first sight to recede so far from the type of the higher Cephalopods as to have rendered it necessary, in the description, to refer to a Gasteropodous genus in illustration of it. The essential difference, however, as has already been shown, consists in the simpler condition of the central mass; the source of volition being thus in harmony with the diminished energies of the muscular, and the contracted sphere of the sensitive system.

"The differences in the distribution of the principal

[1] See the MS. quoted in Owen's *Catalogue of the Physiological Series of the Hunterian Museum*, 4to, vol. i., 1832, p. 266.
[2] 4to, 1832, p. 50.

Introduction.

nerves are not less important in a physiological point of view. In the Cephalopods, whose shells are rudimentary and internal, and whose bodies are enveloped in a naked, and, as we must suppose, sensible mantle, the nerves which supply that part radiate from a ganglion, which, as in the posterior roots of the spinal nerves in the *Vertebrata*, is interposed on the cord which brings them in communication with the central mass. In *Nautilus*, on the contrary, whose body is incased in an insensible calcareous covering, the analogous nerves are wholly expended on the largely-developed muscles which attach the shell to the body; and these nerves, like the motor filaments of the spinal nerves, pass into the muscles directly from the brain without the interposition of any such ganglion.

"The inferiority of the more intellectual senses, sight and hearing, is in correspondence with the simplicity of the brain; and in receding from the higher Cephalopods in the structure of the eye, it inclines more directly towards the Gastropods, numerous genera of which, and especially the *Pectinibranchiata* of Cuvier, present examples of this organ analogous in simplicity of structure, and in a pedicellate mode of support and attachment to the head. As the pearly nautilus, like the latter group of Mollusks, is also attached to a heavy shell, and participates with them in the deprivation of the locomotive instruments of the Cephalopods, ve may thence deduce the more immediate principle of their reciprocal inferiority with respect to the visual organ: for what would it avail an animal to discern distant objects which could neither overtake them if necessary for food, nor avoid them if inimical to its existence?

"As the spheres of vision and of action, however, are thus limited, the power of taking cognisance of proximate objects is proportionably augmented, and the organs of the simpler sense of touch are more amply developed. In the numerous and singularly-disposed tentacles of *Nautilus*, we have also examples of a recurrence of structures heretofore unknown among the Cephalopods, and whose analogues are to be sought for in inferior groups. And here again, as in the case of the eye, after searching in vain among the Pteropodous genera, we are compelled to admit the claims of the Gastropods to a closer alliance with the highly organized class whose affinities the pearly nautilus has tended so materially to elucidate. Thus *Doris*, *Tethys*, and *Tritonia* each present examples of sheathed and retractile tentacula; and in the former of these genera they have the same peculiar structure as is displayed in the ophthalmic tentacles of *Nautilus*." (See Cuvier, *Mém. sur le Doris*, p. 12, pl. 2, fig. 1.)

"On a consideration of the generative system, it will appear that, as far as regards the female, the pearly nautilus does not recede materially from the Cephalopodic type; and it may be remarked that the *Pectinibranchiata*, in their diœcious mode of generation, approximate closer to *Nautilus* than the other *Gasteropoda*, and present a similar laminated glandular organ in the branchial cavity, whose office is supposed to be to secrete the receptacles of the ova after they are expelled.

"The retractile tentacles of *Clio* are constructed on a plan very different from those of *Nautilus*. The consideration, indeed, on which the *Pteropoda* have been placed in the *Règne Animal* next in order after the *Cephalopoda*, and preceding the *Gasteropoda*, appear to be slighter than have usually influenced the immortal author of that work in the position of his groups. Their swimming like the former animals is a relation of analogy; whilst their inferiority to some, at least, of the Gasteropodous families is evidenced by the doubtful nature of their organ of vision, and by their hermaphroditical mode of generation."

Influenced by these views, the author of the work above cited placed the *Pteropoda* below the *Gasteropoda* in the Synopsis of his Lecture on Comparative Anatomy, published in 1835. The *Pteropoda* have the same position in the two editions (8vo, 1843 and 1855) of his *Lectures on Invertebrate Animals*.

Mr Woodward has adopted the same sequence of the classes of encephalous Mollusca in his Excellent, comprehensive, and accurate *Manual of the Mollusca*, 8vo, 1851–1856; and it has received the sanction of Professor Van der Hœven in his *Handbook of Zoology*, second edition, 1855. Thus the position originally assigned by Lamarck[1] to the *Pteropoda* below the *Gasteropoda*, by which they are separated from the *Cephalopoda*, is that which appears now to be generally adopted; and it is perhaps to the genera *Bullæa* and *Gastropteron*, and to the *Firolidæ*, that the different forms of this interesting group of floating Mollusks present the closest affinity.

With regard to the subdivisions of the classes, Cuvier has left little of importance to be proposed in the way of amendment; but some innovations have obtained partial acceptance which seem to be retrograde steps.

In the Lamellibranchiate class (the "Acephales Testacés" of the *Règne Animal*) the extent to which the mantle-lobes are united and developed, the number and position of the adductor muscles, the presence and form of the foot, are still the characters which are chiefly relied on for distinguishing the primary groups of the class.

In the *Gasteropoda*, Cuvier believed that the modifications of the respiratory organs, especially as to position and form, best indicated the orders of the class. The absence, however, of an articulated skeleton—internal or external—permits the softness of the body of the Mollusk to adapt itself to a greater diversity of undefined and unsymmetrical shapes than is possible in the *Articulata* or *Vertebrata*; and hence the relative position of certain organs become changed in a degree beyond anything observable in the primary divisions of animals of more fixed forms. The branchiæ, which, in a vermiform Gastropod like the Doris, may project backwards behind the heart, will be found, where the hinder part of the body has to be lodged in the spiral whirls of a shell, to be tilted forwards as by an act of rotation, so as to project forwards and lie in advance of the heart; as, *e.g.*, in the whelk. It has been accordingly proposed to make this really unessential character, founded on relative position and direction of the gills to the heart, over-ride the more important differences in the extent and relative position of the gills to other parts of the body, and also the structure of the gills themselves; and the order *Prosobranchiata*, in the system of Professor M. Edwards, includes all those Gastropods in which the gills lie in advance of the heart, and thus associates the whelk in the same order with the limpet, and with such floating forms of Gastropod as the *Firola* and *Carinaria*; all other gill-bearing Gastropods being "opisthobranchiate." But in reference to the latter term, the student who may anatomize the species which it is proposed to include, will find it to be in many instances an arbitrary, if not an incorrect one. In *Glaucus*, for example, the gills are external, supported on pairs of processes progressively diminishing in size from before backwards. The heart is situated opposite the middle pair, consequently *behind* the largest and chief pair; yet the *Glaucus* is classed with the Gastropods, which have the gills behind the heart. In *Diphyllidia* the heart is near the middle of the body; the gills, commencing near the mouth, extend along each side of the body. In all the Nudibranchiates with branchial tufts some of the pairs are always in front of the heart; and in general, as far as this inde-

[1] *Histoire Naturelle des Animaux sans Vertèbres*, vol. vi., 1818. The absence of any adequate reason for the change in the position of the *Pteropoda* proposed in this work caused the views of Cuvier to maintain their sway until a comparatively recent period.

Introduction.

finite character is concerned, the *Nudibranchiata* are as entitled to be called "Prosobranchiates" as "Opisthobranchiates."

Some Pteropods are "prosobranchiate;" many might be termed "opisthobranchiate;" but species of the same genus —*Cleodora, e.g.*—would perplex the zoologist confiding in the ordinal character in question by their differences in respect to it. In *Hyalæa* as much of the gill is in front as behind the heart; and one pulmonary vein passes backwards, the other forwards, to the auricle. The really natural character of the group manifesting these varieties in the relative position of heart and gill, shows the soundness of the judgment of Cuvier in founding his orders of Cephalous *Mollusca* on the more truly important characters of the breathing organ itself. The order *Prosobranchiata*, in the class *Mollusca*, resembles in its vague generality the order of the class *Mammalia*, proposed to be founded upon the discoid placenta.

In regard to a later attempt to generalize molluscous characters according to the course of the alimentary canal, there is less to be said. No care has been taken to distinguish the bend of the intestine which follows and is determined by the part of the body containing it, from the bend of the tube which is independent of any bend or production of the body of the Mollusk. And when the anatomical facts have been too plainly adverse to the proposed classification to be overlooked, they are attempted to be explained away. In the *Pecten*, the *Unio*, the *Lutraria*, and other bivalves, the principal loop of the intestine is open towards the dorsal aspect of the body, or that next the hinge of the shell. But such a bend contradicts the proposed classification on intestinal characters; the author of which is therefore compelled to qualify that principal bend of the intestine as being "accidental." The so-called "neural" Mollusks associate the *Polyclinum*, *Terebratula*, oyster, and *Clio* with the *Sepia*; the "hæmal" Mollusks link the Ascidians with the snails and whelks. One consequence of this classification and nomenclature is to throw doubt on, and to confuse the meaning of, the terms "neural" and "hæmal," which are at once definite and intelligible in regard to the *Vertebrata*, to elucidate the nature of which they were devised, and to which end they ought to be, and doubtless will be, restricted.[1]

Homologies of the Mollusca.

The hitherto published illustrations[2] set forth as those of the common plan of structure of the *Mollusca* appear to be premature; there is at least no evidence of their being the result of researches equivalent in number and kind to those which have issued in the most generally accepted views of the archetype of the Vertebrata.

The ways that have led to the present state of knowledge respecting the vertebrate archetype have been manifold and painfully pursued. The inquiry commenced with a comparison of the connections, during the phases of development, of particular parts in the different vertebrate animals, with a view to determine how far the parts in one species answered to the parts in another in the sense implied by the term "homology."[3]

The grounds for the conclusions as to these "special" homologies have been supplied in detail where those conclusions are enunciated. Upon these conclusions have next been founded a higher series of generalizations, under the term "general homologies;" from which have, finally, been deduced the idea of the common plan of structure of the vertebrate province.[4]

Where special homologies have been arrived at in the attempt to define the molluscous archetype, the results are expressed, according to rule, by the proposition of definite names for the parts so deemed to be determined. Thus a part of the visceral cavity of a Mollusk is called "an *abdomen*," or a "*post-abdomen*," as it is placed before or behind the anus;[5] and this definition is an essential basis of the proposed archetype. A general reference to the results of the investigators of molluscous development is made as a warrant for the safety of the above proposition; but the particular proofs are not given; and the writer of the present article has failed to find in the authors cited, or in nature, any evidence to warrant the expression that "the visceral mass is thrust out *behind* the anus"[6] in any Mollusk.

The growth of the abdomen and intestinal canal, resulting in different relative positions of the anus, is essentially the same in fishes and Mollusks. The different relative positions of germ-yolk and embryo being admitted, the progress of development which places the vent in advance of the visceral mass in the fish, is as little due to a "thrusting out" of such mass as it is in the slug, whelk, or snail. The grounds for pronouncing the part of the abdomen in advance of the anus in a gymnotus, to be the homologue of the part of the abdomen in advance of the anus in an eel, and the part of the abdomen—very considerable in the gymnotus—behind the anus to be a distinct part, are not appreciable by the present writer; he can as little understand the reasons for calling this considerable part of the abdomen a "post-abdomen," and the answerable part according to the contained viscera and the protective portion of the spine in another fish an "abdomen." The mere varying bend of the gut, and consequent different positions of the vent, are wholly inadequate for such a distinction. There is nothing in the development of a Gastropod that makes the position of the anus more adequate for a distinction between abdomen and post-abdomen than in the fishes above cited. The really important modifications in the development of a pulmonated Gastropod, as compared with a Pectinibranchiate, do not effect an equivalent change in the course of the intestine. In the present article it is held that the large cavity containing stomach, intestine, liver, and generative glands in the Doris, is the homologous part with the cavity containing the same viscera in the snail; just as the abdomen in a gymnotus answers to that in an eel, although the vent is at the fore part in the one, and at the hind part of the cavity in the other. The arbitrary division of the great visceral cavity of a Mollusk into "abdomen" and "post-abdomen," inasmuch as it is called for to support the idea of the molluscous archetype here discussed, augurs as ill for the stability of that idea as the like arbitrary assumptions by Spix and Geoffroy did for the stability of their ideas of the vertebrate archetype.

In the paper in the *Philosophical Transactions*, above quoted, treating of the archetype of the molluscous province, a few other special homologies are enunciated, as, for example, that certain of the cephalic arms—the four next the dorsal aspect—of the cuttle-fish are homologous with the fore-part of the foot in the snail or whelk, the remaining four to the middle part, the superadded tentacles (which arise internal to, and are distinct from, the ordinary arms) to the hind part, the respiratory tube or funnel to the free thickened border of the mantle in the whelk, and to the

[1] See Professor Huxley's paper in the *Philosophical Transactions* for 1853, p. 45, and in the *English Encyclopædia*, art. Mollusca. The same may be said of the term "post-abdomen," borrowed from "Crustaceology," where it has a definite meaning, but not answering to that in which it is applied to Mollusca.

[2] Ibid.

[3] Owen, *Lectures on the Invertebrate Animals*, 8vo, 1843, pp. 374, 379.

[4] Owen, *On the Archetype of the Vertebrate Skeleton*, 8vo, 1848, p. 7.

[5] Huxley, *Proceedings of the Royal Society*, May 27, 1852; *Philosophical Transactions*, 1853, p. 45.

[6] Ibid., p. 46.

wing-shaped fins, or locomotive muscular expansions in the *Clio* and other *Pteropoda*. The grounds for these special homologies are not detailed in the paper cited: the conclusions themselves are indicated in *Phil. Trans.*, 1853, pl. v., by the symbols *pp*, *ms*, *mt*, and *ep*, to the four parts, as above successively enumerated.

The difficulty, not to say impossibility, of assigning adequate proofs for such homological propositions depends upon the principle, that the general substance of a Mollusk, and the absence of internal firm parts, influence or relate to the development of muscular tissue according to a teleological rather than a homological principle,—as when a part for adhesion, a part for creeping, a part for swimming, a part for seizing, a tube for expulsion of fluid, &c., is developed, where wanted, agreeably with the exigencies and the sphere of life of the species. This principle plainly guides such developments, viewing the molluscous province generally, more than that law of adhesion to a common pattern which enables the anatomist to view the wing of the bird, the fin of the whale, the fore-paw of the lion, and the hand of man, as answerable parts,—modifications of the same "diverging appendage."

Where grounds for determining homologies, like those which support such generalizations in the vertebrate province, are wanting in the molluscous province, it is better to abstain from speaking of parts as "homologous" until sufficient evidence of homology can be assigned.

To call the four dorsal arms of a dibranchiate Cephalopod "propodium," the four ventral ones "mesopodium," the two tentacles "metapodium," the funnel "epipodium," adds nothing to the true knowledge of cephalopodous structure, but is a retrograde step, analogous to many of those made by De Blainville, which have left only a heap of useless terms, tending to encumber science, until finally swept away into the bin of oblivion.

The figure of the general archetype, or common plan of the Mollusca, *e.g.* in the *Philosophical Transactions* of 1853, pl. v., gives a straight intestine with opposite orifices, the anus being terminal at what would be the caudal end of the body in *Articulata* and *Vertebrata*. But the most common or archetypal characteristic of the intestine in the *Mollusca* is its being bent upon itself, with the anus more or less directed towards, and in proximity with, the mouth.

A straight intestine, with opposite terminal outlets, is more common or archetypal to animals generally; but it is just the reflected deviation from this general animal plan of intestine that particularly typifies the molluscous province. A bent intestine does not imply an excessive development of gut; that of the Ascidian and of the Cephalopod is shorter proportionally to the body than is the straight gut of the articulate worm or Crustacean.

Any one who may dissect the common cuttle-fish (*Sepia*), or squid (*Loligo*), will appreciate the remark, that it is not because of any excessive development that the gut is bent and the anus directed towards the mouth; it must have been more developed in length to reach the caudal end of the body. But such disposition is not typical of the *Mollusca* generally.

When the archetype of a group of animals is proposed to show or embody "all the organs and parts which are found in the group, in such a relative position as they would have if none had attained an excessive development," the student requires the standard according to which the "excess" is to be judged. If the proposer of the archetype has no standard to give, his definition has no value.

Another retrogade step in quest of a sound knowledge of the *Mollusca* has been the borrowing of well-defined terms, previously restricted to exemplify the vertebrate and articulate archetypes, and their application to illustrate the proposed molluscous one. Thus, supposing the alimentary canal, from the mouth to the bend of the intestine, to indicate the division of the body into a part *above* and a part *below* such alimentary canal in the slug or snail creeping on level ground, that part in which the functionally most important mass of the nervous system is developed—the supercœsophageal brain or ganglionic mass, which, by its connection with the optic, gustatory, and sometimes acoustic nerves, bears the closest analogy with the fish's brain—has been proposed to be called the "hæmal" side of the slug, and the opposite or under part the "neural" one.

No doubt the upper part of a slug, in which the eyes and feelers, or special organs of exploration, together with the part most like, in function, the pros- and mes-encephalon of fishes, may not be strictly homologous with the dorsal or neural surface of the fish. Such surface in the slug bears a different relation to the vent, the breathing organ, the heart, and, whilst embryonic, to the vitellicle or *vesicula umbilicalis*. But in animals developed on plans so different as the vertebrate and the molluscous, it may be doubtful whether strict homology can be predicated of any organ or part of the body in the two provinces.

What we call *cor*, the "heart," of a snail, is similar in some degree to that of the fish; it has a similar muscular and valvular bilocular structure, and in both it serves for the propulsion of blood. But in the snail the auricle receives the blood from the breathing organ (lungs), and the ventricle propels it over the body; whilst in the fish the auricle receives the blood from the body generally, and the ventricle propels it to the breathing organ (gills). The parts are to a certain extent "analogous organs," and have thereby received the same name, "heart." The circumstances attending the development of the heart, respectively, in the Mollusk and Fish, equally forbid our regarding such heart as strictly "homologous" in the two types. If such homology had existed in nature, there would then be reason in the assertion, that because the heart is situated on the upper or "brain" side of the snail, instead of on the lower or "belly" side of the body, as in the fish, that therefore such upper side in the snail is the true "hæmal" side, and that the snail is as a vertebrate with its "hæmal" or "belly" side upwards.

But the heart of the snail is not the same organ, in the homological sense, as the heart of the fish; it does not therefore determine the same side of the body. It might be less inaccurate to regard it as homologous with the pulsating lymphatic heart which is situated on the dorsal side of the vertebral column in some fishes and batrachians.

An equally retrograde step, as breeding confusion by false analogies and by forced and arbitrary double applications of previously well-defined and well-understood terms, is that proposition which would borrow those of "abdomen" and "post-abdomen" from the articulate archetypal nomenclature, and apply them to parts of the diagrams illustrative of the archetype of the Mollusca.

In the Essay alluded to, the "abdomen" of the Mollusk is defined as "that portion of the hæmal" (meaning *dorsal*) "region which lies in front of the anus:" to that which lies behind it the term "post-abdomen" is applied. Let the student cut off so much of a squid or cuttle as lies behind the anus, and perform the same operation on a whelk; let him then compare the parts which will be included in so much of the common visceral cavity as he will in each case have removed. When he finds that in both he has brought away the stomach, the liver, the heart, the chief generative glands, &c., then let him endeavour to decipher the sense of the proposition, that in the Cephalopod "the intestine has a *neural* flexure in consequence of the development of an abdomen;" whilst in the pectinibranchiate Gastropod "the intestine has a *hæmal* flexure in consequence of the development of a 'post-abdomen.'" If he be successful in comprehending the agreement between these propositions and the nature of the things treated of,

Introduction.

he may better appreciate than the present writer such modes of illustrating the molluscous archetype.

Were the position of the vent homologically the same in all Mollusks, or even in all Gastropods, then that orifice would truly define two regions of the body, and the part in front of it might need one name and that behind it another. But when so extremely variable a part of the surface as that in relation with the anal end of the intestine, in a Mollusk, is assumed as a determinate basis for the enunciation of archetypal or homological propositions, the warmest aspirant for the progress of philosophical anatomy must doubt whether it has been made in the right direction by such guidance.

In the actual state of Zoology and Comparative Anatomy the same terms are, without doubt, applied to different things in different provinces of the animal kingdom; but those terms are not such as have been rigorously defined for a special or technical signification. Thus we speak of the wings of insects and the wings of birds, and of the legs of insects as of quadrupeds,—knowing all the while that the wings of the beetle are not homologous with those of the blackbird, any more than its hind legs are homologous with those of a horse.

Severe logic would call for distinct names for things so different in their structure and development; but one may ask, Will it be more successful than it has been in other matters where it is opposed to common sense? There is a wise moderation that knows how to avoid the greater evil, by drawing a line beyond which precision of terms would be pedantic purism.

The back of a beetle may not possess all the relations to the organs within, which the back of a mole does; but its analogical similarity, like that between the wing of the beetle and the wing of the bird, will insure the permanence of the corresponding term.

So also with regard to the "foot" and "belly" of the Gastropod. If indeed anatomy could demonstrate intelligibly and satisfactorily to its cultivators the part in a snail which was truly homologous with the ventral surface, or with the foot of a vertebrate, we should be bound to restrict those terms to the so demonstrated homologous part. But in the absence of such demonstrations, science in no degree halts through the application of the same general terms, in a few instances, to parts which have a general and patent analogy, though not a strict homology, in different provinces of the animal kingdom.

In the present article the end of the body of the Mollusk, at or near which the mouth opens, is the "fore" or "anterior end;" the opposite is the "hind" or "posterior end." Where the nervous system is reduced to one ganglion, its position in regard to the alimentary canal indicates the *lower* or *ventral* surface of that canal and of the corresponding side of the body; where another ganglion, in connection with antennal and optic nerves, is developed, it is on or near the opposite side of the alimentary canal to that occupied by the homologue of the first or solitary ganglion, and such superadded—usually called "superœsophageal" or "cerebral"—ganglion marks the *upper* or *dorsal* surface of the alimentary canal, and of the corresponding side of the body.

The "abdomen" is the common cavity of the body which includes the stomach, intestine, liver, and generative gland; and is distinct from the respiratory cavity, which is usually more or less completely partitioned off from the abdomen.

Special homologies can be determined throughout the molluscous province in regard to the principal centres of the nervous system, to the mouth, to the alimentary canal and vent, to the liver, and some other glands. But it is not so certain that other parts bearing the same name in the molluscous province are truly answerable. The *branchiæ* of the ship-worm (*Teredo*), for example, are analogous in function, but may not be strictly homologous with the *branchiæ* of the whelk or cuttle-fish; neither can the breathing-tube or "siphon" of the *Teredo* be proved to be the same part homologically with the siphon of the whelk or the funnel of the squid. There is perhaps more ground for inferring that the muscular mass developed from the under or ventral part of the abdomen in most Bivalves is homologous with, as well as analogous to, the muscular part which bears the same name, "foot," in Gastropods.

But whatever doubt may linger regarding the precise homology of the "foot" of a Bivalve and that of an Univalve Mollusk, there can be none respecting the homology of the foot within the limits of the same class. We may trace it as essentially the same part from species to species, from its most rudimental to its most developed state, and under every modification of form, throughout the acephalous or lamellibranchiate Bivalves; and the like with regard to the foot throughout all its modifications in the encephalous Gasteropoda and Pteropoda.

With respect to the Cephalopoda, the chief muscular part of the body forms a conical sheath, containing the retractile mouth or buccal mass, and its more immediate appendages. The inner surface of the sheath is smooth; the outer one gives origin to many parts or processes. When it is found that, in the Gastropods, the acoustic nerves are given off from superœsophageal ganglia in one order (*Heteropoda*), and from subœsophageal ganglia in another (*Pulmonata*), the homology of any of the cephalic muscular developments of the Cephalopods with the foot, or part of the foot, of the Gastropods, will not be established by a similarity in the origin of their nerves; but there will be no misgiving as to the cephalic sheath and its appendages being homologous parts within the limits of the cephalopodous class.

The more special definitions of such homology is a legitimate and useful subject of research. When, in reference to the numerous sheathed tentacula which project from the muscular cephalic cone of the nautilus, it is suggested that the sheath is a much-developed sucker (*acetabulum*), and that the tentacle is the homologue of the caruncle of the sucker on the arms of the dibranchiate Cephalopod, one mode of expressing a sense of the homology of the parts throughout the cephalopodous class is given. According to this view, the anterior circumference of the oral sheath in the nautilus represents four of the eight arms developed therefrom in the cuttle-fish, the four other arms being represented by the four groups of tentacula which are included within the oral sheath in the nautilus.[1]

To this view, while admitting that the oral sheath and its appendages are homologous parts in all Cephalopods, it has been objected[2] that the origin and connection of the inner groups of tentacula in the nautilus correspond better with those of the two long superadded tentacula than with any of the eight ordinary arms in the cuttle-fish, and that each tentacle corresponds, in its complex organization and in the special modification of its inner surface, rather with an entire arm of the dibranchiate Cephalopod than with the caruncle of one of its suckers. According to this view, the more numerous, though comparatively small, tentacles of the nautilus illustrate, in comparison with the fewer and larger tentacles or arms of the dibranchiate Cephalopod, the principle of vegetative repetition. The reduction of the cephalic appendages in number as the Mollusk rises in the scale of the class, their increase in size, and their per-

[1] Valenciennes, Nouvelles Recherches sur le Nautile Flambé, *Archives du Muséum*, 4to, 1839.
[2] Owen, on the Structure and Homologies of the Cephalic Tentacles in the Pearly Nautilus, *Annals of Natural History*, vol. xii., 1843.

fection as prehensile instruments through the superadded suckers, are phenomena which usually attend the march of development.

The pair of fin-like musculo-dermal organs developed from the sides of the body in *Sepiola* are analogous to those in *Pneumodermon;* and if homology could be predicated of musculo-dermal developments in the two classes, the fins of the *Sepiola*, rather than the funnel, would so answer to the fins of the Pteropod. The disc beneath the part of the abdominal integument supporting and inclosing the shell in *Spirula* would seem, in like manner, to be more homologous than the cephalic arms with the ventral disc called "foot" in the *Carinaria.* The derivation of acoustic nerves from the subœsophageal part of the brain inclosed in the cartilaginous skull of the cuttle-fish is as little proof of the homology of such part with the pedial ganglion of a Gastropod as with the superœsophageal ganglion of a Heteropod. No homology will stand or carry conviction, the predication of which involves a suppression or a forced explaining away of opposing facts.

If the homology of the muscular cephalic cone and its appendages in Cephalopods with the muscular ventral disc of Gastropods, cannot therefore be demonstrated; and if the predication of special homologies can only be safely and intelligibly made within the limits of the class, not extended from one molluscous class to another, to the degree in which homologous parts can be traced in the Vertebrata, it is owing to the very nature of the classes of the *Mollusca.* They are more distinct from one another than are the classes of the *Vertebrata;* they exhibit more different, more strongly marked, modifications of the molluscous organization. Above all, differences of structure in the *Mollusca,* and especially the developments of dermo-muscular parts, are, in a much greater degree than in the *Vertebrata,* subordinated to the principle of the conditions of existence, of the reciprocal convenience of parts, of their fitness for the mode and medium of life of the molluscous animal; in a word, are more obedient to teleological than to homological laws.

Every history has its retrogressive as well as its progressive phases; the former have necessitated the foregoing comments.

In resuming the brief account of the real advance of Malacology in recent times, mention ought first to be made of the valuable and beautiful illustrations of the forms, colours, and structure of the new and rare *Mollusca* collected by the scientific naturalists Péron and Lesueur,[1] Quoy and Gaimard,[2] Eydoux and Souleyet,[3] respectively attached to the circumnavigatory voyages instituted by the French government under Baudin, D'Urville, Freycinet, and Vaillant. Their example has been ably followed by Messrs Adams and L. Reeve in the *Mollusca of the Voyage of H.M.S. Samarang,* 4to, 1848–1850.

The figures of the molluscous animals given in these and other original works have been accurately copied, and published in a most useful compendium, in 4 vols. 8vo, by Mrs Gray,[4] the accomplished wife of the learned and experienced Keeper of the Zoology in the British Museum.

Baron Férussac has enriched Malacology with a beautiful work in folio, with coloured plates, entitled *Mollusques Terrestres et Fluviatiles,* of which the last published part, by the Baron, in conjunction with M. Alcide D'Orbigny, treats of the Cephalopods.

Signor Verany[5] has commenced a splendid work, worthy to be regarded as a continuation of that by Férussac and D'Orbigny, on the Mediterranean *Mollusca.* The first part includes upwards of forty plates of Cephalopods, carefully coloured after the living or recently caught animals.

A work of equal beauty and merit on British Nudibranchiata, by MM. Alder and Hancock, has been published by the Ray Society.

Our accomplished countryman, W. J. Broderip, Esq., F.R.S., lately retired from his arduous duties as police magistrate at Westminster, has taken a praiseworthy share in the advancement of his favourite science, by devoting his scanty leisure to an extensive series of most exact and classical descriptions of new species of Mollusca and their shells, chiefly collected by Mr H. Cumming, and published in the *Transactions* and *Proceedings of the Zoological Society of London.* His purse was as liberally opened to secure the rarest specimens of shells brought to the port of London, up to the period when his well-known and most instructive collection was purchased by the British Museum. The several valuable articles on Malacology and Conchology in the *Penny Cyclopædia* are also from the pen of Mr Broderip.

The names of James de C. Sowerby, and of George B. Sowerby, will always be favourably associated with the progress of the molluscous department of natural history. Besides numerous monographs by these authors, the serial works, entitled *The Genera of Recent and Fossil Shells,* the *Species Conchyliorum,* the *Mineral Conchology of Great Britain,* the *Malacological and Conchological Magazine,* and the *Conchological Illustrations,* are indispensable to whoever may devote himself to the study and collection of Mollusca and their shells.

M. L. C. Kiener has beautifully illustrated the conchological treasures of Lamarck and of M. Delessert in his *Species Général et Iconographie des Coquilles Vivantes.* Mr Lovell Reeve has performed a similar desirable work in regard to rarities in English conchological collections, and to Conchology in general, in his *Conchologia Systematica, Conchologia Iconica,* and *Elements of Conchology.* He is also the author of numerous valuable monographs on subjects of the molluscous province.

The intimate structure of shell has been elaborately and extensively illustrated by Dr Carpenter,[6] Mr Bowerbank,[7] and Professor Quekett.[8]

Professor Agassiz has, with his characteristic originality, lent valuable aid to the study of recent and fossil shells by his *Mémoir sur les Moules de Mollusques, Vivans et Fossils,* in which the markings of the interior of shells are instructively displayed. The *Etudes Critiques sur les Mollusques Fossiles,* by the same author, will be found most useful to whoever may be engaged in the elucidation of Geology by Conchology.

The study of the collection of Mollusca and their shells in the British Museum is now greatly facilitated by the catalogues of that department which have been drawn up or edited by Dr J. E. Gray, F.R.S.[9]

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[1] *Voyage de découvertes aux Terres Australes,* 4to, 1800–1807.

[2] *Zoologie du Voyage de l'Uranie,* 8vo and fol., 1824-1827; and *Zoologie du Voyage de l'Astrolabe,* 8vo and fol., 1830–1833.

[3] *Zoologie du Voyage de la Bonite,* 8vo and fol., 1841–1852.

[4] *Figures of Molluscous Animals,* selected from various authors, 8vo, Longmans, 1842–1850.

[5] *Mollusques Mediterranéens,* 4to, 1re Partie, "Cephalopodes," 1851.

[6] On the Microscopic Structure of Shells, *Reports of the British Association,* 8vo., 1844 and 1847.

[7] Observations on the Structure of Shells, *Trans. of the Microscopical Society,* vol. i., 1844. [8] *Lectures on Histology,* 8vo, 1853-54.

[9] *Guide to the Systematic Distribution of Mollusca,* part i., by Dr Gray, F.R.S.; Catalogues of the *Cephalopoda antepedia,* of the *Pteropoda,* of *Placuniadæ* and *Anomiadæ,* and of *Brachiopoda Ancylopoda,* by Dr Gray; of the *Pulmonata* or Air-breathing Mollusca, by Dr L. Pfeiffer; of the Terrestrial Operculated Mollusca, by Dr L. Pfeiffer; of the *Conchifera* or Bivalve Shells, by M. Deshayes; *List of British Mollusca and Shells,* by Dr Gray, F.R.S.; *Nomenclature of Mollusca,* by Dr W. Baird, F.L.S.; *Catalogue of Mazatlan Shells,* by P. P. Carpenter.

The more intimate knowledge of the nature and affinities of the Mollusca has of late years been signally promoted by the series of researches on the embryology or development of those animals, more especially those by Rathké,[1] Carus,[2] Sars,[3] Dumortier,[4] Van Beneden,[5] Milne Edwards,[6] Lovén,[7] Windischman,[8] Koren and Danielssen,[9] Gegenbaur,[10] Schmidt,[11] Vogt,[12] and Quatrefages.[13]

The knowledge of the varying forms of the living Mollusks, of their habits and powers, has been increased, and is likely to be materially advanced, by the rapidly extending practice of preserving them in confined spaces of sea or fresh water. Poli, Montagu, and before them probably other lovers of nature, resident near the sea, availed themselves of large vessels to keep alive, in frequently renewed sea-water, the marine animals in the study of which they were interested. But to Madame Jeanette Power (née de Villepreux), according to the testimony of Professor Carmelo Maravigna, in the *Journal du Cabinet Litteraire de l'Academia Giania*, of Catania, for December 1834, ought to be attributed, if to any one individual, the invention and systematic application of the receptacles now called Aquaria, to the study of marine, and principally of molluscous animals.

Madame Power invented three kinds: one of glass, for preserving and studying living Mollusca in a room; another, also of glass, for small Mollusks, protected by an external cage of bars, in which they could be kept submerged in the sea, and withdrawn at will for inspection; and a third kind of cage for larger Mollusks, which could be sunk and anchored at a given depth in the sea, and raised, when required, for the purpose of observation and experiment. With these different kinds of molluscous menageries, of which the first answers to our present improved and enlarged aquaria, Madame Power carried on her observations and experiments from the year 1832 to 1842 at Messina in Sicily.

She determined the question of the true relation of the *Argonauta*, or Paper Nautilus, to the delicate boat-like shell which it inhabits. She first showed that the so-called "sails" were normally applied over the exterior of the shell, and proved experimentally that they were the organs which formed and repaired the shell.[14] She proved that the *Bulla lignaria* preyed upon, and by its strong gizzard ground down and digested, the *Dentalium entale*. She described the curious manœuvres by which the *Astropecten aurantiacus* seized and conveyed to its mouth and stomach small *Naticæ*. And many other interesting facts were brought to light by this persevering and ingenious observer, through the application of the "Gabioline alla Power,"[15] as her aquaria were termed by the Giœnian Academy, some years before the practice of so studying aquatic animals was introduced and diffused in this country.

The scale on which our improved manufactures of plate-glass have enabled the Zoological Society of London to exhibit living specimens of rare and beautiful marine and fresh-water animals, has struck with admiration the thousands who have witnessed them in the gardens of the Regent's Park.

The management of such aquaria is ably treated of by Mr Warington in the *Annals of Natural History* for 1855, and the instruction and amusement to be derived from them have been illustrated in a most agreeable and interesting style, in popular works, by Messrs Gosse and Sowerby.

The series of works from the establishment of Mr V. Voorst, illustrative of the Fauna of Great Britain, has been enriched by most valuable volumes on the British *Mollusca* by Professor E. Forbes and Mr Hanley.

Dr Johnston[16] and Mr Woodward[17] have compiled most instructive elementary works on general Malacology; both characterized, and the latter more especially, by careful and original research.

Of the illustrations of particular groups of Mollusca in circumscribed localities, those devoted to the fresh-water family *Naiades*, and especially to the genus *Unio*, of the North American rivers, by Mr Isaac Lea, possess the highest value.

Few individuals have contributed so much to the progress of Malacology, since the demise of Cuvier, as Mr Hugh Cuming, F.L.S. His famous collection of shells is known throughout Europe: it contained in 1848 upwards of 19,000 species and well-marked varieties of shells, represented by about 60,000 specimens, which are not only entire, but perfect of their kind, as respects form, texture, colour, and other characters that give the shell value in the eyes of the collector. The mode in which Mr Cuming has accumulated this surpassingly rich illustration of Conchology is as rare and exemplary as the result is marvellous, considered as the work of one individual. Not restricting his pursuit of shells to the shops of the commercial naturalist, the stores of the curiosity-mongers of our seaports, or the casual opportunities of obtaining varieties by purchase, he has devoted more than thirty years of his life in arduous and perilous personal exertions,—dredging, diving, wading, wandering, under the equator, and thence to the temperate zones, both north and south,—in the Atlantic, in the Pacific, in the Indian Ocean, and in the islands of its rich Archipelago,—in the labour of collecting from their native seas, shores, lakes, rivers, and forests, the marine, fluviatile, and terrestrial Mollusks, 60,000 of whose shelly skeletons, external and internal, are accumulated in orderly series in the cabinets which now test the strength of the floors of his house in Gower Street, London.

The result of this personal capture of the chief bulk of his collection is, that he has been enabled to assign to each

[1] *Om Dammuslingen*, *Skrivter of Natur-Historie Selskabet*, Kjobenh., 1797.
[2] Neue Untersuchungen über die Entwickelungsgeschichte Unserer Flussmuschel, *Nova Acta Acad. Nat. Cur.*, tom. xvi., 1832.
[3] Zur Entwickelungsgeschichte der Mollusccn und Zoophyten, Wiegmann's *Archiv fur Naturgesch.*, 1837–1840.
[4] Sur les evolutions de l'Embryo dans les Mollusques Gastropodes, *Nouveaux Mémoires de l'Acad. Roy. de Bruxelles*, tom. x., 1837.
[5] *Recherches sur l'Embryogénie des Ascidies simples*, 1847; and *Recherches sur le Developpement des Aplysies*, 1841.
[6] *Observations sur les Ascidiens Composées*, 1840.
[7] Ueber die Entwickelung der Mollusca Acephala, Wiegmann's *Archiv fur Naturgesch.*, 1849.
[8] Recherches sur l'Embryologie des Limaces (with Van Beneden), Müller's *Archiv fur Physiologie*, 1841.
[9] *Bidrag til Pectinibranchiernes Udviklingshistorie*, 8vo, 1851-1852.
[10] *Beiträge zur Entwickelungsgeschichte der Land Gastropoden*, 1852.
[11] *Ueber Entwickelung von Limax agrestis*, 1851.
[12] Recherches sur l'Embryogénie des Mollusques Gastropodes, *Annales des Sciences Nat.*, 1846.
[13] Sur la vie intrabranchiale des petites anodontes; and Mémoire sur l'Embryogénie des Planorbes et des Limnées, *Annales des Sciences Nat.*, 1835, 1836, and 1841.
[14] *Ragguaglio delle Osservazioni ed esperienze fatte sullo Argonauta Argo* (L.) *da Madama Jeannette Power*, Prof. C. del Maravigna, Messina, 8vo, 1836. See also *Atti Accademici Catania*, 1838.
[15] *Relazione per l'anno 13, dell' Accademia Gionia*, Catania, 1837; Abstract of *Osservazioni fisiche sopra il polpo dell' Argonauta Argo, Lette nella tornata de 26 Novembre* 1836, p. 25.
[16] *An Introduction to Conchology; or, Elements of the Natural History of the Molluscous Animals.*
[17] *Manual of the Mollusca*, 12mo, 1851–1856.

Introduction.

shell, not only its country or "habitat" in the ordinary zoological sense, but all the circumstances in which it lived and was developed. If a land-shell, *e.g.*, its favourite rock, or herb, or tree; if a water-shell, the kind of water; and if marine, the habitual depth, and the nature of the sea-bottom at which the Mollusk resided, the rock that it bored, and the animals, the weeds, or other substances it devoured. The value of every shell, in other collections, to which this information applied, became thus greatly enhanced. The importance of these particulars every naturalist and geologist will appreciate on account of the insight that they afford, not only into the economy of living Mollusks, but into the habits and habitats of the fossil shells of the same or allied species; and perhaps one of the most striking points in the estimate of the scientific value of an extensive collection like Mr Cuming's, arises out of its relation, as an indispensable instrument to the determination of fossil shells, to the present active pursuit of Geology.

From the period when the Atlantic, American, and Polynesian departments of the Cumingian collection reached England in 1831, comparative anatomists, malacologists, and conchologists have found subjects, without intermission, for their investigations and descriptions. The organization of the parasitic *Stylifer*, of *Spirula*, *Calyptræa*, *Lithedaphus*, *Clavagella*, and other rare Mollusks, was brought to light through the specimens which Mr Cuming had preserved in spirits. Almost every part of the *Transactions*, and every number of the *Proceedings of the Zoological Society of London*, since the year 1832, contain the descriptions, by Broderip, Sowerby, and Owen, of the novelties liberally submitted to those naturalists by Mr Cuming. And such novelties were far from being exhausted when Mr Cuming, having undertaken a third exploring voyage, returned in 1840 from Manilla, stored with the conchological riches of the Indian Ocean, which have subsequently kept in activity the eyes and pens of Broderip,[1] Sowerby,[2] Pfeiffer,[3] Lovell Reeve,[4] Adams,[5] Dunker,[6] and Philippi.[7]

Of the rare or unique species thus made known to science, Mr Cuming is the possessor, in most instances, of many individuals; and as "dead" shells, or those found without the animals, are strictly excluded from his cabinet, his stores of unique and beautiful specimens give him the command, so to speak, of all the conchological cabinets of Europe. In his annual visits to the Continent, Mr Cuming carries with him the duplicates of his rarities, representing species with the sight of which the eyes of foreign naturalists are gladdened for the first time. They open to him their treasures in return, and from most of the collections—national and private—of Europe Mr Cuming has borne away rare species he did not before possess, in exchange for the still rarer shells which his abundance has enabled him to offer in exchange without detriment to his own rich stores.

His liberality in opening those stores to the student of Conchology equals the enterprise and intelligence with which they have been brought together; and the Cumingian collection is likely long to remain the most important and instructive in Europe for the advancement of the science of the Mollusca.

Mr Van Voorst has brought out, with his usual excellence of type, and more than his usual beauty and costliness of illustration, so much of the *Genera of Recent Mollusca*, by H. and A. Adams, as relates to Cephalopods and Univalves generally, including descriptions of 680 genera and 437 sub-genera; the number of species average nearly 12 to each genus and sub-genus, and altogether exceeds 13,000. The first part of this work was published January 1, 1853.

A considerable proportion of these species are represented by specimens in the Cumingian collection; about half the number are in the British Museum. Besides the shell of each genus, the operculum, when known, is given, and many figures of the living animals have been selected from the best original works.

The classification adopted in this work does not offer any modification based upon original appreciation of structure and affinities overlooked by preceding authors. Inasmuch as the proposed changes are chiefly those of names, and where otherwise, are opposed to deductions from the anatomy of the animals, this part of the work is a retrogade step. Thus the class *Cephalopoda* is divided into the orders—*Octopoda*, *Decapoda*, and *Polypoda*. Now, besides the inconvenience of the same terminology for a class and its orders, we have here a virtual affirmation that the difference of structure between the Poulp (*Octopus*) and the Calamary (*Loligo*) is not less important than that between the *Octopus* or *Loligo* and the *Nautilus*. By the proposed foundation of the orders of the *Cephalopoda* in 1832 on characters of the respiratory system, Professor Owen sought to harmonize the divisions of the highest class with that of the other classes of Mollusca.[8] The term *Polypoda*, moreover, is that which has been given by Gistel and Aristotle, *e.g.*, to the dibranchiate Cephalopods, or to particular families of them.

In the sale-catalogue of the Yoldi collection of shells by M. Otto Mörch, names that had been applied by old and obscure writers to shells prior to the imposition of generic names on the founding of the Linnæan binomial system, are added, inclosed in brackets, after those names by which the objects are intelligible to Conchologists generally. The Messrs Adams have disfigured their work by the substitution of these justly and practically obsolete terms for many of the well-established generic names applied since the Linnæan system has been in use.

As it may aid in explaining and diffusing the principles upon which the stability of conchological nomenclature is attempted to be preserved by the more judicious cultivators of Zoology, the following list of names offered by the authors of the *Genera of Recent Mollusca*, as substitutes for the accepted names, is appended, together with the comments of a judicious critic, in which the author of the present article entirely coincides:—

Names in use.	Names proposed by Messrs Adams.
Hyalea, Lam. 1799	*Cavolina*, "Gioeni" (not of Bruguière, 1792).
Cleodora, Péron, 1810	*Clio*, "Browne" (not of Linn., Müll., Fabr., Brug., Cuv., Lam., Desh., or any other conchologist of note).
Creseis, Rang, 1828	*Styliola*, Lesueur (teste Blainville).
Cuvieria, Rang, 1827	*Triptera*, Q. & G. 1824.[9]
Clio, Linn. 1767	*Clione*, Pallas, 1774.

[1] Descriptions of Shells collected by H. Cuming, Esq., in the Philippine Islands, *Zool. Proc.*, 1840, pp. 83, 94, 119, 155, 180; Ibid., 1841, pp. 22, 34, 36, 44, &c.

[2] Ibid., 1840, pp. 87, 96, 116, 135, 167; 1841, pp. 1, 17, 19, 24, 39.

[3] Ibid., 1846, pp. 28, 37, 41, 109.

[4] Descriptions of 40 new species of *Haliotes*, collected by H. Cuming, Esq., *Zool. Proc.*, 1846, p. 53; Descriptions of 54 new species of *Mangelia*, collected by do., ibid., p. 59.

[5] Descriptions of new species of Shells, collected by H. Cuming, Esq., *Zool. Proc.*, 1849, p. 169.

[6] Diagnoses specierum novarum generis Planorbis Collectionis Cumingianæ, *Zool. Proc.*, 1848, p. 40.

[7] Descriptiones Naticarum quarundam novarum ex Collectione Cumingiana, *Zool. Proc.*, 1851, p. 233. The notes are limited to a few references to the Cumingian memoirs by the above-cited Malacologists, as being sufficient to indicate the richness of the new materials collected by Mr Cuming.

[8] *Memoir of the Pearly Nautilus*, 4to, 1832.

[9] This name was given to an imperfect and misunderstood specimen. In the same plate and in the same page, the authors figured and described the perfect *Cuvieria* under the name of *Cleodora obtusa*, showing they had no intention of founding a genus (in *Triptera*) equivalent to *Cuvieria*.

Introduction.

Names in use.	Names proposed by Messrs Adams.
Melongena, Sch. 1817	*Cassidulus*, Humph. (not Lam., Fér., or Latr.)
Pleurotoma, Lam. 1799	*Turris*, Humph. (*Cophinosalpinx*, Kl. 1753).
Triton, Montf. 1810	*Tritonium*, Link (not Lovén); *Buccinum*, Kl.
Ranella, Lam. 1812	*Bursa*, Bolten (not Bonanni or Petiver).
Ricinula, Lam. 1812	*Pentadactylus*, Kl. 1753. (Also *Tribulus*, Kl.)
Monoceros, Lam. 1809	*Acanthina*, Fischer, 1817 (*Thais*, Bolten, 1798).
Concholepas, Lam. 1801	*Conchopatella*, Chemnitz !
Magilus, Montf. 1810	*Campylotus*, Guett.[1] (*Tubulites*, Davila).
Oliva, Brug. 1789	*Dactylus*, Kl. (*Cylindrus*, Breynius).
Ancillaria, Lam. 1811	*Ancilla*, Lam. (olim).
Fulgur, Montf. 1810	*Busycon*, Bolten.
Cynodonta, Schum	*Vasum*, Bolten.
Turbinella, Lam. 1799	*Massa*, Klein.
Pyrula, Lam. 1799	*Sycotypus*, Browne, 1756 (*Ficus*, Kl. 1753).
Sigaretus, Lam	*Catinus*, Ad. ("Catinus-lactis," Klein).
Cassidaria, Lam. 1812	*Galeodea*, Link (not Martini or Bolten).
Oniscia, Sby. 1825	*Morum*, Bolten, 1798 (*Cassidea*, Brug. 1792).
Scalaria, Lam. 1801	*Scala*, Klein.
Solarium, Lam. 1799	*Architectonica*, Bolten (*Nerita*, Kl. 1753).
Pterocera, Lam. 1799	*Harpago*, Kl. (Also *Heptadactylus*, *Radixbryoniæ*, &c.)
Rostellaria, Lam	*Gladius*, Kl.
Ovulum, Brug. 1789	*Amphiperas*, Gron. 1781 (*Porcellana*, Kl.)
Pirena, Lam. 1812	*Faunus*, Montf. 1810 (young shell).
Paludina, Lam	*Vivipara*, Lam. (olim), *Saccus*, Klein !
Siliquaria, Brug. 1789	*Tenagoda*, Guett. (*Solen-anguinus*, Kl.)
Crepidula, Lam. 1799	*Crypta*, Humph.
Hipponyx, Defr. 1819	*Cochlolepas*, Kl.
Neritina, Lam. 1809	*Neritella*, Humph. (*Vitta*, Kl. 1753).
Navicella, Lam	*Catillus*, Humph.
Phasianella, Lam. 1804	*Eutropia*, Humph.
Rotella, Lam	*Umbonium*, Link.
Delphinula, Lam. 1803	*Angaria*, Bolten (*Cricostoma*, Kl.)
Puncturella, Lowe, 1827	*Cemoria*, "Leach" (Sw. 1840).
Parmophorus, Bl. 1817	*Scutus*, Montf. 1810.
Acmæa, Esch. 1833	*Tectura*, Aud. & M.-E. (not defined).
Tornatella, Lam. 1812	*Actæon*, Montf. 1810 (*Solidula*, Fisch.)
Doridium, Meckel	*Aglaia*, Renieri.
Umbrella, Lam. 1812	"*Operculatum læve*," Mus. Tessin.
Goniodoris, Forbes	*Doriprismatica*, D'Orb. ("voc. pravum." Herrm.)
Antiopa, A. & H	*Janus*, Verany.
Embletonia, A. & H	*Cladia*, Lovén (not the same thing).
Firola, Brug. 1792	*Pterotrachea*, Forsk.
Auricula, Lam. 1799	*Ellobium*, Bolten (*Auris-Midæ*, Kl.)

"The names thus introduced by the authors are of three kinds:—Some are taken from works published before the time of Linnæus; others were never characterized, and come under the denomination of 'MS. names;' while a few were published under peculiar circumstances, so as to escape observation, and have become obsolete.

"With respect to pre-Linnæan names it is unnecessary here to advocate the practice adopted by all the best naturalists; we will only hint the extreme inconvenience of a nomenclature ever liable to change, and ever receding into the obscurity of olden literature. If the names of Klein are to be adopted, why not those of Langius and Davila, and Breynius, Bonanni, and Petiver? And if some of Klein's names are used, why not all?

Tunicata.

"The question of manuscript names is more difficult, owing to wilfulness of authors. One says it is sufficient to write a new generic name on a tablet and shut it up in his cabinet,—it is to be *dated* from that act.[2] Another distinguished professor of an English university holds that to inscribe the name on a *museum* specimen is a sufficient act of publication, leaving the determination of the date to the memory of the curator. Some consider the insertion of a new generic name in a catalogue, without a word of description, without even a specific name attached, is sufficient to give 'priority.' Others, more modestly, admit the desirableness of the addition of a known specific name, but do not consider any description necessary; any one that pleases may find out the characters of the new genus, and if it has none, it is but one more name added to the synonymy.

"The genera of Humphrey, quoted in the foregoing list, appeared in the *Museum Calonneanum*, a catalogue published anonymously in the year 1797, and containing names only, without definitions. Names attributed to Bolten are also supposed to be taken from a catalogue. We have found the name 'Gevers' placed as the authority for Meuschen's names in the *Mus. Geverianum*, and 'Berlin' for Link's names in the Berlin Museum. But who wrote the *Museum Boltenianum*?

"The Linnæan code, of which Herrmannsen gives an excellent digest, and the rules of the British Association, require that names should be really published, and accompanied by a description sufficient to identify the object and justify the imposition of the new term."

The adoption of generic and specific names in the following pages will be governed by those rules.

PROVINCE MOLLUSCA, Cuvier.

(*Heterogangliata*, Owen.)

CLASS I.—TUNICATA, Lam.

(*Acephales sans Coquilles*, Cuvier.)

Acephalous Molluscoids inclosed in an elastic uncalcified tunic, perforated by two apertures, and composed of a peculiar substance resembling the "cellulose" of plants, in having no nitrogen, but only carbon and hydrogen.[3]

Order I.—SACCOBRANCHIATA,[4] Owen.

(Les *Ascidies* and Les *Aggregés*, Cuv.)

Mantle united to the tunic at the two orifices; elsewhere commonly more or less detached. Branchia, a dilated, ciliated, vascular sac, with commonly a tentaculiferous orifice.

Tribe 1.—AGGREGATA, Cuv.

The aggregate, associated, or compound Ascidians (fig. 5) are all of small size. Their organization is essentially like that of the larger solitary species, but the viscera are somewhat differently disposed,—the cavity of the body is in most longer and narrower, the entire animal viewed singly being more vermiform. In their natural organic association they are arranged in different modes, and under different forms characterizing different families. Some, as the beautiful *Diazona*, diverge, like the petals of a compound flower, from a common base; others, as the *Botryllus*, are arranged in circles round a common central aper-

[1] We cannot find any such "genus" in Guettard's Memoirs, but according to Blainville it was merely a name given to a miscellaneous assemblage, including *Vermetus*, *Scalaria*, *Magilus*, &c.

[2] Introduction to D'Orbigny's *Prodrome de Paléontologie*.

[3] Schmidt, *Zur vergleichenden Physiologie der Wirbellosen Thiere*, 8vo, 1845.

[4] Greek, signifying "sack-shaped gills."

ture, beneath which the anal extremity of the intestine of each individual terminates; whilst many of these circles of individuals are aggregated together, and enveloped in a common cellulose tunic. The substance of this in some species, *e.g. Septodinum*, is crowded with calcareous granules; in others, *e.g. Botryllus*, it exhibits distinct fibres.

Some of the compound Ascidians are ramified (as, *e.g.*, *Perophora*, fig. 5), and their tunics are so transparent as to permit the movements of the internal organs to be studied in the living animal. The individuals of this genus are connected only by tubular prolongations of the common tunic, and are rather "social" than "compound" animals. In these a very singular condition of the circulating system has been detected.[1] The blood moves backwards and forwards, to and from the heart, in the same vessels, as it was supposed to ebb and flow in the human veins before Harvey's great discovery. The oscillation of the currents is not constant and regular; the blood is received from the vessel at one end of the heart (fig. 5, *n*), and propelled by a contractile wave into the vessel at the opposite end. After a true circulation has gone on in this course for a certain period, a change is observed in the course of the peristaltic contractions of the heart; the blood for an instant stagnates in the sinuses and vessels, and then the wave travels in the opposite direction; the heart drives the blood into the vessel from which it had before received it, and the course of the circulation is reversed. In the compound Ascidians the vascular systems of the different individuals anastomose freely with each other. The veins are chiefly in the condition of large lacunar sinuses. The heart and vessels circulate blood, not water: if the vessels, as some contend, had no proper tunics (and their transparency in the living Ascidians renders them, in most of the sinuses, invisible), the sea-water which freely passes from the branchial to the muscular cavities would flow into the so-called intervisceral lacunæ were they merely such as they seem.

At first sight it is difficult to conceive how the fixed and compound Ascidians can multiply their race in situations at a distance from that which they themselves occupy.

This difficulty has been removed by MM. Audouin and Milne Edwards, who observed that the young of the compound Ascidians were not only at their origin solitary and free, but possessed the power of swimming rapidly by the aid of the undulatory movements of a long tail (fig. 5, C). They were seen occasionally to attach themselves to the side of the vessel of sea-water containing them, and then to recommence their course, as if to seek a more suitable point of attachment. After two days of free and locomotive life, they finally fixed themselves, and, when detached, remained motionless.

Similar locomotive phenomena are now known to be common to the embryo of many of the lower sedentary animals. In regard to the Ascidians, it has been confirmed by Sars in the *Botrylli* of the coast of Norway,[2] by Sir John Graham Dalyell in a solitary Ascidian of the Firth of Forth; and the embryogeny of the *Cynthia Ampulla* has been well followed out by Professor Van Beneden.[3]

In the genera *Polyclinum* and *Amaroucium*, amongst the compound Ascidians, Milne Edwards has observed that the ovum, whilst still included in the ovarian mass, consists of the small central germinal vesicle, of a granular vitellus, and a vitelline membrane. In the progress of the ovum to the cloacal cavity the yolk acquires a deep yellow colour, the germinal vesicle disappears, and in its place there is a nebulous speck upon the surface of the yolk. The extremity of the yolk opposite to the caudal attachment developes a series of cylindrical productions. Three of them have expanded extremities which increase in length; whilst the other processes diminish, and finally disappear. A spiral filament is continued from the membrane of the vitellus down the centre of the tail. In this state the embryo escapes from the ovum, generally while in the cloaca of the parent, but sometimes after the egg has been expelled from the common central outlet.

The young animal immediately unfolds its tail, and begins to swim like the tadpole of the frog, which it so much resembles in form. The three clavate cephalic processes are the organs by which Milne Edwards believes it effects its final adhesion and settlement. When this has taken place, the tail shrinks, and is usually detached by progressively increasing contraction at its base,—a kind of spontaneous fission.

The sessile and adherent trunk now becomes the seat of an active development. The integument is thickened. The germ-mass becomes elongated and divided by a circular constriction into two unequal parts, which severally open a passage, constituting, the one an oral (fig. 5, *g*), the other an anal (fig. 5, *f*) orifice. The subdivided germ-mass, which now begins to be rapidly metamorphosed into the special tissues, also acquires a distinct tunic *b*, which soon separates itself from the thick and gelatinous external integument *a*.

The quadrifid orifice of the branchial sac (fig 5, *e*) is first formed upon the internal tunic. The contour of the great respiratory pharynx can next be discerned, and the constriction of the sac opposite to the mouth, which indicates the œsophagus (fig. 5, *d*). About the same time may be seen the outline of the anal orifice (fig. 5, *k*) upon the internal integument; then the opaque yellow tunics of the dilated stomach (fig. 5, *i*) and the reflected intestine appear; and below these parts the pulsations of the large transparent vasiform heart (fig. 5, *n*) render that organ conspicuous. Around each external orifice some mammilloid processes (fig. 5, *g'*) bud out, which first lengthen, and afterwards in some species become lost in the thickening integument. The eye-speck continues for some little time, and is situated in the middle of the nervous collar (fig. 5, *k*). At the base of the abdomen the opaline concretionary body appears, to which the heart is subsequently attached, and which is provided with vibratile cilia.

The whole of the viscera included by the smooth integument have been observed to rotate in the cavity formed by the thick gelatinous tunic, to which the visceral mass again becomes attached by the adhesion of the muscular tunic at the branchial and anal orifices, and by the establishment of corresponding orifices in the integument.

Savigny[4] was of opinion that the ovum of the compound Ascidian contained the germs of all the individuals composing the characteristic groups in the mature aggregate animal, and that their development was simultaneous. In one sense, doubtless, the ovum contains the germs of all the future individuals developed by gemmation, in so far as a portion of the germ-mass is retained unchanged in the body of the first developed individual; but the cell-progeny of the primary germ-cell constituting that germ-mass are not simultaneously developed, nor does any development begin until the first individual is completed, fixed, and nourished by the action of its proper digestive apparatus. Thus stimulated and strengthened, the second mode of reproduction, namely, that by gemmation, is superinduced upon the young Ascidian (fig. 5, B), after the foregoing development from the impregnated ovum (fig. 5, A). This offers an interesting ana-

[1] Lister, *Philosophical Transactions*, 1834.

[2] Zur Entwickelungsgeschichte der Mollusken und Zoophyten, Wiegmann's *Archiv fur Naturgeschichte*, 1837 and 1840.

[3] Recherches sur l'Embryologie des Ascidies simples, *Mém. de l'Acad. Roy. de Belgique*, 1847.

[4] *Mémoires sur les Animaux sans Vertèbres*, 8vo, Paris, 1816.

Tunicata. logy to the phenomena presented by the polype-larva of the Medusa. The individuals (fig. 5, B) formed by the gemmation of the primary bud of the young Ascidian (fig. 5, A), instead of being detached, are retained, the process of gemmation being regulated so as to produce the characteristic pattern in which the different individuals are grouped in the mature compound animal.

Family I.—BOTRYLLIDÆ.

Body fixed; tunics of many individuals fixed together into a mass, in which the individuals are grouped into systems.

Genus Botryllus,[1] Gaertner, 1774.—Body of the individual not divided into thorax and abdomen; branchial aperture circular, without rays; social systems numerous, with from six to twenty individuals in each, lying nearly parallel to the periphery of the mass; vent remote from the simple branchial aperture.

Sp. *Botryllus violaceus.*—Greenish-gray, with dark-blue stars, yellow in the centre round the common orifice. On stones and sea-weed near low-water mark. British.

Genus Didemnium,[2] Sav.—Thorax and abdomen distinct; branchial aperture with six equal rays or lobes.

Sp. *Didemnium candidum.*—Gulf of Suez.

Genus Diazona,[3] Sav.—Compound group sessile, subcircular, hollow in the middle; individuals arranged in concentric circles; both branchial and anal apertures six-rayed.

Sp. *Diazona violacea.*—The compound mass resembles an Actinia, and attains a diameter of 6 inches; it is of a beautiful violet colour. Mediterranean.

Genus Polyclinum,[4] Sav.—Divided into thorax or branchial cavity; upper abdomen with the digestive organs, and lower abdomen with the heart and reproductive organs; branchial orifice six-rayed, anal orifice simple.

Sp. *Polyclinum constellatum.*—Hab. Mauritius.

In the progress of the gemmation by which the compound groups of the foregoing family are formed, a bud is first developed in the form of a small tubercle from the abdominal portion of the internal tunic of the young Botrylloid. The tubercle becomes prolonged, retaining an active circulation in its interior, and is accompanied by a corresponding growth of the outer cellulose integument, which becomes clavate. The process then bifurcates; the divisions, in like manner, becoming elongated, expanded, and bifurcated at their extremities.

Soon the outline of an Ascidian is sketched in each of these extremities. The primitive connection with the parent is obliterated; but the young individuals remain united together by their common peduncle according to the law which determines their mode of grouping into systems. By the progressive increase of their outer gelatinous integument they coalesce and form the compound mass.

The procreative force of the germ-mass finally exhausts itself in the formation of the male and female organs, in which that force is again mysteriously renewed, under its two forms of the spermatozoon and the germinal vesicle, by the combination of which the reproductive cycle again begins its course.

Family II.—CLAVELLINIDÆ.

Body fixed; individuals connected by repent tubular prolongations of their common fixed tunics.

Genus Clavellina,[5] Sav.—Body oblong, erect, pedunculate; tunic transparent; branchial and anal apertures without rays; branchial sac short, not plicated, without papillæ.

Sp. *Clavellina borealis*, Sav. (*Ascidia clavata*, Pallas. *Spicil. Zool.* x., tab. i., fig. 16).—Thoracic region marked with coloured lines. Greenland. Tunicata.

Genus Perophora[6] (discovered by Lister, 1834; so named by Wiegmann).—Body compressed, suborbicular, pedunculated, upon a common repent tubular stem; branchial sac occupying a great part of the body, with a papillose orifice.

Sp. *Perophora Listeri* (fig. 5).—Shores of Britain.

Tribe 2.—SOLITARIA.

(*Les Ascidies*, Cuv.)

The exterior tunic of the solitary Ascidians (fig. 6, *a*) is a thick gelatinous or coriaceous elastic substance, adhering by its base, or by a long flexible peduncle, to some foreign body, and perforated at the opposite end or at the side by two apertures *h* and *f* (fig. 6). The exterior of this tunic is sometimes rough and warty, the inner surface always smooth and lubricous. Microscopically examined, it consists chiefly of a conglomerate of non-nucleated cells like the parenchyma of *Cacti*. Chemically analysed, 100 parts of the tissue, free from ash and water, gives, of carbon 45·38, hydrogen, 6·47; being the same composition as the "cellulose" of plants.

This non-azotized tissue is traversed by large blood-vessels, and towards its inner surface crystals and nuclei are abundant in the clear homogeneous basis. The lining membrane is composed of a layer of polygonal, nucleated, epithelial cells.

The second tunic *bb* is muscular; it adheres to the outer tunic at the circumference of the two orifices *h*, *f*, and is connected to it by blood-vessels at a few other points; elsewhere it is quite free, and the opposed surfaces of the intervening space between the muscular and elastic tunics have the aspect of a serous cavity. Its fine fasiculi of fibres are remarkably distinct, and are arranged in two layers,—the external circular, the internal longitudinal. The fibres or fasiculi of the outer layer are smaller than those of the inner one, and less regularly disposed.

They describe regular circles around the processes leading to the orifices of the tunic. Other fibres of the outer layer pass transversely from one tube to the other. The longitudinal fasciculi radiate from the two orifices, and decussate each other, winding round the bottom of the sac. Deeper again than this layer there is a sphincter surrounding the base of each tube or orifice, from which a third more delicate layer of longitudinal fibres is given off.

Of the two more or less protuberant and stellate apertures in the outer tunic, one (fig. 6, *f*) leads directly into the muscular sac, the other (*h*) into a wide vascular branchial sac (*dd*) contained in the muscular one. The entry to the branchial sac is defended by a circle of short tentacles. A portion of the muscular tunic is dissected from the branchial sac at *c*. The branchial sac is opened, and one-half reflected backwards, showing the inner surface at *dd:* the opposite wall of the sac *d* is dissected away from the alimentary canal *ee*. The inner surface of the sac *dd* is marked by parallel and equidistant transverse lines, the interspaces of which are divided into a series of narrow, vertical, perforated, and richly-ciliated compartments; two opposite narrow longitudinal tracts are entire. A groove along that which traverses the larger curvature of the sac leads to the mouth—an orifice (fig. 6, *k*) near the bottom of the branchial sac. This orifice conducts, by a short œsophageal canal, to the stomach *b;* this is an oblong cavity with longitudinal folds. The intestine is disposed in a sigmoid flexure, adheres to the outside of the branchial *d*, and the inside of the muscular sac *b*,

[1] Gr., signifying "a cluster of grapes."
[2] Gr., signifying "double couch."
[3] Gr., signifying "in circles."
[4] Gr. for "many cavities."
[5] Gr. for "little staff."
[6] Gr. for "sack-bearer."

Tunicata.

and terminates by a fimbriated anal aperture *n*, near the base of the second or anal orifice of the tunic *f*.

The liver consists of blind follicles produced into tubes which anastomose, surrounding more or less of the intestine as by a network, and ultimately, at least in *Cynthia tuberculata*, communicating with the stomach by a single aperture, from which a groove is continued towards the cardia.

Tunicata.

The heart is a simple, elongated, vasiform muscle, inclosed in a pericardium attached to the branchial sac, continued at either end into a vessel; the ramifications of one being expended chiefly upon the respiratory organ; those of the

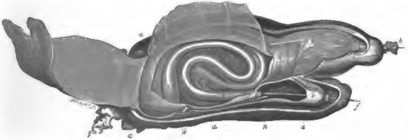

Fig. 6.
Ascidia gelatinosa.

other upon the tunics of the body, or speedily expanding into sinuses surrounding the viscera. According to the direction of the circulating currents, the one trunk-vessel will be an artery, the other a vein, and the circulation itself will be pulmonic or systemic.

The nervous system must be first sought for in the interspace between the two openings of the muscular tunic: there is situated a ganglion (fig. 5, *k*), from which it is not difficult to trace filaments diverging to each aperture of the sac where the circular disposition of the muscular fibres prevails; other branches accompany the longitudinal fibres, and supply the respiratory sac; two contiguous filaments are continued to the œsophageal orifice.

Eight pigmental spots or eye-specks have been detected at the entrance of the respiratory tube, and six, of a deep yellow colour, at the entrance of the anal tube.

In the animal manifesting this organization, which is much richer unquestionably than the amorphous and rugged exterior would seem to promise, the only vital actions obvious to ordinary vision are an occasional ejection of water from the orifices of the tunic by a sudden contraction, succeeded by a slow and gradual expansion of the entire body. Such contractions and expansions, aided by the ciliary currents, and the peristaltic movements of the alimentary, circulating, and secerning tubes, are all the actions which the organic machinery has to perform in the living Ascidian. The respiratory currents of sea-water, with the nutrient molecules in suspension, are introduced by the ciliary action through the branchial orifice *h* (fig. 6) into the pharyngeal respiratory sac *d*, from which the œsophagus *k* selects the appropriate food. The alimentary excretions and the generative products are expelled through the anal outlet *f*, by the contraction of the muscular tunic *b*.

In consequence of the space between this and the outer tunic being closed, that tunic accompanies the muscular tunic in its contraction, through the influence of the surrounding pressure; when the muscle ceases to act, the elasticity of the outer coat begins to restore the contractile sac to its former capacity, and the surrounding water flows into its cavity, either directly or by distending the branchial sac. We shall find other instances of the economizing of muscular force by the substitution of elasticity as we ascend in the survey of the molluscous organization.

Eysenhardt[1] has observed the act of gemmation in a simple Ascidian. In this, as in the compound kinds, gemmation commences by the development of a small tubercle from the abdominal portion of the internal tunic of the young Ascidian. Some solitary *Ascidiæ*—*e.g.*, *Cynthia*—according to my observations, are of distinct sex. In the male a generative gland, commonly dendritic in shape, occupies the concavity of the intestinal fold, and sends a short and simple duct to terminate near the anus. In the female of the *Cynthia tuberculata* there are two ramified ovaria; the ovisacs being appended to the branches of a central stem, passing up the side of the rectum, and extending over one side of the branchial sac. In these the ova in different stages of development may be seen. The sexes are distinct in *Doliolum*; but are stated to be united in most solitary Ascidians, as in the compound forms. The impregnated germ-cell multiplies itself at the expense of the yolk, and incloses that substance by a series of secondary cells. As this process goes on, the yolk, so subdivided and assimilated, takes on a granular surface, each granule or tubercle having its hyaline nucleus. By the coalescence of the peripheral layer of these cells an external membrane is formed, on the exterior of which are oil-like globules. An albuminous fluid is now interposed between the chorion of the egg and the germ-mass. A filamentary body next begins to be formed from a part of the exterior germ-cells forming the basis of the test, which body bends over the visceral mass. This body or process progressively elongates, then uncoils itself, liberating the rest of the test with the visceral mass, and becoming a freely-vibrating locomotive caudal appendage, as in the larva of the compound Ascidian (fig. 5, C). After its attachment it becomes metamorphosed and developed into the animal, whose organization is illustrated in fig. 6.

Family Ascidiadæ.

Individual solitary, fixed; branchial sac simple or plicate.

[1] Ueber einige merkwurdige Lebenserscheinungen an Ascidien, *Nova Acta Acad. Nat. Curios.*, tom. xi., 1823.

Tunicata.

Genus BOLTENIA, Sav.[1]—Body sub-globular, pedunculate; tunic coriaceous; orifices lateral, 4-cleft; branchial sac deeply plicated, with compound tentacles at its orifice.

Sp. *Boltenia reniformis*, M'Leay.—Greenland. This species has been brought up from a depth of 70 fathoms.

Genus CHELYOSOMA, Broderip.[2]—Body depressed, discoidal, sessile; tunic coriaceous, composed of polygonal plates; orifices closed by six triangular valves.

Sp. *Chel. Macleayanum.*—Greenland.

Genus CYNTHIA, Sav.[3]—Tunic coriaceous, sessile; orifices 4-lobed; branchial sac plaited longitudinally, with a tentaculate orifice.

Sp. *Cynthia papillata*, Sav.; *Cynthia microcosmus*, Cuv.—The latter is esteemed as an article of food in some parts of the Mediterranean.

Genus ASCIDIA.[4]—Body sessile, covered with a coriaceous or gelatinous tunic; branchial orifice 8-lobed, furnished inside with a circle of simple tentacular filaments; anal orifice 6-lobed; branchial sac not plaited, its meshes papillated.

The Ascidiæ vary in length from 1 inch to 5 or 6 inches. The test is pale and semitransparent, the inner tunic orange or crimson, or sometimes marbled with crimson and white; the ocelli are red, or yellow with a central red spot.

Sp. *Asc. gelatinosa* (fig. 6).

ORDER II.—DACTYLOBRANCHIATA,[5] Ow.

(The character of the order is also that of the single family composing it.)

FAMILY PYROSOMIDÆ.

In one (the commonly occurring) state, many individuals form a compound body, swimming freely, with the tunics fused into a cylindrico-conical mass, in which they have a verticillate arrangement. In each individual the apertures of the external covering are opposite and terminal. The branchial sac with two gills, girt anteriorly by a membranous denticulate ring; open posteriorly. All the species are pelagic.

Genus PYROSOMA,[6] Péron.—A connecting link between the Ascidians and Salpians is afforded by certain compound floating gelatinous *Tunicata*, called, from their phosphorescent or luminous property, *Pyrosoma*, the individuals of which are permanently aggregated into a compound organic whole, having a definite form like a flattened cylinder. The common tegumentary mass is toughish and semitransparent. The tubercles with which its exterior is covered consist each of one inhalent end of an individual member of the living group; the opposite exhalent end of the individual opens into the cavity of the cylinder. Besides the common envelope, each individual has a distinct tunic or mantle attached at the oral or branchial orifice, at the anal orifice, and also to the two rounded bodies at the upper part of the branchiæ. The mantle is connected with the envelope by the delicate membrane of the venous sinuses. The branchiæ are two in number, oval in form, with their dorsal borders in contact and attached to the mantle, and their ventral borders separated by a large sinus; their numerous vessels anastomose at right angles, forming a quadrangular network, and the covering tissue is beset with vibratile cilia, which perform vortex-like movements with beautiful harmony and rapidity. The currents so discharged from the individual into the common cavity produce an outflow from the open end of the cylinder, and the re-action impels it slowly with its blunt end foremost. The œsophagus is curved and of a bright red colour; the stomach is subglobular, yellowish, and opaque; the intestine is short, bent abruptly on itself; the anus directed backwards towards the posterior orifice. The liver is a globular gland, with converging segments; it is attached to the intestinal loop. These viscera are situated posterior to the branchial sac, leaving a free passage to the water, which traverses the cavity. The nerve-ganglion lies upon the anterior end of the branchial sac. The heart is placed at the posterior part of the body, below the visceral mass, which is connected with the mantle by a pedicle near the inner part of the endostyle. There is a long, apparently hollow, filament contained in the dorsal sinus. Savigny figures an ovum, and a part which he supposed to be an oviduct; but the precise condition of the generative organs in the *Pyrosoma* is at present not clearly made out. Savigny, to whom the knowledge of the compound nature of the *Pyrosoma* is due, seems plainly to have observed an embryo, which had already constituted by gemmation four individuals before being excluded. This is the commencement of the cylinder at its smaller and closed end; it appears to be elongated by the like parthenogenetic propagation of successive circles or whirls of Ascidian-like individuals.

Sp. 1. *Pyrosoma atlanticum*, Péron.—Individuals arranged round the cylinder in close whirls. The name was applied to the compound cylinder, under the impression that it was the individual. It is ordinarily from 3 to 7 inches in length, and from 1 to 3 inches in circumference; open at one end, closed and bluntly rounded off at the other.

Syn. *Pyrosoma giganteum*, Lesueur (*Voyage aux Terres Australes*, pl. 30, fig. 1); Savigny (*Mém.*, ii., pl. 4, fig. 7; pl. 22 and 23).

The species is widely distributed over the tropical and warmer seas. Viewed from a ship's deck, they sometimes seem to form vast tracts of luminous matter stretched across the waves; when closely scanned, as the keel ploughs through the mass, it appears to be composed of countless cylinders resembling incandescent iron. Fishes and other contiguous marine animals are made visible by the light of the Pyrosoma. It is of a vivid greenish hue, appearing to be emitted in sparks from the individuals in quick succession, beginning at the point touched. In captivity the power gradually fails, and the light excited by a touch or concussion soon fades whilst the animal is in sea-water; but under the stimulus of fresh water it is said to be brightly emitted as long as life remains.

Sp. 2. *Pyrosoma elegans*, Lesueur.—Individuals arranged round the cylindroid in regular circles.

This species is founded on conical cylindroids of a small size, found in the Mediterranean. (The truth and constancy of the characters of this species need confirmation.)

ORDER III.—TÆNIOBRANCHIATA,[7] Ow.

Mantle adhering throughout to the tunic; orifices opposite, terminal or subterminal without tentacles; branchia riband-shaped; animals pelagic, free, floating; inhaling water by one aperture, expelling it by the other; individuals, in one generation, connected chain-wise; free in the next generation; and so alternately associated and solitary.

FAMILY SALPIDÆ.[8]

The third order of the *Tunicata* includes the Salpians, which float in the sea, and are characterized by their transparent elastic outer tunic, which is elongated, compressed,

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1 After Dr Bolten.
2 Gr. for "tortoise-body."
3 A name of Diana.
4 Gr. for "a little skin-bottle."
5 Gr., signifying "gills with a ring."
6 Gr. for "fire-body."
7 Gr. for "riband-gilled."
8 Gr., *salpe*, a luminous fish.

Tunicata.

or prismatico-cylindroid, and open at both extremities. The efferent orifice (fig. 7, *d*) is simple and tubular; it can be closed by a sphincter when the outer tunic expands, the water then flowing in by the opposite orifice *c*. This is in the form of a transverse slit, having an upper and a lower lip. The latter is reflected inwards, and forms a semilunar valve, allowing the entry and preventing the exit of water; the muscular fibres of the mantle *f*, or membrane lining the cartilaginous tunic *ab*, are arranged in flattened, often subannular, bands *g*; their elementary fibre is striated. The mouth, the stomach *l*, the liver and the heart *o*, are aggregated in a small mass or nucleus near the anterior aperture of the tunic; the intestine *k* extends towards the opposite aperture, and terminates freely at *l* in the common cavity of the mantle. The intestine, in *Salpa gibbosa*, has two cæca which project into the centre of the loop. In *Salpa zonaria* the liver envelopes nearly all the intestinal canal, and consists of a mass of cæcal tubes, with a few small appendages near their free ends. The group of small yellowish nervous ganglia is situated just above the oral attachment of the branchia *n*; near it is often observed a pigment-speck or ocellus. The single narrow plicated riband-shaped branchia *n* extends obliquely lengthwise across the pallial cavity. The heart *o* is elongated, and in some species slightly curved and sacculated; it communicates with a large vessel *m* at each extremity, one of which is ramified principally upon the visceral mass, the other upon the branchia and the muscular tunics. The blood passes into extensive venous sinuses before returning to the heart; its course is oscillatory, as in the Ascidians.

The sexes are distinct in certain individuals of the Salpians, as they are in some of the solitary Ascidians.

The testis is described by Krohn[1] as of an oblong form, single, lodged in the centre of the nucleus in *Salpa maxima*, in which it consists of numerous delicate seminiferous tubes filled with a white fluid, and opening by a short canal into the common cavity of the body. The two oblong bodies *d*, sometimes of a violet colour, attached to the mantle, have been regarded as ovaria; but they are more properly a "proliferous stolon," engendering by independent force, or independently of direct impregnation. Thus Sars maintains that the solitary individuals of the Salpæ are sexless. The germinative tube, in which the chain of young Salpæ are contained, winds round the visceral nucleus, hanging freely by one end in the cavity of the mantle, and being attached by the other end to the back of the nucleus. The Salpæ, thus developed from internal buds, are usually produced in groups, which are successively excluded through an aperture in the tunic opposite the end of the stolon.

The chief conspicuous vital action in the Salpians is the rhythmical contraction and expansion of the body, in which the elasticity of the outer tunic antagonises the muscular contraction of the inner one. During expansion the sea-water enters by the aperture *c*, and is expelled in contraction by the opposite one *d*, its exit by the first aperture being prevented by the valve. The re-action of the jet, which is commonly forced out of a contracted tube, occasions a retrograde movement of the animal. The currents which successively traverse the interior of the animal renew the oxygenated medium upon the surface of the re-

Tunicata.

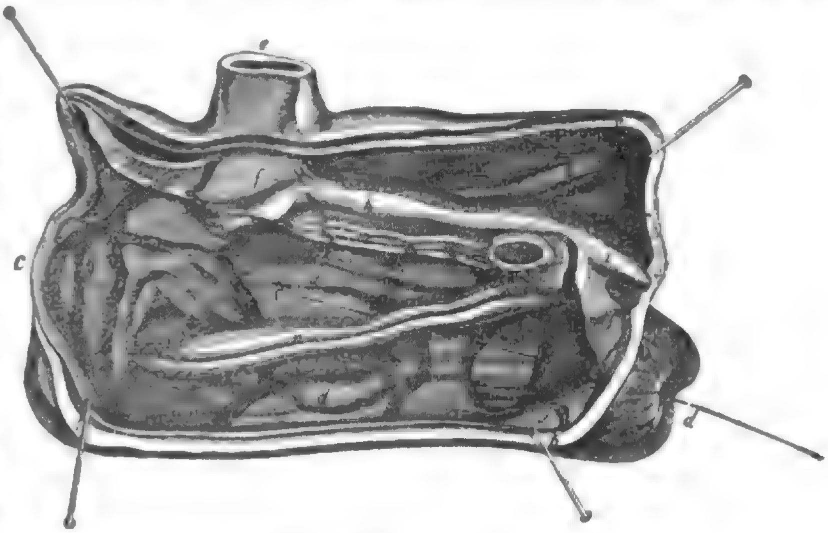

Fig. 7.
Salpa pinnata.

spiratory organ, bring the nutrient molecules within the reach of the ciliated sub-spiral labial membrane of the mouth, and expel the excrements and the generative products. Thus, a single act of muscular contraction is made subservient to the performance of the functions of locomotion, nutrition, respiration, excretion, and generation.

The aggregate Salpians quit their gemmiparous parent, associated together in long chains. After floating for a certain time, each individual, as De Chamisso[2] first discovered, propagates a young one like itself. The solitary *Salpa* propagated by each individual of the chain is the product of an impregnated ovum, and is for a time suspended by a peduncle from the dorsal wall of the visceral cavity of the parent. The development of the individual Salpæ has been studied by Dr Leuckart. The first evidence of differentiation is the formation in the embryonic mass of a closed cavity, from the walls of which the bar-shaped gill is detached, leaving behind it a space, which becomes the cloaca. The alimentary canal simultaneously makes its appearance. At a later period the branchial chamber communicates with the exterior by the branchial and cloacal orifices. In the *Salpa zonaria*, however, as many as three pedunculated young have been found in one parent when liberated. The solitary *Salpa* grows to the size of the grandparent, and then brings forth a social chain of young Salpæ, which, by the exercise of their uniparous generation, again give origin to the solitary and multiparous individuals. "Thus," observes Chamisso, "only the alternate generations resemble each other."

The case is strictly analogous to the generation of the compound Ascidians, of which the solitary young gives origin, by generation, to a connected group, each individual of which again procreates, by impregnated ova, free individuals. Most Salpians are usually luminous by night.

Genus SALPA.—The characters of the family are those also of the type-genus. Syn. *Thalia*, Brown; *Dagyza*, Banks and Solander (Home, *Comparative Anatomy*, vol. ii., pl. lxxi., figs. 2 and 3, engraved from drawings by John Hunter; see Owen's *Physiological Catalogue of the Hunterian Collection*, vol. i., p. 133, 4to); *Biphores*, Cuvier.

Sp. 1. *Salpa maxima*, Forskael. (Syn. *Salpa africana*, Forsk.)

[1] Observations sur la Génération et le Developpement des Biphores, *Annales des Sciences Nat.*, 3ième serie, tom. vi., p. 128, 1846.
[2] De Animalibus quibusdam e Classe Vermium, Fasciculus 1. *De Salpa*, 4to, 1819.

Sp. 2. *Salpa runcinata*, Chamisso. (Syn. *Salpa fusiformis*.)

Sp. 3. *Salpa pinnata*, Forsk. (fig. 7). (Syn. *Salpa cristata*, Cuv.)

Sp. 4. *Salpa gibbosa*, Quoy and Gaimard (*Voyage de l'Astrolabe, Zoologie*, tom. iii., 1835, pp. 559-598, pl. 86-89).—Specimens, Nos. 480, 481, Physiol. Ser., Hunt. Mus., London.

Sp. 5. *Salpa infundibuliformis*, Quoy and Gaim., ibid.—Specimens, Nos. 482, 483, Physiol. Ser., Hunt. Mus., Lond.

Sp. 6. *Salpa polycratica*, Forsk.

Genus Anchinæa, Eschricht.—This name has been given to small Salpæ, associated in a single row to a gelatinous filament.

Genus Doliolum.—Body cask-shaped, open at the ends; muscular bands six, equidistant; branchiæ in two bands with vertical bars, one on the dorsal, the other on the ventral surface, converging and confluent posteriorly.

Sp. *Doliolum denticulatum*, Quoy and Gaimard.—Only the solitary form of this species has been yet observed.

Genus Appendicularia, Chamisso. (Syn. *Oikopleura*, Mertens;[1] *Vexillaria*, Müller.)—Body ovoid, with a long appendage from the dorsal surface of the posterior end, making an angle with the axis of the body, and leading to a large cavity with venous sinuses. The branchia is represented by a ciliated pharynx, communicating with the exterior by two short tubes (discovered by Gegenbauer), ciliated where they leave the cavity, and opening immediately on the dorsal surface in front of the base of the appendage.

Sp. *Appendicularia flabellum*, Chamisso.—This species is one-sixth to one-fourth of an inch in length, and has been observed in such numbers as to form cloudy patches of red substance on the surface of the sea. It resembles the larva of the Ascidians; but Mr Huxley states that he observed spermatozoa in some individuals.[2] No female or aggregated form of *Appendicularia* has yet been seen.

CLASS II.—BRACHIOPODA,[3] Cuvier.

The Acephalous Mollusks of this class are deprived, like the Ascidians, of the power of locomotion, and are attached by a peduncle or by the shell to foreign bodies. Their soft tunic or mantle is, as it were, slit open, and consists of two broad membranous expansions, called "lobes," which are covered by two calcareous plates or "valves," applied, one to the dorsal, the other to the ventral surface, so as to inclose and defend all the soft parts of the animal. The breathing organs consist chiefly of vascular ramifications or processes on the inner surface of the pallial lobes, whence the name Palliobranchiata,[4] which has been applied to the Brachiopods. The viscera are situated at the part of the shell next the hinge or peduncle, and in one order are confined to a small space there. The rest of the interspace of the pallial lobes is almost entirely occupied by two long fringed arms, continued from the sides of the mouth, and disposed wholly or partly in spiral curves. All the species are marine. They may be briefly characterized as follows:—

Body symmetrical, with a dorso-ventral bivalve shell, lined by a closely-adherent mantle of two widely-separated lobes. Oral brachia two, long, fringed, and ciliated, usually more or less spirally disposed.

Order I.—ARTHROPOMATA, Ow.[5]

Shell-valves articulated; calcareous; viscera occupying one-third, brachia two-thirds, of the shell-cavity.

Family I.—TEREBRATULIDÆ.[6]

Shell-structure minutely tubular. Ventral valve (fig. 8, *V*) with a prominent notched or perforated beak, and two curved hinge-teeth; dorsal valve (fig. 8, D) with a depressed umbo, a cardinal process between the dental sockets, and an internal calcareous, usually looped, appendage *f* supporting the two long bent and spiral brachia *d, e*; attached by a short pedicle *n*, or sessile by a part of the ventral valve.

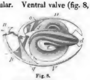

Fig. 8. *Waldheimia flavescens.*

The subdivisions of the *Terebratulidæ* or lamp-shells, which include the most characteristic living forms of the Brachiopodous class, are based upon modifications of the brachial appendage. The foramen in the ventral valve is usually more or less formed by a small separate shelly piece called the *deltidium*.

The viscera and shell-muscles occupy a small space near the hinge; the rest of the shell-cavity is almost wholly occupied by the two long fringed arms, which diverge from the sides of the mouth and terminate in spiral coils. (fig. 9, *f*).

Of the muscular system, the *adductor longus anticus* is shown at *o* (fig. 8); the *adductor longus posticus* at *p* (figs. 8 and 9); the *adductor brevis* at *q*. Other parts of the complex muscular system are described and figured in Owen's *Anatomy of Terebratula,—Introduction to the British Fossil Brachiopoda*, by Davidson, printed for the Palæontolographical Soc. 1853.

The stem of the brachia is hollow (fig. 9, *e*), and contains muscular fibres so disposed as to compress the fluid contained in the cavity. The nervous system consists of three principal parts—the "pallial," brachial," and "visceral;" the origins of these systems centre in the ganglionic basis of the œsophageal ring, which basis determines the dorsal and ventral aspects of the body as above defined. The details of the nervous system are described and figured in the *General Introduction to the British Fossil Brachiopoda*, above cited, p. 11, pl. 2; and in Owen's *Lectures on Invertebrata*, 8vo, 1855, p. 491.

The mouth of the *Terebratula* (fig. 9, *a*) is situated in the

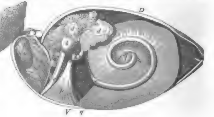

Fig. 9. *Waldheimia flavescens* (magnified).

middle line, and opens ventrad above the fringed transverse bar or common base of the brachia, and at the beginning of the passage formed by the spiral fold of the brachia; a short œsophagus ascends dorsad, and swells into the stomach, which curves backwards and downwards to *b*; the major part of the cavity is concealed by the hepatic follicles *d, d*;

[1] *Mémoires de l'Acad. Imp. de St Petersburg*, tom. i., p. 205, 1831.
[2] *Phil. Trans.*, 1851.
[3] Gr. for "arm-feet."
[4] Gr. for "cloak-gilled."
[5] Gr. ἄρθρον, a joint; πῶμα, a valve.
[6] Dim. of *terebratus*, perforated; in reference to the hole for the peduncle.

Brachiopoda.

the intestine *e* is short, and terminates near the ventral valve behind the *adductor posticus*. The writer of the present article has detected fœcal masses of infusorial shells in this intestine, and has pressed such out of the intestine in young specimens of *Terebratula caput-serpentis*, recently dredged: but the anus appears to become obliterated in some mature Terebratulæ.

The mantle lobes are remarkable for the size of the branched vessels of their inner layer, and for the tubular processes of the outer layer, which penetrate the pores of the shell. The trunks of the pallial vessels are connected with organs (fig. 9, *o*), discovered in the *Terebratula flavescens*, and first described as "a small transversely-plicated membranous process, continued from each side of the beginning of the intestine."[1] The homologous organs were soon after independently discovered in *Lingula anatina* by M. Vogt,[2] who described them as "peculiar sacs," lying one upon each heart, with its free border folded like a frill. "At the connecting line of the folds there is a fissure which leads to an extremely delicate canal, whose further continuations I could not follow; but it seemed to me that it opened externally between the two lobes of the mantle."[3]

The present writer, having subsequently convinced himself of the communication of these plicated organs with the visceral sinuses and ramified pallial vessels, described them as having the relation of auricles or hearts to that vascular system.[4] Lovén[5] concludes, from their external orifices, that they are kidneys; Mr Hancock[6] that they are oviducts. The latter author conceives that the pallial vessels circulate, not blood, but sea-water, and compares them to the atrium of the Ascidians, and the water-chambers of the Cephalopods. He confirms the connection of this system of vessels with the plicated organs, the relations and varying conditions as to size of which are figured in the *Anatomical Introduction* above quoted, pl. 3. The ramification and subdivision of the pallial vessels near the margin of the mantle, the complex fringe of setigerous (*Terebratula*) or jointed (*Lingula*) bristles at their free margins, the modifications and developments of the inner layer of the mantle, described by Cuvier as "gills" in *Lingula*, and the perforating pallial tubuli discovered by Dr Carpenter,—all point to the respiratory function of the pallial lobes. The present writer has, however, observed ciliary actions on the fringes of the brachia in a living *Terebratula caput-serpentis;* and has remarked that "wherever the blood is exposed in its vessels and sinuses to the sea-water, a respiratory action must go on."[7] A slender filament[8] accompanies the larger pallial vessels throughout all their ramifications. The generative cells (testes or ovaria) are developed within the pallial vessels, and apparently from the more slender ramified body.[9] In a *Lingula anatina*, preserved in spirits, the writer has observed the following stages of development in ova taken from the ramified pallial ovarium, which was bathed in the fluid of the correspondingly ramified sinuses:—*1st*, An impregnated ovum, in which the germinal vesicle had disappeared and the germ-mass had been formed; it occupied the entire ovum, which had assumed an oblong form; a peripheral stratum of the derivative germ-cells was more compact and of a somewhat lighter colour than the central mass. *2d*, A germ, showing the formation of a smooth membrane round the germ-mass. *3d*, A germ with a central cavity and the rudiment of a peduncle. *4th*, An embryo with the peduncle more produced, but without a visible trace of the shell. These stages are described and figured in the *Anatomical Introduction to the Fossil Brachiopoda*, p. 22, pl. 1, fig. 7, *a* to *c*. They show that the young *Lingulæ* are provided with a peduncle before they quit the parent; and it is very improbable that they escape through the plicated organs which Mr Hancock regards as oviducts.

The first step in the investigation of a small and complex Mollusk, especially when, as a rarity, it is brought preserved in spirit to the anatomist, is to find, describe, and figure the structures that exist; the determination of their function, when found, is the work of ulterior research, and in regard more especially to the circulation, depends upon observations of the living animals. The present writer has derived much satisfaction in finding almost all the parts and organs which he had described and figured in successive contributions to the anatomy of the *Brachiopoda* confirmed by later investigators, with a difference of opinion as to the function of some parts, and a change of name of other parts. The anus of the *Terebratula, e.g*, is described and figured by Mr Albany Hancock in the beautiful drawing of the dissection of the *Waldheimia flavescens* which he contributed to Dr Gray's *Catalogue of the Mollusca Brachiopoda of the British Museum*, 12mo, 1853, p. 14, fig. 2,[10] "*v* vent;" also in the figure published in Mr Woodward's *Manual of the Mollusca*, p. 210; and in Mr Davidson's *Classification of the Brachiopoda*, Palæontographical volume for 1853, p. 55, fig. 1. But in specimens subsequently dissected, Mr Hancock states he has not been able to detect the outlet at the end of the intestine. The same author, while he admits that the walls of the brachial canal (fig. 9, *e*) are supplied with delicate muscular fibres, which run diagonally round the tube, and which are crossed by "delicate longitudinal fibres," failed to detect anything like the "double spiral arrangements of fibres" described by Professor Owen. Whether science really gains by such changes of nomenclature as of "occlusors" for "adductors," and of "adjustors" for "protractors," may be questioned.

Genus Terebratula (as restricted by Davidson).—Shell oval, elongated, or transverse, externally smooth or plaited; valves more or less unequally convex; margin even or waved; hinge-line curved; beak short, truncated by a foramen, partly margined by a deltidium in one or two pieces; appendicular (internal) loop short, attached to the dorsal valve; brachia projecting considerably in front of the loop; no internal septum in the ventral (socket) valve.

Sp. *Terebratula vitrea*, Glassy Lamp-shell.—Habitat Mediterranean, in 90 to 250 fathoms. More than 100 species of Terebratula with short loops have been found fossil. They range from the Devonian epoch to the present day. Of the fossil species the most remarkable is the *Terebratula diphya* of Colonna, from the Oolite of Italy. Both valves are perforated in the mid-line, in the same perpendicular, in advance of the hinge. Mr Woodward[11] states that the young had bi-lobed valves, which united in the adult so far as to leave the above apertures.

Genus Terebratulina, D'Orb.—Shell generally longer than wide, more or less oval, finely striated; deltidium small; in some obsolete loop short, becoming annular in the

[1] Owen, Lecture xx., *On Invertebrata*, 8vo, Longmans, published in June 1843.

[2] C. Vogt, *Neue Denkschriften der allg. Schweizer Gesellschaft f. d. ges. Naturwiss.* vii., Neuchatel, 1845, mit 2 Taf.

[3] Ibid.

[4] R. Owen, "Lettre à M. Milne Edwards sur l'appareil de la Circulation chez les Mollusques de la classe des Brachiopodes," *Ann. des Sc. Nat.*, 3ième Série, iii., 1845, *Zool.* pp. 315–320, plate 4.

[5] *Bulletin Physico-Mathem. Acad. Imp. Petersb.*, Oct. 1855, p. 223.

[6] *Annals of Natural History*, Aug. 1857, p. 145.

[7] *Lectures on Invertebrata*, 1855, p. 496.

[8] First described and figured by Owen as "arteries" in *Trans. Zool. Soc.* i., pl. 22 and 23. The impressions of these delicate filaments and vessels are sometimes preserved on fossil shells of Terebratulites that have ceased to exist since the Permian period,—*e.g.*, in *Camarophoria multiplicata*. (King, *Monograph of English Permian Fossils*.) By virtue of the minute radiated spicula of carbonate of lime with which the mantle, brachia, and brachial cirri are, as it were, frosted over, the preservation of these delicate soft parts, or of instructive indications of them, in fossil Brachiopoda, seems due.

[9] *Lectures on Invertebrata*, p. 496.

[10] *Annals of Natural History*, Aug. 1857, p. 10.

[11] *Manual*, p. 215.

adult by the union of the oral processes, forming a shelly band behind the mouth.

Sp. *Terebratulina caput-serpentis* (Snake-headed Lamp-shell).—Hab. from Norway to the Mediterranean, at from 10 to 150 fathoms. About twenty fossil species are known; ranging from the Oolitic to the actual epochs.

Genus Waldheimia, King.—Shell smooth or plaited, with the dorsal valve impressed, in some species depressed or concave; perforation of beak completed by a deltidium of one or two pieces; loop long, usually exceeding two-thirds of the length of the valve, and reflected; septum of dorsal valve elongated.

Sp. *Waldheimia flavescens* (*Terebratula australis*, Quoy and Gaim.)—Hab. Australia, from just below low-water mark to 20 fathoms. This is the species of which the anatomy is illustrated in the *Anatomical Introduction to the British Fossil Brachiopoda* above cited, and in fig. 9 of the present article.

Terebratulidæ with long loops have been found from the Lias to the present period.

Genus Terebratella, D'Orb.—Shell smooth, or with radiating folds; dorsal valve longitudinally impressed in most; beak-hole partly margined by a deltidium of two pieces, in some disunited above the umbo; beak with a flattened area on each side of the deltidium; loop elongated and attached to the septum as well as to the hinge.

Sp. *Terebratella dorsata*, Lam.—Hab. Straits of Magellan. The soft parts and apophysary system of the genus were described from this living species in the *Transactions of the Zoolog. Society*, vol. i., p. 141, pl. xxii., 1835. The species of this genus, now ranked under sub-genera, range from the Cretaceous period to the present day.

Family II.—THECIDIIDÆ.

The characters of the family are also those of the single genus composing it.

Genus Thecidium,[1] De France.—Shell thick, punctate, attached by the substance of the ventral shell at or near the beak; interiorly a deep or thick granulated margin generally encircles the valves, and in the ventral one, after reaching the front, extends inwards in the shape of a rounded mesial ridge; oral processes united, forming a bridge over the visceral cavity; loop often unsymmetrical, lobed, and united more or less intimately with the sides of the grooves.

Sp. *Thecidium mediterraneum.*—Hab. Mediterranean; attached to corals. The animal has elongated brachia folded on themselves, with their curve long and not close-set.

"This genus, so far as we know, first appeared in the salt-marls of St Cassian. In the Lias the species are both numerous and large; from that epoch the genus continued uninterruptedly to the present period, and the family is still represented by a single species." (Davidson's *Monograph*, above cited.)

Family III.—SPIRIFERIDÆ, Sowerby.

All the species are extinct; they were chiefly distinguished by much-developed brachia, supported on spirally-disposed shelly processes, which were sometimes spinulose.

Davidson admits five genera and two sub-sections of this family. The species range from the lower Silurian epoch through all the Palæozoic formations, and apparently died out in the Lias.

Family IV.—RHYNCHONELLIDÆ.

Shell impunctate, oblong, or trigonal beaked; hinge-line curved; no area; valves articulated, convex, often sharply plaited; foramen beneath the beak, usually completed by a deltidium, sometimes concealed; hinge-teeth supported by dental plates; hinge-plate deeply divided, supporting oral lamellæ, rarely provided with spiral processes; muscular impressions grouped as in *Terebratula*; vascular impressions consisting of two principal trunks in each valve, narrow, dichotomizing, angular, the principal posterior branches inclosing spaces which leave punctate impressions in casts of the shell.

Genus Rhynchonella,[2] Fischer (*Notice des Fossiles du Gouv. de Moscow*, 1809).—Animal with elongated spiral arms directed inwards towards the concavity of the dorsal valve; visceral mass scarcely extending beyond the umbones, separated from the general cavity of the shell by an aponeurosis, in the centre of which is the mouth; labia united at the sides of the mouth and produced into the spiral brachia; alimentary canal terminating behind the insertion of the adductor in the ventral valve; mantle not adhering, its margin fringed with a few short setæ.

Sp. *Rhynchonella psittacea.*—Hab. northern seas. The organization of this recent species is illustrated in the *Transactions of the Zool. Society*, vol. i., 1835, p. 145.

Rhynchonella nigricans.—Hab. New Zealand. The above are the only two existing species at present known. Upwards of 250 species of this family have been found fossil. It manifests one of the most ancient types of animal organization, ranging from the Cambrian to the present period. The chief modifications of the family type were exemplified by the extinct genera *Pentamerus*, Sowerby; *Camarophoria*, King; *Atrypa*, Dalman.

Family V.—ORTHIDÆ.[3]

Shell transversely oblong, depressed, rarely foraminated; hinge-line wide and straight; beaks inconspicuous; valves plano-convex, or concavo-convex, each with a hinge-area notched in the centre; ventral valve with prominent teeth; muscular impressions occupying a saucer-shaped cavity with a raised margin; adductor central; cardinal and pedicle impressions conjoined, lateral, fan-like; dorsal valve with a tooth-like cardinal process between two curved brachial processes; adductor impression quadruple; vascular impressions consisting of six principal trunks in the dorsal valve, two in the ventral, the external branches turned outwards and backwards, inclosing wide spaces called ovarian. Indications have been observed in several genera of horizontally-coiled spiral arms, but they had no calcified supports; the space between the valves is often very small. The shell-structure is minutely tubular or punctate, except in a few instances, where the original texture is probably obliterated.

All the species are extinct; some appear to have lived free, others to have been fixed by means of a pedicle. They range from the Cambrian to the end of the Liassic period: the type genus *Orthis* has not been found above the Carboniferous formations.

Family VI.—PRODUCTIDÆ.

Shell concavo-convex, with a straight hinge-line; valves in some species (*Stropholosia*, King) regularly articulated, in others without hinge-teeth; closely appressed, striated,—the striæ developing close-set tubular spines; ventral valve convex; dorsal valve concave; internal surface dotted with conspicuous funnel-shaped punctures; dorsal valve with a prominent cardinal process; brachial processes sub-central, without calcified supports; vascular markings lateral, broad, and simple; adductor impressions dendritic, separated by a narrow central ridge; ventral valve with a slightly notched hinge-line; adductor scar central, near the umbo; cardinal impressions lateral, striated.

All the species are extinct: they range through the Devonian, Carboniferous, and Permian periods.

[1] Gr. for "small pouch."

[2] Gr., sign. "small beak."

[3] Gr. for "straight."

Brachiopoda.

ORDER II.—LYOPOMATA, Owen.[1]

Shell-valves inarticulated, and, save in the annectant family *Craniadæ*, subcalcified; viscera occupying one-half, brachia the other half, of the shell cavity.

FAMILY I.—CRANIADÆ.

Shell orbicular, hingeless; external surface smooth, or spinous, or with radiating costæ or foliaceous expansions; dorsal valve limpet-like; interior of each valve with a broad granulated border, well exhibiting the tubular or punctate shell-structure; disk with four large muscular impressions, and digitated vascular impressions.

Genus CRANIA, Retzius, 1781.—Animal usually attached by the substance of the ventral valve, with free spiral arms directed towards the concavity of the dorsal valve, and supported by a nose-like prominence in the middle of the lower valve; mantle-lobes extending to the edges of the valves, and closely adhering, with the margins plain and thin.

Sp. *Crania anomala*, Müller.—The thick, cirrigerous, spiral, labial arms are confined to the anterior half of the shell-cavity, and are devoid of calcareous supports; the pallial sinuses are digitate.

"The valves of *Crania* appear to have been opened by the action of sliding muscles, as described by Professor Owen in *Discina*; those which advance the dorsal valve (*protractor* muscles) are aided by a single small muscle in the median line, answering to the *cardinal* muscle of *Terebratula*. The pair of muscles which bring the free valve back to its place (*retractors*) are attached outside the anterior adductors of the free valve, and to a point between the posterior adductors in the fixed valve, like their equivalents in *Discina*, according to Owen."[2]

The species of *Crania*, most of which are now extinct, range from the Cambrian to the present period.

FAMILY II.—DISCINIDÆ.

Shell-valves unarticulated, minutely punctate; animal attached by a very short and thick mass of musculo-tendinous fibres, passing through the ventral valve by a slit in the hinder portion, or by a circular foramen.

Genus DISCINA,[3] Lam. (*Orbicula*, Broderip and Sowerby).

Sp. *Discina* (*Orbicula*) *lamellosa*, Brod. The following are notes of dissection of two specimens of this species, which were given to the writer by Mr H. Cuming, who collected them on the Peruvian coast:—The shell is of an irregular, rounded, flattened form, of a reddish-brown colour; the edges of the layers of increase are horny, and the margin of the shell is of a soft texture and thickened. The layers of increase are large in proportion to the size of the shell, and very irregular; the dorsal valve resembles that of a low limpet, having the apex behind the centre; the ventral valve is flat. The orifice in the ventral valve is a slit at the bottom of a depression; it is three lines long and half a line wide. Through this slit the organ of adhesion passes, and immediately expands into a round sucker, which fills up the whole of the depression, concealing the margins of the slit. Beyond the margins of the valves long shining setæ project from two to four lines, which are inserted all round the free or disunited margins of both lobes of the mantle; but the outer shell-forming layer of the mantle extends a little beyond the setigerous border. The setæ are much longer in proportion than in *Terebratula*, and rather longer than in *Lingula*; they are beset with minute *setulæ*. The muscles and viscera are situated in a rounded mass in the posterior half of the shell. At the fore-part are two oblong ends of muscles with their anterior sides converging; in the triangular space between them is the green-coloured liver; behind these the mass of the gray ovary; and at the posterior part of the circle are two smaller "post-adductor" muscles.

On removing the lower valve, which must be cut through to the fissure on each side in order not to disturb the viscera, the same structure of mantle is perceived, there being a single vascular trunk or sinus on either side; but the viscera are quite concealed by the dilated disc for adhesion. On removing the mass of the follicular liver and ovary, the alimentary canal is observable extending down the middle to the posterior part of the shell, and then bending to the right, viewed from behind, it enters the right egg-receptacle, and terminates by opening externally between the mantle-lobes and just behind the right extremity of the arm. Four shining tendons are also observable: two superior diverging. The two superior pairs arise by a common origin from between the insertion of the anterior large muscles, and are inserted outside the posterior pair of muscles; and two inferior converging, to be inserted at the inner side of the same. These are attached by their opposite extremities to the sides of the membranous circle containing the ova, and protecting the viscera. The two posterior large muscles are inserted into the lower valve close to the slit.

On turning down the ventral lobe of the mantle, the vessels are also seen converging from the respiratory margin to two trunks, which terminate in two oblong plicated cavities on either side. These are the hearts of the pallial sinuses ("kidneys" of Lovén, "oviducts" of Hancock); they are situated between the two strong membranes which circumscribe the visceral mass, and divide it into two cavities. These cavities are large, and were filled with a coagulated light-gray substance and a brownish matter: the latter, under the microscope, presented a granular appearance, like ova, but the lighter substance had no form or structure; it might be coagulated blood. The arms are joined at their bases below or across the ventral side of the mouth, on which aspect they form a transverse, semilunar, fleshy stem, fringed and convex anteriorly; at the extremities of this ridge they are bent upon themselves, and turn upwards and forwards their extremities, making one turn and a half in front of the mouth. These reflected parts of the arms are closely connected to the first-described portion, and cannot be freely everted and protruded, as in *Lingula*. The lateral parts, where the bend is, may be pushed out like elbows, and so the shell be opened; or it may be opened by their contracting from the bend towards the mouth, and so becoming thicker and opening the shell. The brachial fringe consists of round equal filaments, with an entire surface; but when viewed through the lens, dark lines seem to traverse them longitudinally.

The *Discinidæ*, of the genus *Trematis*, Sharpe (*Orbicella*, D'Orb.), as well as those of *Siphonotreta*, De Vernueuil, belong to the Silurian periods. The species of *Orbiculoidea*, D'Orb., range from the Silurian to the Neocomian periods, and were most numerous during the Carboniferous period. The true *Discinæ*, as restricted by D'Orbigny, first appeared at the Tertiary epoch, and are still represented by the species which the writer has had the opportunity to anatomize.

FAMILY III.—LINGULIDÆ.

Shell oblong or orbicular, sub-equivalve, attached by a long pedicle passing out between the beaks of the valves; texture horny, minutely tubular; arms fleshy, unsupported by calcified processes.

Genus LINGULA,[4] Bruguière, 1789.—Shell oblong, compressed, slightly gaping at each end, truncated in front, rather pointed at the umbones; dorsal valve rather shorter, with a thickened hinge-margin and a raised central ridge inside.

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[1] λύω, to loosen; πῶμα, valve.

[2] Davidson, *Monograph on British Brachiopoda*, p. 123.

[3] Gr., signifying "small plate."

[4] Lat., "a little tongue."

Brachiopoda.

Animal with the mantle-lobes firmly adhering to the shell, and united to the epidermis, entire circumference of their margins distinct, and fringed; pallial sinuses giving off numerous narrow loops from their inner surfaces; visceral cavity occupying the posterior half of the shell, and surrounded by a strong muscular sheath; pedicle elongated, thick; adductor muscles three, the posterior pair combined; two pairs of retractors, the posterior pair unsymmetrical, one of them dividing; protractor sliding muscles, two pairs; stomach long and straight, sustained by inflections of the visceral sheath; intestine convoluted dorsally, terminating between the mantle-lobes on the right side; oral arms disposed in about six close whirls, their cavities opening into the prolongation of the visceral sheath in front of the adductors.

Sp. *Lingula anatina*, Lam.—From dissections of this species, the Brachiopodous type of structure was first made known in the memoir by Cuvier in the *Annales du Muséum*, vol. i., 1802. Cuvier here shows, in *Lingula*, a condition of the respiratory organ which might be paralleled with one of the transitory states of that organ in the Lamellibranchs,—that, viz., in which the rudimental gills appear as processes from the inner surface of the pallial lobes, and in which the distinction, whether morphological or physiological, of the gills and mantle is not fully established. The modifications of the breathing organ in both *Terebratula* and *Discina* exhibited a more interesting condition, comparable to a still earlier stage of the respiratory system in the embryo Lamellibranch,—that, viz., in which the vessels of the pallial lobes have not begun to bud out in parallel rows of vascular loops,—the first stage in the formation of gills, and the one at which it is arrested in the *Lingula*. Additional particulars of the organization of *Lingula* will be found in the *Transactions of the Zoological Society*, vol. i.; in the *Anatomie der Lingula anatina*, by Vogt; in the *Neuer Denkschrifte der Schweizerischen Gesellschaft*, Bd. vii.; and in the *Introduction to the Monograph on British Fossil Brachiopoda*, pl. i., figs. 5, 6, and 7; pl. ii., fig. 3.

The high antiquity of the *Lingula*, and the maintenance of the genus under very slightly modified specific representatives to the present day, render a knowledge of so enduring a plan of organization highly interesting. Fossil *Lingulæ* (*L. Davisii*, M'Coy, *e.g.*) occur in the Cambrian or lowest fossilliferous beds of North Wales; and *Lingulæ* continued to exist in the seas that are now British as late as the period of the Coralline Crag. The genus is represented at the present day by living species, which as yet have only been found in warmer latitudes; *e.g.*, in the seas washing the coasts of the Indian Archipelago, the Moluccas, Australia, the Fiji and Sandwich Islands.

The *Lingula anatina*, living near the surface, and sometimes where it would be left exposed by the retreating tide were it not buried in the sand, must meet with more variety and abundance of nutriment than can be found in the deeper waters, where *Terebratula*, *Crania*, and *Discina* usually reside. Hence its powers of prehension are greater; and Cuvier suspects that it may even enjoy a species of locomotion from the superior length and muscularity of its pedicle. The organization of its mouth and stomach indicates the molecular character of its food; but its convoluted intestine shows a capacity of extracting a quantity of nutriment proportioned to its superior activity, and to the greater extent of its soft parts. The more extended pallio-vascular surface is in harmony with the above conditions of structure and habits.

With regard to *Discina*, and more especially the deep-sea species of *Terebratula*, both the respiration and nutrition of such animals—which exist beneath a pressure of from sixty to ninety fathoms of sea-water—are subjects suggestive of interesting reflections, and lead one to contemplate with less surprise the great strength and complexity of some of the minutest parts of the frame of these diminutive creatures. In the unbroken stillness pervading those abysses their existence must depend upon their power of exciting a current around them in order to dissipate the water already laden with their effete particles, and to bring within the reach of their prehensile organs the animalcules adapted to their sustenance.

The Brachiopods appear to have been most abundant, and certainly manifested their most varied forms, in past epochs of the globe. They are now, though comparatively few in number and restricted in generic modifications, widely diffused over the earth's surface; and some species exist at greater depths than other bivalve Mollusks. They are thus amongst the most ancient of existing types of animal structure, and their range in space is as extensive as has been their range in time.

With regard to the affinities of the *Brachiopoda*, Siebold[1] compares their spiral-fringed brachia to the tentacles of *Alcyonella*; and this idea of their affinity to the *Bryozoa* has been reproduced and supported by Mr Hancock[2] and Professor Allman, who deem the affinities of the *Bryozoa* to pass off in two directions,—in one through the *Tunicata*, and in the other through the *Brachiopoda*; but they believe the *Brachiopoda* to be much more nearly allied to the *Lamellibranchiata* than they are to the *Bryozoa*.[3] Cuvier indicated his sense of the distinct and well-marked type of the structure of the *Brachiopoda* by placing the class below that of the *Tunicata*,—a position which it retains in the edition of the *Règne Animal* of 1830.

The knowledge of the structure of the mature forms of *Terebratula*, *Waldheimia*, *Rhynchonella*, *Crania*, *Discina*, or *Orbicula*, and *Lingula*, led the writer in 1835 to regard the *Brachiopoda* as a group equivalent to the *Tunicata* on the one hand, and to the *Lamellibranchiata* on the other; and in the linear series, necessitated by progressive description, the proper place of the *Brachiopoda* was deemed to be, as in the present article, between the *Tunicata* and the *Lamellibranchiata*. Should the embryology of the *Brachiopoda* show that they propagate by gemmation as well as by impregnated ova, and that the embryo quits the ovum under the guise of a ciliated gemmule, such facts would weigh strongly for the closer affinity of the *Brachiopoda* to the ciliobrachiate Polypes. Should the *Brachiopoda* be found to propagate exclusively by impregnated ova, and—as the scanty observations on *Lingula* show that the embryo undergoes a development which brings with it a recognisable approach to the mature form before it quits the parent—should the little embryonal Brachiopodous Bivalves be found also to be hatched in the sinuses of the respiratory layer of the pallial lobes,—all these developmental characters will tend to confirm the position which is here assigned to this well-defined class of Acephalous Mollusks.

CLASS III.—LAMELLIBRANCHIATA.[4]

(*Acephales Testacees*, Cuvier; *Bivalvia*, Fleming).[5]

Approximations to the characters of the Lamellibranchiate Bivalves are made in the foregoing class by *Rhynchonella*, in respect to the structure of the shell, by the absence of the minute canals and co-adapted pallial tubes which traverse the shell in other Brachiopods; in respect to the mantle, by its being consequently less adherent to the valves; and in respect to the oral brachia, by the rudi-

[1] *Lehrbuch der Vergleichenden Anatomie der Wirbellosen Thiere*, 8vo, 1848, p. 260.

[2] "On the Anatomy of the Fresh-water Bryozoa," *Annals of Nat. Hist.*, 1850.

[3] *Monograph of Fresh-water Polyzoa*, 4to, 1856.

[4] Meaning "leaf-gilled" or "plate-gilled."

[5] The term "Bivalves" will be used in this article in the sense defined by the estimable Naturalist above cited, and as the English equivalent of *Lamellibranchiata*.

Lamellibranchiata.

mentary condition of their calcareous supports, and by their consequent greater freedom and mobility, in which they resemble the long labial palps of *Anomia*. A like approximation is made by *Lingula* in the complexity of the inner respiratory layer of the free lobes of the mantle, and in the proportion of the shell-cavity occupied by the visceral mass. Reciprocally, the genera *Anomia* and *Ostrea*, among the Lamellibranchs, resemble the *Brachiopoda* in the attachment of the shell to foreign bodies by either its substance or by altered muscular fibres, and in one valve being downwards, the other upwards; so that they are distinguished into "lower" and "upper" valves, in the position in which the living animals are commonly found. The lobes of the mantle, moreover, are as little united as in most Brachiopods; and the generative glands are developed in a ramified form upon them in *Anomia*; in which genus, finally, the muscles of the shell and pedicle or plug present a complexity almost equal to those in *Discina*.

The homology of the "pallial lobes" of *Brachiopoda* with the same-named parts in *Lamellibranchiata*, and of the mouth and its labial productions in *Lingula* with those in *Anomia*, may be as true as it seems obvious; but in *Acephala*, developed on plans so different in the general disposition of the soft parts in the shell, the grounds for determining special homologies are by no means so satisfactory and convincing as in the different members of the animals organized on the same vertebrate type. The principle of a final purpose more obviously governs the number and position of the shell-muscles in *Discina* and *Anomia*, than any uniformity of plan to which such resemblance might be referred. But the dogmatic assertion of the abstract nature of the correspondences above cited, as being, *e.g.*, of "analogy," not of "affinity," will not close the eyes of the impartial observer of nature to their presence and probable signification.

We have seen that the relation of the soft parts to the bivalve shell of the *Brachiopoda* is such that one valve is "ventral," the other "dorsal" in position. In the *Lamellibranchiata* one valve is applied to the right side, the other to the left side of the animal. The ciliated labial tentacles, as compared with those in the *Brachiopoda*, are short, and are more glandular than muscular; and there is usually a pair on each side of the mouth (fig. 11, *h*). Most of the *Lamellibranchiata* are free and locomotive. The instrument by which they move from place to place is a single symmetrical muscular organ (fig. 10, *e*) developed from the

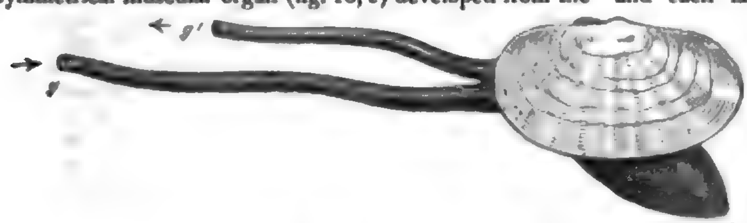

Fig. 10.
Psammobia florida.

ventral surface of the visceral mass. The body, and usually also the shell, is longer in proportion to its depth than in *Brachiopoda*, and the normal number of muscles passing from

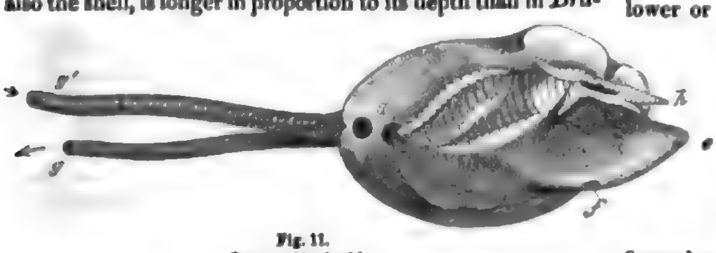

Fig. 11.
Psammobia florida.

valve to valve is two. They are called "adductors," and are antagonized by an elastic substance, so inserted at the hinge uniting the two valves as that it is squeezed when the shell is closed, and opens the shell when the adductor muscles relax. The visceral mass occupies about half the cavity of the shell next the hinge (fig. 11); the rest of the interspace of the pallial lobes is chiefly occupied by the "foot," when this is developed, and by the "branchiæ." The breathing organs (fig. 11, *p*, *p*) are mostly lamellose, or shaped like long subcrescentic leaves or plates, two on each side, dependent from the inner surface of the mantle-lobes (fig. 11, *a*). This characteristic of the breathing organs gives its name to the present class of Acephalous Mollusks. The heart consists of a ventricle with usually two auricles; and as a rule, the ventricle is traversed by the end of the intestine (fig. 17, Q). An excretory organ, developed from the veins near the heart, communicates externally by the pericardial or aquiferous outlet. With the exceptions above mentioned the Lamellibranchiate Bivalves live with the back uppermost, resting on the ventral edge of their shell, as in the position of the sand-shell *Psammobia* (fig. 10).

True Bivalves, as a general rule, are diœcious and ovo-viviparous.

The well-known oysters, cockles, mussels, razor-shells, and ship-borers, exemplify the present class of *Mollusca*, of which all the members are aquatic, and most are marine.

The bivalve shell of the Lamellibranchs (fig. 12) offers, as might be expected, many modifications corresponding in general with those of the mantle, but otherwise related in a few species to boring habits and a peculiar locality; other calcareous parts in a tubular or other form being then usually superadded. The shell consists essentially of an organized extra-vascular combination of albuminous membrane and calcareous earth, chiefly carbonate of lime, arranged in successive layers. The innermost is the largest and latest formed, and each layer presents a cellular, lamellar, or prismatic texture, which presents characteristic variations in different families.[1] Each valve of the normal shell is a cone, showing every grade of depth from the flat plate of the *Placuna* to the produced and spiral cavity of *Isocardia* and *Diceras*; it is commonly shallow, with the apex or *umbo* turned more or less to one side and directed forwards. If you place a bivalve shell in the position of the *Cytherea* (fig. 13), the direction of the *umbo* determines A as the anterior border, and P as the posterior one; the upper or dorsal, and the lower or ventral borders, are as marked in the cut. The length of the shell is taken from A to P; its height or breadth at right angles from the dorsal to the ventral border; its thickness is measured across the closed valves, at the most prominent part from the right to the left side of the animal, as shown in fig. 12. Transfer yourself in imagination within the shell (fig. 13), with your head towards A and your back towards the dorsal border, and you will recognise the valve figured as the *right* valve. Anterior to the *umbo* there is usually an oval depression, forming a concavity in the outline

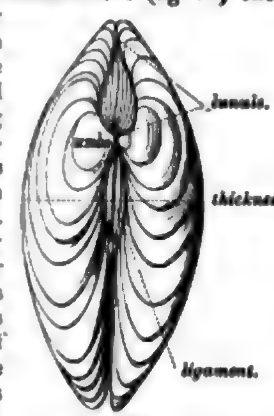

Fig. 12.
Cytherea.

[1] See Carpenter in *Reports of the British Association* for 1844 and 1847.

of the valve; it is called the *lunule*. The hinge ligament is sometimes between the *umbones*, never anterior to them. If the shell be divided by a line dropping from the apex of the *umbo* into an "anterior" and "posterior" part, it is never

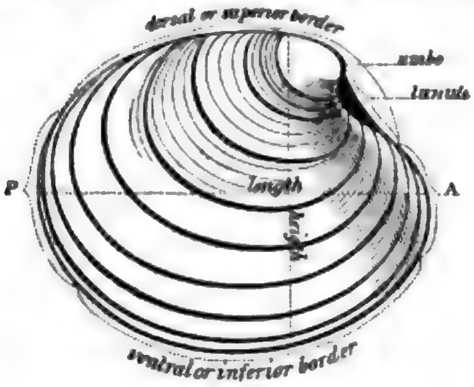

Fig. 13.
Cytherea chione.

equally divided; in other words, it is unequilateral. *Pectunculus* is least so; in *Glycymeris* and *Solemya* the anterior moiety is longer than the posterior one; in almost all other Bivalves it is shorter, as in *Cytherea* (fig. 13); commonly it is much shorter. Most Lamellibranchs are *equivalve;* that is, the right and left valves are of the same size and shape as in *Cytherea* (fig. 12). The exceptions occur in the stationary and often fixed species, which lie on one side when the lower valve is deeper and more capacious than the upper one. This lower valve in the oysters (*Ostrea*), in *Pandora*, and *Lyonsia*, is the left valve; the smaller and flatter upper valve is the right one. In *Chamostrea* and *Corbula* the left is the smallest valve. The *Placunæ, Pectines, Spondyli*, and *Aviculidæ* rest on the right valve; the *Anomiæ* are attached by degenerated muscular fibres passing through a hole or notch in that valve to a more or less calcified lamellar plug. All these shells are called *inequivalve*.

The bivalve is called *close* when the valves fit accurately; it is *gaping* if part of the borders do not come into contact when the shell is shut. In *Gastrochæna* this permanent opening is anterior, and serves for the passage of the foot. In *Mya* it is posterior, and serves for the passage of the byssus; in *Solen* and *Glycymeris* the shell gapes at both ends.

The outer surface of the shell is usually coated by an uncalcified layer of albumen called the periostracum or epiderm, continuous with the mantle. This surface is variously ornamented in many species, sometimes with ridges or "ribs," which may be either *concentric* and conformable with the layers of growth, or *radiating* from the umbones to the free margins of the valves; and the ribs may be bent, direct, oblique, or wavy. In *Tellina fabula* the sculpturing is confined to the right valve. In many species of *Pholas, Teredo*, and *Cardium* the surface is divided into two areas by a dorso-ventral furrow or by a change in the direction of the ribs. The thorny oysters (*Spondylus*) are so called on account of the spines which project from the rib-lines; they are longest and in greatest number upon the non-adhering valve. In some conditions of the shell the spines expand into foliaceous forms.

The part where the two valves are joined together is called the hinge. The *cardinal* or hinge-line is short in *Vulsella*, long and straight in *Avicula* and *Arca;* of moderate length, and curved in most genera. The locomotive Bivalves have generally the strongest hinges; however, a very well-developed example of the hinge mechanism may be studied in the *Spondylus*. Certain projections or teeth of one valve interlock into cavities in the opposite valve. The central teeth, usually beneath the umbo, are called *cardinal* teeth; those on each side are *lateral* teeth. The *Alasmodon* and *Kellia* have only lateral teeth; in many Bivalves only cardinal teeth are present. The teeth are apt to become thickened and even obliterated by age, through irregular growth, or by the encroachment of the hinge-line. Some of the fixed and boring Bivalves are edentulous.

The soft mechanism of the hinge consists of the *ligament* and *spring* (fig. 16, T, *b*). The ligament is a tough, thickened portion of albuminous matter like that of the periostracum, and is usually attached to ridges on the outer (dorsal) part of the hinge-margin, behind the umbones; it is consequently stretched by the closing of the valves. The *spring*, sometimes called "internal ligament," and (though improperly) the "cartilage," is lodged in the furrows between the ligamental plates, or in pits along the hinge-line. It is composed of elastic fibres placed perpendicularly to the surfaces of attachment, so as to be compressed by the shutting of the shell, which the elastic fibres consequently tend to open as soon as the action of the adductors ceases. The two parts are very distinct in the genus of Bivalves, thence called *Amphidesma* (double ligament), but they co-exist in most genera, with alternate proportions; the ligament being small in *Mactra*, which has a large "spring," and large in *Anodon*, which has a small "spring." The *Pholades* have the spring, but have not the ligament. This is replaced by the homologue of the anterior adductor, which is so situated as to act as an opener of the shell, and is called the "umbonal muscle." The functions of the shell in this boring Bivalve are too active and too frequently in exercise to be performed by the passive antagonist of the muscular closing powers which suffices for ordinary Bivalves.

The formation and repair of the shell are due to the development, change of form, and calcification of cells from the mantle; the nucleated cells of its outer surface being the matrix of the nacreous layer, its thick and periodically glandular margin that of the opaque outer portion.

The microscopic structure of bivalve and univalve shells has been well illustrated by Professors Carpenter[1] and Quekett.[2]

The primitive nucleated condition of the cell is sometimes retained after calcification. The dissolved lime-salts, after endosmotic penetration of the organic walls of the modelling cell, obey so far the general crystallizing force as to polarize light. The forms of the constituent lime particles of the shell, so moulded by combined vital and polarizing forces, are manifold in the various genera of Bivalves. The shell of the *Pinna*, save a thin internal layer, is composed of vertical, slender, usually hexagonal prisms. A thin outer layer of the shell of the oyster also presents the prismatic cellular tissue; but in a great proportion of this shell nearly all trace of development from cells is lost. The gelatinous basis is lamelliform, and this variety is called the subnacreous shell-substance.

Fine tubes, analogous to those of dentine, permeate the thickness of this substance in many shells,—radiating vertically between the ribs in *Arca*, vertical and scattered in the inner layer, and reticulate in the outer foliaceous spines, of the shell of *Chama*, which has an intermediate layer of ill-defined vertical prisms. The prismatic structure is rarely found, and then only in small proportion, in the Bivalves which have the mantle lobes in any degree united. The distinction between the internal or nacreous layers and the external or fibrous layer, has long been recognised, and has been forced, as it were, upon the notice of the palæontologist by the circumstance of the two being often separated from each other in fossil shells, and sometimes from one having perished whilst the other remained. As the

[1] *Reports of the British Association*, 1844 and 1847.

[2] *Lectures on Histology*, 8vo, 1853-4.

nacreous layer alone forms the characteristic hinge uniting the two valves of the shell, and alone receives the impressions of the soft parts, the true characters of fossil shells, as those of the *Aviculidæ* and *Radiolites*, which, in consequence of their position in porous chalky beds, have lost all the nacreous layer, cease to be determinable, save when a natural mould of the interior has been formed before the pearly lining of the shell was dissolved. When the inner layer is preserved, its impressions reveal the organization of the ancient fabricator of the shell as clearly as do the forms and processes of fossil bones that of the extinct vertebrate animal. The layers of the thick subnacreous inner substance of the shell of the *Spondylus* have frequently wide interspaces, called, from their contents, "water chambers." This "camerated" structure is well shown in the right or lower valve of *S. varius*, fig. 19.[1]

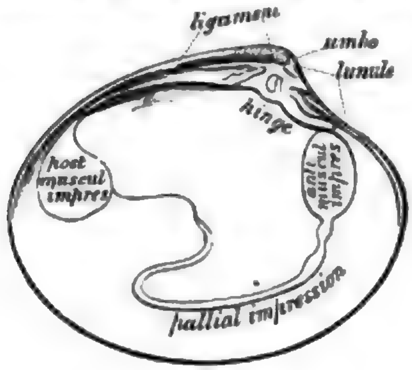

Fig. 14.
Cytherea chione.

In fig. 14, showing the internal surface of a *Cytherea*, the chief impressions are named. When two adductors are present, as in the Bivalves thence called "dimyary," they leave the anterior and posterior muscular impressions; when one adductor only exists, it answers to the posterior muscle, but is more central in position. The oyster is a familiar example of such "monomyary" Bivalve. When the pallial line or impression extends in an unbroken curve from the anterior to the posterior muscular impressions, it may be inferred that the inhabitant of the shell had either no siphon, or a very small or a non-retractile siphon; when the line is bent towards the centre before it reaches the posterior adductor, as in fig. 14, the presence of a retractile siphon is indicated, this notch being occupied by the retractile muscle of that part. When a foot is present, its retractor-muscles usually leave recognisable marks on the interior of each valve. The siphon in some of the elongated *Inclusa* cannot be retracted into the shell; they are consequently exposed, as in *Pholadomya* and *Pholas;* such species derive extrinsic shelter by burrowing in the sand or stone. The *Pholades* have supplemental calcareous pieces in the hinge of the shell: two small plates protect the umbonal muscles, and a long narrow plate fills up the dorsal interspace of the valves. The *Clavagella* (fig. 15) and *Aspergillum* line their burrows with a calcareous layer *d*, which forms in the latter (fig. 23) a distinct tube, closed at the larger extremity by a perforated calcareous plate. One of the valves of the normal shell adheres to the tube in the *Clavagella* (fig. 15, *f, g, h*), and both are cemented to its inner surface in the *Aspergillium* (fig. 23). In the *Teredo navalis* (fig. 25) the valves are reduced to mere appendages of the foot at one extremity of the animal, and are almost restricted in their function to the action of boring. As the ship-worm advances in the wood, it lines its burrow with a thin layer of calcareous matter. The length of the body is chiefly due to the prolongation of each respiratory tube, the siphon of which is provided with a small elongated calcareous triangular paddle-shaped plate. In the *Teredo gigantea* the calcareous tube, which sometimes surpasses

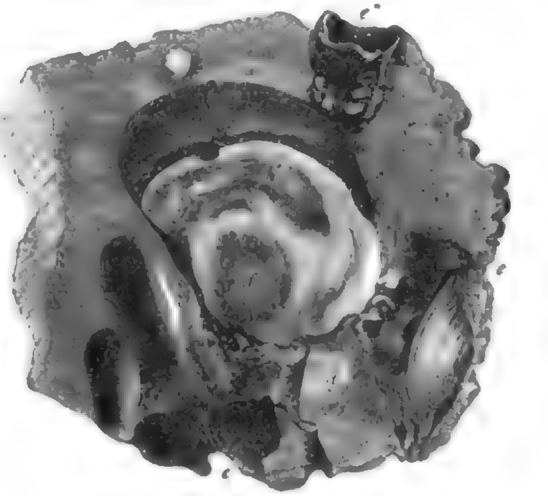

Fig. 15.
Clavagella lata.

6 feet in length, has parietes of from 4 to 6 lines in thickness, the texture of which is crystalized or spathose. Two tubes are developed within its siphonal end. In *Teredo norvegica* the calcareous tube is divided longitudinally, and also transversely, into compartments by irregularly-placed incomplete concave septa.

The valuable pearls of commerce are a more compact and finer kind of nacre, often developed in the substance of the mantle or around a particle of sand or other foreign body which has gained admission to the pallial cavity. The *Meleagrina* or *Avicula margaritifera* of the Persian and Indian seas is most famous for these productions; those developed in the gills or inner layer of the mantle are small and numerous; those of the outer layer are the largest but least regular, and are attached to the shell. The "external" pearls consist of a concentric layer of minute vertical prisms; the "internal" pearls of concentric layers of wavy calcified membrane.

The iridescent nacreous lining of the pearl oysters (*Avicula*), and many other shells, consists of the same wavy lamelliform tissue; the pearly lustre is due to the diffraction of the rays of light by the out-cropping edges of the laminæ, and in some cases to the minute plication of a single lamina. (Brewster.)

If the shell of a living pearl oyster be perforated, and a minute particle of sand introduced, it becomes a nucleus round which a pearl is developed. Linnæus was knighted on making known to his sovereign this practical application of his science; but the artificial production of pearls had long been known to the Chinese, who obtain them of definite forms by introducing substances of the required shape into the shell.

The *Unio margaritifera*, or pearl mussel of British lakes and rivers, is fished up for the ornamental excretions to which it is subject. It is probable that the pearls from this source, collected by the ancient Britons, may have given rise to the statement of Tacitus, in his *Life of Agricola*, of "pearls not very orient, but pale and wan," being among the indigenous products of the conquered island.[2]

[1] *Annals and Mag. of Nat. History*, vol. ii., 1838, p. 407.
[2] Owen, *Report on Animal Substances in the Great Exhibition of* 1851, 8vo, p. 164.

The mantle (fig. 16, *ab*) is that portion of the skin of the Lamellibranch which, after investing the viscera, gills, and foot, is reflected, ventrad, in the form of plates and "lobes" to line the shell which it has formed, and be produced, when needful, into breathing-tubes. It consists of a middle layer of fibro-cellular tissue, in which contractile fibres are

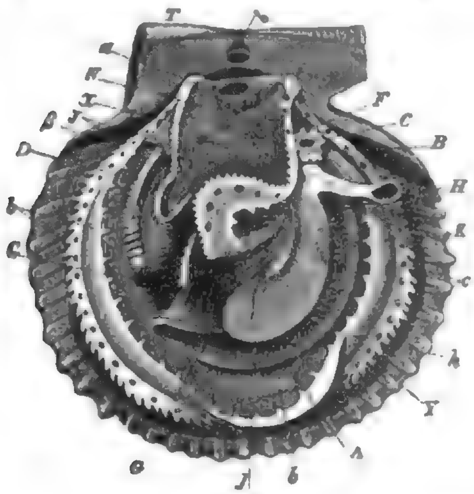

Fig. 16.
Pecten opercularis.

variously developed, of an internal layer of "ciliated epithelium," and of an external layer of epithelial cells, with nuclei, sometimes called "glandular epithelium."

The lobes of the mantle may be widely separated (*Ostrea*, *Pecten* (fig. 16, B, *b*); or partially united between the branchial and anal orifices (*Mytilus*); or united behind, leaving a single siphonal orifice; or united between the siphonal orifices and in front of the branchial opening; or the union of the mantle-lobes may be so extended as to leave a pedal or byssal opening, a branchial, and an anal opening, —all of small size (*Dreissena*); or finally, the mantle may become like a sheath, with terminal pedal and siphonal apertures (*Solen*); and the former may be reduced to a small foramen, and surrounded by a thick cushion of boring muscles, as in *Clavagella* (fig. 20).

The mantle is complicated in some Bivalves by glandular sacs (fig. 16, *a*), which sometimes contain a gaseous fluid subserving the Pectens,—*e.g.*, to float with their light shell, and change their situation at the ebb and flow of the tide. The Pectens, also, well exhibit the valvular reflected sub-marginal fold (fig. 16, *h*) of the mantle, the tentacula developed from that fold and from the free margin of the mantle (fig. 16, *b*), together with the eye-specks or ocelli *c*, near that margin.

The jawless and toothless mouth (figs. 16 and 17, C) is surrounded by a plicate (fig. 17) or tentaculate (fig. 16, F) labial border, produced into the labial palps (fig. 17, E), of very varying length in different Bivalves. The stomach (fig. 17, U) receives the hepatic ducts; and, save in most *Monomyaria*, develops a sac (fig. 17, V) containing the part called the "crystalline style," the gastric extremity of which (V) supports a thin cartilage, called the "tricuspid body" (fig. 17, *v*). The chief part of the style and of its sac is directed towards the pore by which water is admitted into the foot; and it has been conjectured to give some resiliency to that organ, with which it usually co-exists. In *Anomia*, however, it supports a free portion of the mantle. Poli supposed the tricuspid body to regulate the flow of bile into the stomach, for which its position seems to fit it. The intestine is short in *Anomia* and *Ostrea*, and exhibits various proportions up to twelve times the length of the entire Mollusk, as, *e.g.*, in *Cardium echinatum* (fig. 17, D). The curious relation of the rectum (*P*) to the heart Q is shown in this figure. The position of the rectum in the *Pecten* may be seen at D (fig. 16). The circulation may be traced, beginning with the abundance of veins which

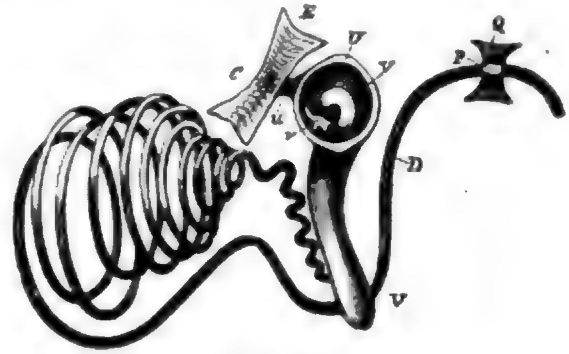

Fig. 17.
Cardium echinatum.

rise from the alimentary canal and from the superficial capillaries of the labial tentacles and generative mass, to the trunks receiving also the contents of the dilatable sinuses of the foot and peripheral part of the mantle, and pouring it into the median venous sinus, in which course it passes through the cavernous structure of the excretory (renal?) organ; the large sinus situated upon the posterior adductor and below the pericardium conducts the blood to the gills; but part of the veins of the mantle terminate, as Mr Garner first observed,[1] directly in the auricles. These, however, chiefly receive the blood from the branchial veins. Two semilunar valves regulate the flow of the blood from each auricle into the ventricle, and valves also prevent the reflux of the blood from the aorta into the ventricle. In *Arca*, *Lima*, and some *Pectunculi*, the ventricle is divided. Whenever the veins expand into sinuses they preserve a proper tunic. In *Ostrea* and *Anomia* the ventricle lies upon the rectum.

The gills (fig. 11, *p*, *p*) are essentially internal highly vascular folds of the pallial membrane, and are strengthened by series of delicate-jointed filaments, which support several rows of curved vibratile cilia. The respiratory currents are occasioned by the ceaseless action of these cilia, aided by that of the ciliated epithelium of the mantle, and are not dependent upon any opening or closing of the valves of the shell. The ciliary action is that likewise which brings the nutrient molecules to the mouth, chiefly along the marginal grooves of the branchial plates, where the molecules are mixed with mucus, and moulded into small filamentary masses.

In *Lucina* and *Corbis* there is only a single gill on each side; as a general rule there are two. Each gill consists of two membranous plates, continued into each other at the free margin of the gill; the contiguous plates of the two gills are continuous at the base or bottom of the branchial interspace where they are fixed, the basal border of the plate forming the opposite side behind the foot in the fresh-water mussels. The two plates of each gill are united together at pretty regular intervals in the direction of their breadth by transverse septa or bars, so as to include canals running transversely to the gill-plates. According to the course of the current of water through these interlaminar canals, they commence by the small slits or pores along the groove on the free margin in the branchial chamber, and terminate by the wider openings at the fixed margin of the gill in the anal chamber.

The minute particles suspended in the branchial currents

[1] *Zool. Trans.*, vol. ii., p. 90.

are carried by the ciliary actions towards the mouth, and the water is filtered through the interlaminar canals before it escapes. The walls of the interlaminar tubes support a regular network of blood-vessels, longitudinal and transverse,—the latter being most prominent; the meshes are parallelograms, and form open spaces fringed internally by a narrow ciliated membrane. The cilia compel the requisite movements of the water in the branchial chamber when the Bivalve remains suspended in the air, as happens to a mussel attached to a rock above low-water mark. Even when the animal is in such a position as to be immersed only for about two hours in seventy-five days out of the year, it can live and grow, the retained water deriving oxygen from the atmosphere, and the animalcular food propagating therein. The life of the "tree oysters" (*Ostrea polymorpha*), suspended to the mangrove branches, is similarly explained through the wonderful mechanism of the ever-active microscopic cilia.

The two gills of one side are usually connected with those of the opposite side by their hind ends only, but sometimes the union is more extensive. In a few genera, as *Anatina* and *Pholadomya*, the two gills of the same side are so united as to appear like a single gill. In the *Pholadomya* this forms a thick oblong mass, finely plicated transversely, attenuated at both extremities, slightly bifid at the posterior one.

Although the microscopic cilia form the ordinary and constant dynamical part of respiration, the function is occasionally influenced by the muscles of the shell, as when the water is squirted out of the siphons by a sudden shutting of the valves. The quiet and ordinary respiratory current enters in *Anomia* at the anterior base of the shell, and escapes posteriorly near the termination of the branchiæ. In *Modiola vulgaris* the current enters by the cirrigerous border of the mantle, and between that part and the foot; it escapes by the posterior produced part of the mantle. In *Mactra* and *Tellina*, when the conjoined siphons are extended, and the hyaline valve is exerted from the anal siphon, the current flows in at the "inhalent" branchial or ventral siphon (fig. 10, *g*), and rushes out by the "exhalent" dorsal or anal siphon (fig. 10, *g'*); there is no current at the pedial aperture. The branchial siphon is often much dilated, so that its diameter greatly exceeds the anal one,—*e.g.*, in *Pholas*. The siphonal apertures, especially the inhalent one, are provided with a circle of tentacles to prevent the ingress of noxious particles.

There is a remarkable plexus at the base of the gills, near the pericardium, which surrounds a distinct glandular organ in the higher Bivalves. It is double: each sac is elongated with glandular walls, and communicates with the pallial cavity by a small prominent orifice, usually close to the genital pores. The secretion of this body abounds with calcareous particles, and it was called by Poli the secreting organ of the shell. Modern analysis has detected uric acid in these sacs, and has thus determined them to be the renal organ.

An orifice at the extremity of the foot of Solen, at the middle of the foot of Cardium, and the tube situated above the pedunculate anus of Pinna, severally admit the sea-water into a reticulate system of channels in the substance of the foot, thence extending into the lobes of the mantles, and into a part of the visceral mass. By this provision for the admission of water the foot can be swollen out like a sponge, and made to exceed the capacity of the shell. The relations of this aquiferous system to the sanguiniferous one are not satisfactorily determined. The fine jets of water expelled from the foot and the border of the mantle, when a Solen is suddenly removed from the water, are from the aquiferous canals.

The nervous system of the *Lamellibranchiata* is here illustrated by the modification which it presents in the common mussel (*Mytilus edulis*, fig. 18).

The labial or subœsophageal ganglions *b* may be distinguished by their yellow colour. At the base of the labial processes they are connected by a short transverse chord *a*, passing dorsad, and in advance of the mouth. Four sets of

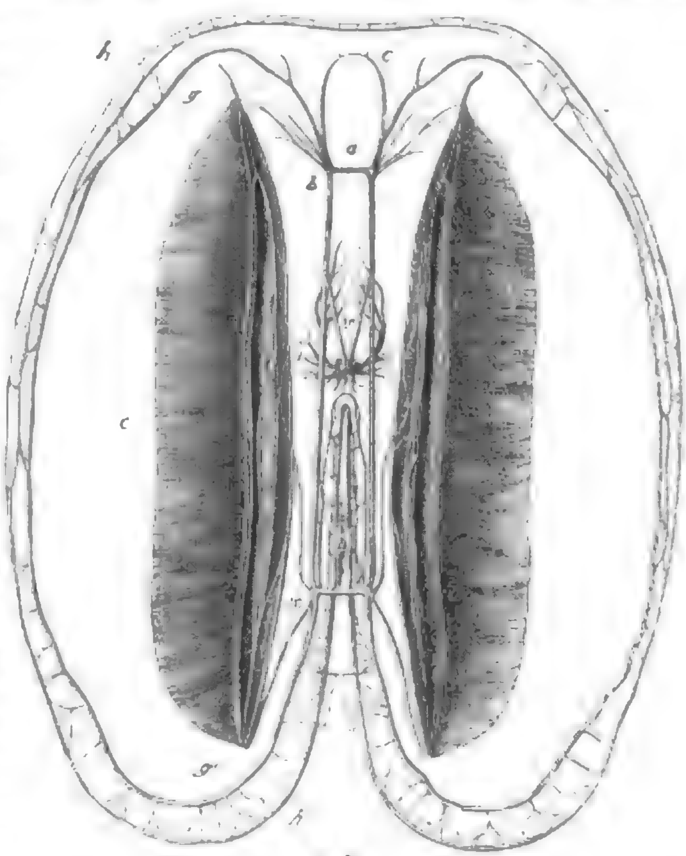

Fig. 18.
Mytilus edulis.

filaments diverge from the labial ganglions,—viz., the proper labial nerves, filaments to the hood-shaped process of the mantle above the mouth, nerves to the anterior adductor and continued into the circumpallial plexus *g*, and the principal nerve-trunks *b*, dividing or resolving on each side into the nerves to the pedial ganglion *v*, and those to the branchial ganglions *x*. The pedial ganglion completes the wide collar surrounding the œsophagus; it sends off nerves to the retractors of the foot, to the byssal ganglion, and to the acoustic sacs. The branchial or branchio-pallial ganglions *x* send off nerves which diverge as they pass to the base of their respective gills *c*; then each gives off a large nerve *g'*, which passes across the post-adductor muscle to the hinder part of the pallial lobe, along which it curves, and is continued forwards near the border of the mantle until it meets and anastomoses with the corresponding nerve *g*, which was continued over the ant-adductor from the labial ganglion. These circumpallial nerves *gg'* send off branches which form loops at the base of the pallial tentacles and along the rest of the free border of the mantle, forming the circumpallial plexus *hh'*, which is continued into the cardinal plexus *i*; such continuation being unconformable with the circumpallial nerve *gg'*.

Oysters are sensible of light: it has been observed that they closed their valves when the shadow of an approaching boat was thrown forward, so as to cover them, before

any undulation of the water could have reached them. The Pecten has a number of sub-pedunculate ocelli (fig. 16) arranged round the inner margin of the mantle, whence Poli called the animal *Argus*. But the name is equally merited by some other Bivalves. As many as sixty ocelli have been counted on the convex lobe of the mouth, and ninety on the plain lobe, in *Spondylus gæderopus*.

The organ of hearing consists of a small sacculus, with thick transparent walls attached to the fore part of the pedial ganglion, and containing cretaceous sub-crystalline particles which perform oscillatory movements.

The labial tentacles seem well adapted, both by structure and position, in most Bivalves, to exercise the sense of smell; but in *Nucula* the palps are rigid. The mouth is highly susceptible of impressions from contact of its free, and commonly tentaculigerous border.

The nervous system in Acephalous Mollusks advances according to the complexity of their general organization, and especially of the muscular system.

To revert to the *Tunicata*, in a brief review of this progress and its chief physiological conditions, for which alone we have at present space:[1]—The wants of the Ascidian are to breathe, to feed, to discharge its excrements, and emancipate its progeny. But the food is obtained by the same process as breathing, in this as in other Acephalous Mollusks; the streams of water which distribute oxygen over the surface of the vascular gill at the same time bring the nutrient particles to the mouth. This, moreover, begins at the œsophagus. There is no true mouth, no jaws, no teeth; for there is nothing to comminute or prepare for deglutition. In ourselves, when at rest, respiration is an involuntary or reflex action. It is accelerated by volition, to meet, perhaps, the exigencies of some violent locomotive effort; but locomotion is denied to the Ascidian. The same stimulus of necessity which in man is carried, during sleep, to the *medulla oblongata* by the *nervus vagus*, and which is reflected along the phrenic nerves, causing diaphragmatic action, independently of sensation or volition, is, we may suppose, similarly impressed upon and reflected from some analogous nervous centre in the Ascidian.

Ordinary respiration in this animal is, however, effected by an organization of which the actions seem to be less dependent upon a nervous centre than those of any of the peristaltically moving parts; the respiratory medium is renewed upon the vascular surface of the gill by the action of the vibratile cilia. Occasionally, at intervals, the sac may be seen unusually distended, and the water to be expelled by a sudden and forcible contraction of the mantle,—an act which may be compared with the involuntary yawn by which we distend our lungs to the utmost, and empty them by a violent expiration.

In the Ascidian the contents of the rectum and the generative organs are expelled by the same action of the mantle, though by a different outlet from that which gives passage to and fro to the respiratory currents. Both outlets are provided with feelers and sphincters, to prevent the entry of noxious bodies, and to regulate the exit of the excretory currents. The apparatus of nervous matter, in such a being, is a ganglion situated between the inhalent and exhalent orifices, as shown at fig. 5, *k*. Nervous filaments transmit to the ganglionic centre certain impressions; the requisite influence to cause contraction is reflected by other nerves to the muscular sac. But particles in the respiratory sac may be unfit for food, or hunger may require a greater or more frequent distension of that sac. Impressions are conveyed, therefore, from the mouth, or nutrient orifice, by nervous chords to the branchial ganglion; and, reciprocally, impressions received by the branchial ganglion are conveyed to the mouth.

In the oyster the mouth is released from the respiratory sac; it is so placed as to have a wider field of choice. We now therefore find it provided with "labial processes," or organs for selection, if not prehension: hence the necessity for their possessing nervous centres of their own. But the oyster becomes fixed, like the Ascidian; there is no locomotion in the adult state. Expulsion of respiratory streams, and of the excrements and sperm-cells or ova, by sudden approximation of the valves, and contraction of the pallial lobes, is the sole sign of vigorous motion, and it produces the same effect as the contraction of the muscular tunic in the Ascidian. The stimulus to such action is reflected from the ganglion upon the adductor to that muscle, and to the muscles of the pallial border. Such ganglion is, therefore, analogous to, if not homologous with, the ganglion *k* in the Ascidian: it is the "branchial" ganglion; the superadded nervous centre is the "labial" one.

In the mussel, with the additional muscularity and fringed structure of the mantle-lobes, and with that further development of the whole muscular system which governs an increased activity of the breathing function, the "branchial ganglions" are increased and parted. The foot, which, besides guiding and fixing the byssus-threads, is an exploratory organ, calls for an additional centre of the nervous system—the "pedial ganglion." Bivalves are conscious of light, but cannot discern an approaching object. The movements of the predatory crab or insidious whelk, whether by day or night, upon the rock from which the mussel swings, produce vibrations that will affect an acoustic organ. The tip of the protruded foot may be the first part to receive their appulse, direct or reflected, from the parts of the shell to which it is affixed. Certain it is, that with the pedial ganglion (fig. 18, *v*) is associated that little sac, with prismatic oscillating otolites, which its discoverer Siebold and all subsequent physiologists hold to be a rudimental organ of hearing. The relations of this organ we shall find to change, in higher Mollusks, according as a ganglion may be situated near parts better adapted for the ready reception of the peculiar stimulus affecting it.

Thus the "pedial ganglion" is the third additional nervous centre in the Acephalous development. The fourth is where a small "siphonic ganglion" is developed at the point of confluence of the muscular respiratory tubes in the Bivalves which possess those accessory mechanical organs of respiration. The physiological explanation of this nervous centre is the same as that of the ganglion of the foot: the newly-developed parts extend and diversify the relations of the Bivalve with the surrounding world, and there must be corresponding centres for the reception and reflection of stimuli.

Take from man the necessity of clothing himself, by giving him a natural covering of scales or hairs, and you suppress, at the same time, all the arts which have attire for their object. Blunt his sense of taste, and the culinary arts must disappear; and so on for the other wants. Now, between the wants and the actions lie the faculties. The animals which have fewest organs have fewest wants, perform the fewest actions, and possess the fewest faculties. Hence the mystery which envelopes the psychical operations of animals is not so impenetrable as it seems.

The following table briefly expresses the principal characters of the soft parts upon which the Lamellibranchiate Bivalves have been divided and subdivided. It is based upon that given by Mr Garner in his paper upon the anatomy of this class of Mollusks,[2] with modifications suggested by subsequent observations of the writer and others:—

[1] The chief steps of this progressive development of the nervous system may be found described in Owen's *Lectures on Invertebrata*, 1855, p. 510-511.

[2] *Zoological Transactions*, vol. ii., p. 100.

CLASSIFICATION OF THE LAMELLIBRANCHIATA.

- MONOMYARIA, *Lam.* With but one adductor muscle.
  - Labial tentacles very long, not distinct from the branchiæ; branchiæ united; adductors subdivided, and with an adductor-like byssal muscle...... ANOMIA—Placuna.
  - Labial tentacles short, separate from the branchiæ..............
    - no foot ...... OSTREA—Gryphæa.
    - a foot.....
      - branchiæ disunited medianly.........
        - foot long, cylindrical; ocelli at the edge of the mantle...... PECTEN—Pedum.
        - foot short, thick, with a disk at the extremity, from the centre of which depends a pedicellated oval body; ocelli........ SPONDYLUS—Plicatula.
        - foot compressed; no ocelli...... LIMA.
      - branchiæ conjoined medianly...... VULSELLA.
- DIMYARIA, *Lam.* With two adductor muscles.
  - Mantle without separate orifices or tubes.......
    - foot slender, byssiferous; lips simple...... AVICULA.
    - foot long, rounded, deeply grooved, with a callosity...... ARCA.
    - foot compressed, crescent-shaped; its margin undulated...... PECTUNCULUS.
    - foot oval below, its margin serrated; lips volute...... NUCULA.
    - foot large, pointed anteriorly, bent at an angle...... TRIGONIA.
  - Mantle with a distinct anal orifice............
    - foot small, byssiferous.......
      - anterior muscle small; retractile muscles of the foot numerous; byssus large...........
        - byssus divided to its base...... MYTILUS.
        - byssus with a common corneous centre...... MODIOLA.
        - anus furnished with a long ligulate valve...... PINNA.
      - muscles equal, two pairs of retractile muscles only; byssus rudimentary...... LITHODOMUS.
    - foot large, not byssiferous in the adult...... UNIO.
  - Mantle with an anterior and posterior orifice; not elongated into tubes ....
    - mantle widely open,
      - foot long, sickle-shaped...... CARDIUM.
      - foot very long, folded...... LUCINA.
    - mantle closed around the foot or byssus
      - foot short and discal, byssiferous; anterior muscle small...... TRIDACNA.
      - foot small, cylindrical, bent at an angle; lips foliated...... CHAMA.
      - foot long, sharp; lips simple...... ISOCARDIA—Diceras.
  - Mantle with two produced tubes, or siphons...
    - branchiæ not produced into the lower tube......
      - mantle more or less open in front...
        - tubes disunited; foot lanceolate....
          - foot large, rather falciform; external branchiæ shortened; mantle tentacular; labial tentacles small, pointed............ DONAX—Capsa.
          - foot moderate, tongue-shaped; external branchiæ shortened; edge of mantle simple; tentacles long, tapering............ PSAMMOBIA—Soletellina, &c.
          - foot moderate; external branchiæ rudimental; tentacles very large; margin of the mantle fringed...... TELLINA.
        - tubes more or less united; foot various...
          - branchiæ united medianly.
            - tubes small, partially divided; foot very long, obtuse........... CYCLAS—Cyrena, &c.
            - tubes small, united to the extremity; foot large, heeled, and pointed...... MACTRA.
            - tubes large, united half-way; foot short and prominent behind.... VENERUPIS.
          - branchiæ disunited medianly.
            - foot lanceolate; tubes small, united half-way...... CYTHEREA.
            - foot securiform; tubes larger and more or less distinct............ VENUS—Astarte, &c.
      - mantle only open inferiorly for the protrusion of the foot...............
        - tubes small; lips long.
          - foot small; branchiæ of each side united into one...... PANDORA.
          - foot larger; branchiæ separate... CORBULA.
        - tubes long.
          - foot not byssiferous; tubes large and coriaceous; lips long. ..... MYA.
          - foot byssiferous; tubes moderate, lips short...... SAXICAVA.
    - branchiæ produced into, or attached, to the lower tube; tubes always united ....
      - mantle open anteriorly.
        - foot long, club-shaped; tubes short...... SOLEN—Sanguinolaria, &c.
        - foot very short, rounded
          - two distinct adductor muscles; anterior one situated below a reflected portion of the mantle, uniting the beaks instead of a cartilage; tentacles large...... PHOLAS—Gastrochæna, &c.
          - body very elongated; adductor muscles united; end of mantle with two calcareous pieces; tentacles small; no cartilage nor reflected portion of mantle...... TEREDO.
      - mantle with a minute pedal opening anteriorly...
        - foot very small...
          - shell cemented by one or both valves to the shelly tube...... CLAVAGELLA—Aspergillum.

* The *Monomyaria*, although they form an order or primary group of this class in most systems, are far from equivalent in the characters of their organization to the dimiary group; and the same remark applies, though not with equal force, to the binary division based upon the absence or presence of siphons or respiratory tubes. The quinary division of the class, as proposed by Cuvier, expresses more natural and equivalent groups. The classification here

Lamellibranchiata.

proposed is essentially that given in the writer's lectures on Invertebrata, 1855.

Family I.—OSTREADÆ.[1]

No anterior adductor; lobes of the mantle widely separated; foot none, or small and byssiferous. Shell inequivalve, sub-inequilateral; hinge, in some, edentulous.

Genera—***Anomia, Ostrea, Placuna, Pecten*** (fig. 16), ***Lima, Spondylus*** (fig. 19), ***Pedum, Plicatula.***

Of this family, the oyster (*Ostrea edulis*)—the most valuable of British Bivalves—may be regarded as the type. From the time of the discovery of Britain by the Romans the flavour of the oyster has been held in high esteem. The species is gregarious, and forms banks, usually on a rugged rocky bottom of from 5 to 20 fathoms depth, where they are obtained by the dredge. When collected with a view to the market, they are usually transferred to artificial grounds in shallow water, where they increase in size, but more tardily than in their native beds, not becoming full-grown until from five to seven years; neither do they breed so freely, and they are liable to fatal effects from severe frost. They, however, "fatten," as it is called, and acquire a more delicate flavour. The "close" or spawning season is in May and June; the season for sale and distribution in London is from the 4th of August to the 12th of May inclusive. About 30,000 bushels of "natives," or oysters from artificial beds, and about 100,000 bushels of sea-oysters, are annually sent to the London market. The western coast of Scotland and the Hebrides offer conditions peculiarly favourable for the propagation and perfection of the edible oyster. In the artificial beds, which thrive best in sheltered bays and estuaries, the oysters sometimes acquire a green colour. On close examination, the colour is seen to be confined to particular parts. The branchiæ and the intestinal canal beyond the stomach, *e.g.*, are of a bright green; the liver is of a blackish-green instead of its usual reddish tint. The heart, nerve-ganglions, adductor-muscle, and mantle retain their normal colours. The above partial coloration is conjectured to be due to Confervæ or green monads in the breeding tanks.

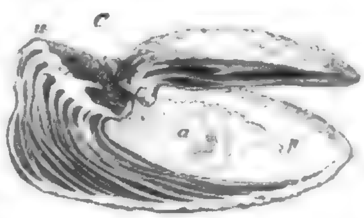

Fig. 19.
Spondylus varius.

Family II.—AVICULIDÆ.[2]

A very small anterior adductor; mantle lobes separate; foot small, byssiferous.

Genera—*Avicula, Meleagrina, Malleus, Vulsella, Gervillia, Perna, Crenatula, Inoceramus, Pinna.*

In this family the "hammer-oysters" (*Malleus*) are most remarkable for their form; the pearl-oysters (*Aviculæ*) and *Pinnæ* most attractive on account of their products.

The *Aviculæ* with shells less oblique in form, and with flatter and more equal valves, showing the posterior pedal impression blended with that of the great adductor, constitute the subgenus *Meleagrina*, of which the proper "pearl-oyster" (*Mel. margaritifera*) is the most valuable species, on account of the nacre and pearls which it produces. The "nacre," or "mother-of-pearl," is the iridescent, pearl-like, inner layer of the shell. For this substance, which is used largely in ornamental manufactures, immense numbers of the "pearl-oyster" are annually imported: the "silver-lipped" variety from the Society Islands, the "black-lipped" from the Philippines, and a smaller kind from Panama. These fetch from L.2 to L.4 per ton. The nature of "pearl" has been already defined. The pure pearl of commerce is generally spherical, and has a yellowish-white or bluish colour, with a peculiar iridescent lustre. Its hardness is due to carbonate of lime, which dissolves with effervescence in acid, leaving fine films of membrane. Such pearls bore an almost fabulous price with the ancient Romans; their greatest naturalist testifies:—"Principium culmenque omnium rerum pretii, margaritæ tenunt." (*Plin. Hist. Nat.*, lib. ix., c. 35.) In modern times their value has declined. A handsome necklace of Ceylon pearls, in size less than a large pea, may fetch from L.170 to L.300; the single pearls selling at about a guinea each. Pearls of the size of peppercorns sell at from 2s. 6d. to 10s. Pearls of still smaller size are called "seed-pearls." They are mostly sent to China. A pearl, pear-shaped, regular, and said to be without blemish, nearly 3 inches in length, and two-thirds of an inch in diameter, brought up at Catifa in Arabia, and now in possession of the Shah of Persia, has been valued at L.10,000. Mr Hope's pearl, exposed to view at the "Great Exhibition" of 1851, measures 2 inches in length, 4 inches in circumference, and weighs 1800 grains.

The best pearl-forming pearl-oysters are brought up from about 12 fathoms in the Persian Gulf, off the west coast of Ceylon, in the straits of Malacca, and at Tuticorin on the Coromandel coast. The largest pearls are found in the deepest places, as at the island Kharrak in the Persian Gulf. The Persian pearls are more esteemed than those of Ceylon. The pearl fishery of Tuticorin is monopolized by the East India Company, and that of Ceylon by the government; but it is very doubtful whether the results justify these exceptions to the general laws of political economy.

The animal of the ***Pinna***, called ***Chimera*** by Poli, is remarkable for the abundance, length, fineness, and lustre of the filaments composing the "byssus." The part so called exists in many Bivalves; but in some it is peculiar to an early period of life; in none does it attain so great a development as in *Pinna*. The byssus-filaments are united towards their roots into a common mass; they are attached in a cavity at the base of the foot by a peculiar substance secreted there (conjunctive matter). From the cavity a furrow runs to nearly the extremity of the foot, and along this furrow is situated the glandular tissue by which the byssus is secreted. Réaumur maintained that these horny threads were spun just like the web of caterpillars and the nets of spiders. With the assistance of the muscular foot, these threads are directed to determinate situations, and caused to adhere there firmly by their broad disciform extremities; they grow again if cut off.[3]

The byssus serves as an anchor to the Bivalve, of which use the common mussel offers a familiar instance. Vigorous strokes of the hatchet are needed to divide the byssus in detaching the great clam or "benitier" shell (*Tridacna*) from the rocks. The silky byssus-threads of the *Pinna nobilis* are woven into gloves and stockings in Sicily and Calabria; but they are objects rather of curiosity than of daily use.

Family III.—MYTILIDÆ.

A small anterior adductor; mantle lobes united between the branchial and anal slits; foot cylindrical, grooved, byssiferous. Shell equivalve; hinge edentulous.

Genera—***Mytilus, Modiola, Lithodomus, Crenella.***

The common mussel (*Mytilus edulis*) is the most important member of the present family in regard to human food. Mussels are gregarious, in extensive beds, always uncovered at low water; they are as widely distributed as

[1] Lat. for "oyster."

[2] Lat., signifying a "little bird."

[3] A. Mueller *de Bysso Acephalorum Acad.*, Tab. ii. Berolini, 1836, 4to; and in Wiegmann's *Archiv.* 1837, §§ 1–39, Tab. i., ii.

the oyster, and more easily attainable. The flesh is most esteemed and is least unwholesome in autumn; in spring, during the spawning season, cases of the gastric affection, followed by cutaneous eruption, called "musseling," are most common. They are, however, sufficiently exceptional to permit an immense consumption of this mollusk. It is estimated in Edinburgh and Leith at 400 bushels—say 400,000 mussels—annually; still greater numbers are collected for bait in the deep-sea fisheries. The species thus affords employment to numerous women and children of the fishing villages, especially along the Frith of Forth.

A singular form of fresh-water mussel (*Mytilus polymorphus*, Lam.), a native of the Aralo-Caspian rivers, is supposed to have been introduced with foreign timber into the Surrey Docks, where it was observed by Mr J. de C. Sowerby in 1824. It has since spread into canals, and has established itself as a British species. The anal and branchial slits are a little produced—the latter like a short siphon; and the rest of the mantle is closed, save at a small aperture through which the foot and byssus protrude. Accordingly, this mussel has been separated generically from *Mytilus*, as *Dreissena*, and under other names; and the *Dreissena polymorpha* departs widely from the pallial characters of the family Mytilidæ.

In most dimyary Bivalves the foot is an organ of locomotion. To some which rise to the surface of the water it acts, by its expansion, as a float; to others it serves, by its bent form, as an instrument to drag them along the sands; to a third family it is a burrowing organ; to many it aids in the execution of short leaps. In the piddocks (*Pholas*), two strong muscles are sent from the foot to be attached to the rough spatulate terminations of the bent processes under the beaks of the valves; these serve as fulcra in the excavating actions of the foot.

We may generally observe, in relation with the greater development and more active function of the foot, a corresponding complexity of the respiratory system. This is effected by the superaddition of accessory organs in the form of tubular prolongations of certain parts of the margin of the mantle, which are provided with a special development of muscular fibres. These are called "siphons" (fig. 11, *g*, *g'*).

Family IV.—Arcadæ.

Anterior and posterior adductors subequal; mantle-lobes separate; foot large, bent, deeply grooved. Shell equivalve; hinge long, multidenticulate.

Genera—*Arca, Cucullæa, Pectunculus, Limopis, Nucula, Isoarca.*

The animal of the *Yoldia* of Müller, otherwise nearly allied to *Isoarca*, departs from the pallial characters of the family in having the branchial and anal openings distinct, and produced into short retractile siphons. It makes a transition to the next family.

Family V.—Solenellidæ.

Mantle-lobes united behind with a single siphonal orifice or retractile siphon. Shell equivalve.

Genera—*Solenella* (foot deeply cleft, hinge with fine sharp teeth); *Solemya* (foot proboscidiform, hinge edentulous).

Family VI.—Trigoniadæ.

Mantle-lobes separate; foot long, pointed, sharply bent. Shell equivalve, trigonal; hinge-teeth few, diverging.

Genera—*Trigonia, Myophoria, Axinus, Lyrodesma.*

Of *Trigonia* only three living species or varieties are known; they are peculiar to Australia. Upwards of one hundred extinct species have been defined from fossil shells, ranging from the Trias to the Chalk, in Europe. It is remarkable that no species of *Trigonia* has been found in the Tertiary deposits of that continent.

Family VII.—Unionidæ.

Mantle-lobes united between the siphonal orifices and, rarely, in front of the branchial opening; foot very large, tongue-shaped, compressed, byssiferous in the fry. Shell usually equivalve; anterior teeth thick and striated; posterior ones laminar, sometimes wanting.

Genera—*Unio, Castalia, Anodon, Iridina, Ætheria, Mülleria.*

The common fresh-water mussels (*Anodon*), and the river mussels (*Unio*), exemplify the present family. To the latter genus belongs the pearl-forming species (*Unio pictorum*, Lam.; *Mya margarifera*, Linn.) of many of the rivers of Scotland. The family arrives at its maximum in regard to species and individuals in the large rivers and lakes of North America, and has furnished the subjects for the beautiful monographs by Mr Isaac Lea and Mr Kirtland in the *Transactions of the American Philosophical Society*, 2d series, vols. iii. and iv. (on the *Naiadæ* and species of *Unio*). In most of the Bivalves of the present family the fry are hatched in one of the gills, which swells out to such a size as to require a particular space in the shell for their lodgment; and the valves of the female are consequently more convex than those of the male.

The following dimyary families have short siphons and the pallial line simple:—

Family VIII.—Chamidæ.

Pedal orifice small; foot very small. Shell inequivalve; hinge-teeth 2—1 (two in one valve, one in the other).

Genera—*Chama, Monopleura, Diceras.*

The species of the latter genus are extinct, and characteristic of the Middle Oolites. The shell is remarkable for the much-produced spiral umbones or beaks, which give the valves the appearance of rams' horns.

Family IX.—Hippuritidæ.

(Order *Rudistes*, Lam.)

All the genera are extinct. The best illustration of their nature and affinities is given by Mr Woodward.[1]

Family X.—Tridacnidæ.

Pedal orifice large; siphonal orifices surrounded by a thickened pallial border, the anal one with a tubular valve; foot small, cylindrical, byssiferous. Shell equivalve, open; muscular impressions sub-central and blended.

Genera—*Tridacna, Hippopus.*

In this family the Lamellibranchiate type of organization is manifested under its largest size. The valves of *Tridacna gigas* are accordingly used to ornament gardens, as basins for fountains, and in Romanist churches for holding the holy water. The two large valves for this purpose in the church of St Sulpice at Paris measure each two feet in breadth. Linnæus records a shell in the "Museum Ludovicæ Ulricæ" which weighed 532 pounds.

Hippopus maculatus, or the "bear's-paw clam" of dealers, is perhaps the most beautiful of Bivalves, whether in regard to form, texture, or colour.

Family XI.—Cardiadæ.

Pedal orifice large; siphons usually short; foot large, sickle-shaped. Shell equivalve, cordiform; cardinal teeth 2, lateral teeth 1—1, in each valve.

Genera—*Cardium, Hemicardium, Lithocardium, Serripes, Adacna, Conocardium.*

The sapid Mollusk called cockle (*Cardium edule*) exemplifies the present family. It affects and often abounds in sandy bays, near low water. On the recess of the tide it burrows a few inches below the surface, its place being marked by a small depression. Women and children dig

[1] On the Structure and Affinities of the Hippuritidæ, *Quarterly Journal of the Geological Society of London*, February 1855.

up the shell-fish with a piece of crooked iron or a narrow shovel. They are in season during March, April, and May.

FAMILY XII.—LUCINIDÆ.

Mantle usually widely open below, with one or two siphonal apertures; foot long, cylindrical or ligulate, sometimes byssiferous. Shell orbicular, closed; hinge-teeth 1 or 2, lateral teeth 1—1, or obsolete.

Genera—*Lucina, Corbis, Ungulina, Kellia, Montacuta, Lepton.*

FAMILY XIII.—CYCLADIDÆ.

Mantle open in front; siphons more or less united; foot large, tongue-shaped. Shell sub-orbicular, closed; hinge with cardinal and lateral teeth.

Genera—*Cyclas, Cyrena, Pisidium.*

The species of this family live in fresh or brackish water. The fry of *Cyclas* are hatched in the internal gill.

FAMILY XIV.—ASTARTIDÆ.

Mantle-lobes united behind by a curtain pierced with two siphonal orifices; foot thick or compressed, tongue-shaped. Shell equivalve, closed; cardinal teeth 1—3, and usually a lateral tooth in each valve.

Genera—*Astarte, Circe, Cyprina,*[1] *Crassitella, Isocardia Cypricardia, Cardita.*

In the following families the siphons are long and retractile, leaving a sinuous "pallial line":—

FAMILY XV.—VENERIDÆ.

Mantle with a rather large anterior opening; siphons unequal, more or less united; foot tongue-shaped, compressed, sometimes grooved and byssiferous. Shell regular, closed; hinge with usually three diverging teeth in each valve.

Genera—*Venus, Cytherea, Artemis, Lucinopsis, Venerupis, Petricola, Glaucomya.*

"The shells of this tribe are remarkable for the elegance of their forms and colours; they are frequently ornamented with chevron-shaped lines. Their texture is very hard, all traces of structure being usually obliterated. The *Veneridæ* appeared first in the Oolitic period, and have attained their greatest development at the present time. They are found in all seas, but most abundantly in the tropics." (Woodward).

FAMILY XVI.—MACTRIDÆ.

Mantle more or less open in front; siphons united with fringed orifices; foot compressed. Shell equivalve, trigonal; hinge with two diverging cardinal teeth, and usually with lateral teeth.

Genera—*Mactra, Gnathodon, Lutraria, Anatinella.*

FAMILY XVII.—TELLINIDÆ.

Mantle widely open in front; foot tongue-shaped, compressed; siphons separate, long and slender. Shell usually equivalve and closed; cardinal teeth not exceeding 2, lateral teeth 1—1, sometimes wanting.

Genera—*Tellina, Psammobia, Sanguinolaria, Syndosmya, Scrobicularia, Mesoderma, Donax.*

In the following families the mantle is sheath-shaped, closed, save at the pedal and siphonal apertures. The group answers to the "Enfermés" or *Inclusa* of Cuvier. The species are burrowers in sand, mud, wood, or stone:—

FAMILY XVIII.—SOLENIDÆ.

Siphons short and united (in the long-shelled genera), long and partly separate (in the shorter and more compressed genera); gills prolonged into the branchial siphon; foot large, sub-cylindrical. Shell gaping at both ends.

Genera—*Solen, Cultellus, Machæra, Solecurtus.*

The "razor-shells" or "spout-fish" (*Solen siliqua* and *Solen curtus*) exemplify the present family. They are used in many places as food. Their burrows at low water are indicated by a small orifice like a key-hole, and they are found a foot or two beneath the surface. It is said that they never voluntarily quit their burrows; but fishermen in quest of them have the habit, in some localities, of throwing a pinch of salt in their holes, when they speedily rise to the surface, and are hooked out by a bent iron. If permitted, they soon bury themselves again. When used as bait for haddock or cod, the "razor-fishes" are kept for a day or two.

FAMILY XIX.—MYACIDÆ.

Siphons united; foot small. Shell gaping behind.

Genera—*Mya, Corbula, Neæra, Thetis, Panopæa, Saxicava, Glycimeris.*

The "gapers" (*Mya arenaria* and *Mya truncata*) exemplify the present family. They are found from a few inches to a foot below the surface, in mud or shingle. They are eaten in the Hebrides and in Zetland; and are collected for baits by fishermen.

FAMILY XX.—ANATINIDÆ.

Siphons long, more or less united; foot very small. Shell often inequivalve.

Genera—*Anatina, Pholadomya, Lyonsia, Pandora, Myochama, Chamostrea.*

The "lantern-shells" (*Anatina rostrata* and other species) exemplify this family. *Pholadomya* has an external ligament only; the gills are compacted into a single mass on each side, and the mantle has a fourth opening for a supplemental rudiment of the foot.

FAMILY XXI.—GASTROCHŒNIDÆ.

(*Tubicolidæ*, Lam.)

Siphons long, united to near their free ends; foot finger-shaped, sometimes grooved and byssiferous; mantle with a boring disc in front. Shell regular, wedge-shaped, gaping in front; in some more or less cemented to a superadded calcareous tube.

Genera—*Gastrochæna,*[2] *Clavagella, Aspergillum.*

"The *Gastrochæna modiolina* perforates shells and limestones; its holes are regular, about 2 inches deep and ½ inch diameter; the external orifice is hour-glass shaped, and lined with a shelly layer, which projects slightly. When burrowing in oyster-shells it often passes quite through into the ground below, and then completes its abode by cementing such loose material as it finds into a flask-shaped case, having its neck fixed in the oyster-shell." (Woodward.) In the *Gastrochæna numia*, Spengl. (*Fistulana clava*, Lam.), from the coast of Coromandel, the tube is free, and grains of sand often adhere to it; other species burrow in madrepores, and their calcareous breathing-tube is elongated to keep pace with the growth of the Polypes.

The "water-pot shells" (*Aspergillum*), and the "club-shells" (*Clavagella*), inhabit each an elongated tube, the extremities of which correspond to the anterior and posterior ends of the animal's body. The posterior end is widely open, expanding in a foliated form in the open sea; the opposite end communicates, by a varying number of minute and often-branched tubes, either with the interstices of a sandy bed, as in *Aspergillum*, or with cavities in the sandstone or coral rock in which *Clavagella* is more commonly found imbedded.

From the greater resistance, therefore, which the nidus of *Clavagella* presents to the development of the anterior tubes, these are less regular both in the number and place

[1] This Lamarckian name is too like the Linnæan *Cyprinus*; the name of the family, which ought to be retained for the use of Ichthyology exclusively, is accordingly here changed.

[2] Gr., in reference to the front or ventral gaping of the shell.

than in *Aspergillum;* their formation being influenced by the proximity to the tube of other cavities in the rock.

Where these tubes have been developed from nearly the whole of the surface of the mantle which intervenes to the wide aperture of the shell, the specimen of *Clavagella* has been termed *echinata*, though these processes are not closed and pointed at the extremity, as might be implied by Lamarck's trivial denomination; where, on the contrary, their formation has been limited to the anterior part of the mantle, the specimen has been raised to the dignity of a species by the term *coronata*. *Clavagella*, like its congener *Gastrochæna*, is remarkable for the wide opening of the valves. These cannot in the natural state be brought into opposition on their ventral margins; they are unequal to the protection of the soft parts; and hence the necessity of the extraneous defence which the walls of their rocky chamber afford them, these walls being also lined to a greater or less extent with a calcareous exudation from the mantle. Yet a specific character has been seized from this disposition of the valves, indicated by the species called *Clavagella aperta*. The soft parts of *Clavagella*, when exposed by the removal of the free valve and outer layer of the mantle, present the appearance shown in fig. 20. The true foot is wholly concealed by the great development of the muscular margin *l* of the mantle. The extremities of the labial tentacles *n* protrude at the interval between the anterior adductor *g'*, and the retractor of the siphon. The relative position of the soft parts (fig. 20) to the dwelling-chamber (fig. 15) is as follows: The mouth is turned towards the closed end of the chamber

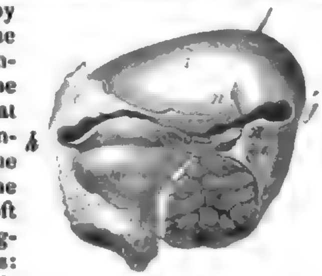

Fig. 20.
Clavagella aperta.

a, which is the anterior part; the heart and rectum are nearest the side where the valves are connected by the ligament *b*, or the dorsal part; the visceral mass projects towards the opposite or ventral side *c*, while the siphon extends into the commencement of the calcareous tube *d*, which leads out of the anal or posterior part of the chamber. The fixed valve (fig. 15) which covers the rough surface of the porous rock or coral like the tiling of a chamber floor, and affords a smooth, polished surface for the support and attachment of the animal, is the left valve; the right valve (figs. 21, 22) remains free, or is connected only to the soft parts and cardinal ligament, in order to assist in the excavating and respiratory actions.

That these actions are of a powerful kind is to be inferred from the remarkable development of the muscular system in the *Clavagella*. The impression of the great or posterior adductor (fig. 22, *f*) is carried two lines beneath the surface of the chamber posteriorly, but gradually rises to the level of the valve. The impression of the smaller anterior adductor (fig. 22, *g*) is fainter, and is continued into the sinuous pallial impression which follows the contour of the anterior margin of the valve at about two lines' distance from it. In the free valve (fig. 22) the last two muscular impressions are separate.

Fig. 21.
Free valve (*Clavagella aperta*).

The shelly substance of the fixed valve passes without interruption into that of the tube; a slight ridge circumscribing the entry of the tube into the chamber may be regarded as the line of separation, unless the extent of the valve be limited to that of the internal nacreous deposition.

The area of the tube is of an oval form. The calcareous parietes are 1-50th of an inch in thickness at the outlet of the tube, and about 1-30th at the opposite extremity.

The free valve (figs. 21 and 22) is an unequal triangle, with the angles rounded off, about the thickness of a sixpence, moderately concave towards the soft parts, striated only in the direction of the layers of increment on the outer surface. The layers of increment of the free valve gradually increase towards the dorsal edge for a little more than one-half of the valve, beyond which the layers continue of almost equal breadth. This growth of the valve corresponds to the direction in which the chamber is enlarged, which is principally on the dorsal, dextral, and anterior sides. Now this is the mode of enlargement best adapted for the full development of the ovary; so that it would seem that the *Clavagella* continues for a certain time to work its way into the rock without material increase of size, leaving behind it a calcareous tube which marks its track, after which it becomes stationary, and limits its operations to enlarging its chamber to the extent necessary for the accomplishment of the great object of its existence.

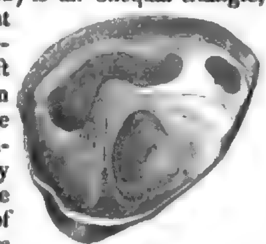

Fig. 22.
Free valve (*Clavagella aperta*).

The mantle envelopes the body like a shut sac, but is perforated for the siphon and foot, the opening for the latter being reduced to a small slit marked by the insertion of a bristle in fig. 20, which serves to keep up a communication between the chamber and its inhabitant; and it is seen that the chamber has always a communication with neighbouring cavities in the rock by means of the calcareous tubules, the formation of which is determined by the proximity of those cavities. When therefore the *Clavagella*, by a sudden contraction of its adductor muscles (fig. 20, *f*, *g'*), has forcibly expelled the branchial currents from the siphon, the space between the free valve and the walls of the chamber would be simultaneously filled either by water rushing in through the tubules or forced out from the branchial cavity through the small pedal orifice of the mantle.

The outer dermoid layer of the mantle is extremely thin, and where it does not line the valves, it is mottled with minute dark spots, and presents a glandular appearance under the microscope. The muscular layer, after forming the siphon and its retractors, is confined to the anterior part of the mantle, where it swells into a thick convex mass of interlaced and chiefly transverse fibres attached to the valves along the sinuous submarginal depression above mentioned, and forming one of the principal instruments in the work of excavation. No fibres could be detected in other parts of the mantle, nor could any longitudinally radiating muscles be expected in a mantle which had no lobes to be retracted.

The siphon, in the contracted state which it presented in the specimen dissected by the writer, formed a slightly compressed cylindrical tube half an inch in length, and the same in the long diameter. It is traversed longitudinally by the branchial and anal canals, which are separated from each other by a muscular septum extending to the end of the siphon, beyond which the two tubes do not separately extend outwards. The inner extremity both of the anal and respiratory tube is provided with a valvular fold. Their terminations are beset with short papillæ. The retractor muscles attach the siphon to the posterior adductor on one side, and to the anterior extremity of the oval mass of muscular fibres above mentioned on the other, leaving an intermediate space on both sides of the body, which exposes part of the gills and labial tentacles. The muscular mass which bounds the anterior part of the animal's body is of an oval form, 1 inch 3 lines in length, 8 lines in breadth,

and varying in thickness from 2 to 3 lines. It is smooth and convex externally, and hollowed out within to lodge the viscera at the base of the foot, for the passage of which it leaves the small orifice above mentioned. The margins attached to the valves are more or less irregular; that which is affixed to the loose valve is the broadest, being at the ventral extremity 3 lines in breadth; it may here be regarded as a third adductor. Posteriorly it is continued into the small adductor muscle. This muscle is marked *g'*, the great or posterior adductor *f*, in fig. 20.

The ovary is of a gray colour, forming a mass at the dorsal aspect of the body above the great adductor muscle, and extending ventrad on either side the œsophagus and stomach to the opposite end of the base of the foot.

All this mass of intestinal folds, hepatic follicles, and ova, was covered by a thin membrane. The little muscular process or foot which passes through the anterior slit of the mantle is but 4 lines long and half a line in breadth.

The organization of *Clavagella*, like that of *Aspergillum*, described in the *Reise von Afrik* of Dr Rüppell, is thus seen to be modelled on the Lamellibranchiate type, and follows most closely, in the variations from that type, the modifications which have been observed in *Gastrochæna*.

The lengthened worm-like figure of *Aspergillum* is exchanged in *Clavagella* for a shorter form, with greater lateral development; and instead of the small rudimentary valves, which are inchased, as it were, in the calcareous sheath of *Aspergillum*, we find them here largely developed, and one of them always remaining at liberty to be applied by a powerful muscular apparatus to those offices which are essential to the forcible expulsion of the fluid in the branchial cavity.

The *Aspergillum* exhibits the most extreme modification of the true Bivalve type of shell by the complete coalescence

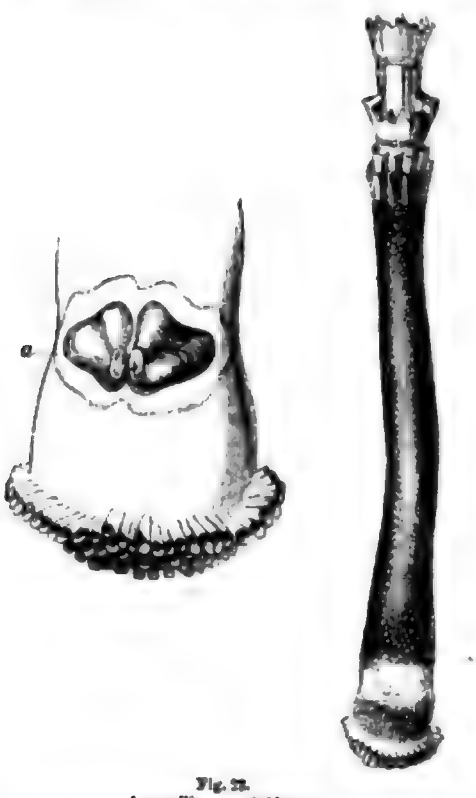

Fig. 23.
Aspergillum vaginiferum.

of its valves (fig. 23, *a*) with the parietes of the shelly tubes. They there form the stamp of its true affinities, but subserve as little any ordinary final purpose as the teeth buried in the gums of the fœtal whale.

The larger end of the tube is pierced by a number of short and small tubules and by a minute central fissure; the opposite or siphonal end is open, it is either plain or ornamented by circular plicated outstanding plaits formed by the shell-secreting layer of the siphons, and indicative of successive phases of growth of the tube.

The *Aspergillum vaginiferum* (fig. 23) inhabits the Red Sea; other species have been found in Java, Australia, and New Zealand.

Family XXII.—PHOLADIDÆ.

Animal clavate or vermiform; siphons large, long, united nearly to their ends; foot short, truncate. Shell gaping at both ends; hingeless, with sometimes accessory valves, or a supplementary tube and palettes.

Genera—*Pholas*,[1] *Xylophaga*, *Teredo*, *Teredina*.

The piddocks (*Pholas*) perforate all substances that are softer than their own valves. The mantle extends over the hinge, and, in *Pholas dactylus*, developes two accessory plates to protect the umbonal muscle, and a small transverse plate behind; a long unsymmetrical plate fills up the dorsal interspace of the valves behind the hinge. The prominent parts of the valves are beset with calcareous inequalities, connected by fine transverse parallel ridges, roughening the outer surface like a rasp. This species is used for food in Scandinavia, and for bait in the south of England; the hyaline style, lodged in the translucent foot, is worthy of note in the recent animal. The common piddock is gregarious. Fig. 24 shows a block of stone perforated by the

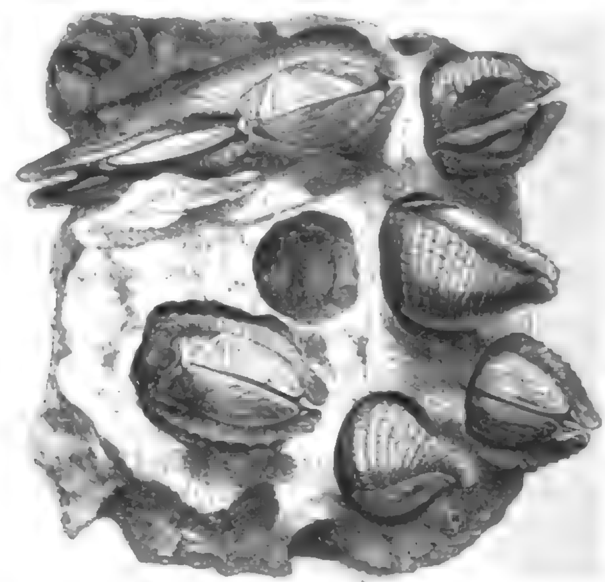

Fig. 24.
Pholas dactylus.

Pholas dactylus: the breakwater at Plymouth is thus infested.

In *Pholas dactylus* the labial processes are relatively longer than in *Pholadomya*, but are equal, and both have the usual transversely-plicated structure, although the outer one adheres by a great part of its outer surface to the mantle. In the *Pholas crispata* the whole external surface of the labial process is adherent, but it retains the fine plicated membranous structure; the internal labial process is a thick, broad, scarcely flexible mass, convex outwardly, concave where it is closely applied to the visceral mass, of a soft parenchymatous structure, quite smooth on the con-

[1] Gr. verb, "to be hid in a hole."

cave side, with hardly perceptible traces of the transverse lineations on the convex surface. This condition of the inner labial process has not been found in other Bivalves.

The ship-worms or pile-worms (*Teredo navalis*) live in wood, which they perforate in the direction of the grain, save where a knot in the timber or the tube of another *Teredo* is met with. The cavity in which they reside is lined with a calcareous incrustation. They grow in the wood, and do not first enter it as adult animals, for the external aperture, towards which the two tubes (*palettes*) are turned, is too narrow to allow the inclosed animal to enter. In fig. 25 the small valves of the true Bivalve shell are shown at *a*; the foot, which with the valves constitutes

Fig. 25.
Teredo navalis.

the boring organ, is shown at *c*; *d* is the liver and alimentary canal; *e* the branchiæ; the siphon-tubes and "palettes" terminate the vermiform body, and always point to the outlet of the burrow.

For the distinction of species recourse is had, amongst other characters, to the form of the two small shovel-shaped calcareous plates at the base of the siphons, commonly named *palettes* or *palmulæ*. One species, famous for the injury it caused to the piles of the dykes in Holland, in the beginning of the last century especially, is referred by some Dutch naturalists to the *Teredo Sellii* (*Teredo navalis*, L. et auctor. in part, *Teredo batavus*, Spengler). It is figured in the work of Sellius, and in Blumenbach, *Abh. naturhistorischer Gegenstände*, No. 89. The palettes are fixed on a short pedicle, inversely triangular, and terminating at the broad end on each side in a point. Piles that had been driven only six or seven weeks previously were seen to be entirely eaten through by this worm, and robbed of all their strength. In this way the island of Walcheren was in 1730 threatened with destruction. From time to time the same mischief was discovered in other places, especially on the Zuiderzee near Medemblik, Lambertshagen, &c.; West Friesland was forced, in consequence, to mask its dykes with large stones, which, being brought into the country from abroad, occasioned a great expense. Since the middle of the last century the mischief has much diminished. Copper-sheathing and broad-headed iron nails have been found most effectual in protecting ship-timbers and piers from the ravages of this singular little Bivalve. An excellent account of the pile-worm is given in the work of G. Sellius, *Histor. nat. Teredinis*, Traj. ad Rhen. 4to. Fossil *Teredines* are found in the Tertiary and Chalk strata.

The phenomena of boring substances of different kinds and densities by the Bivalve Mollusks have been the subject of many observations and experiments, and have suggested many hypotheses.

The peculiar shape and development of the foot in the *Solen* and other "burrowing" Bivalves, might have led to its recognition as an excavating agent, if even it had not been seen to effect the purpose in the living Mollusk. Direct observation of the "boring" Bivalves in the act of perforation has been rarely enjoyed, and the instruments have been more frequently guessed at or judged of from the structure of the animal. The peculiar shape, great strength, and restricted size of the concentrically-ridged valves, the disproportionate size and strength, and the red colour of their adductor muscle, with the curved umbonal processes for its advantageous leverage, in the *Teredo navalis*, could not fail to attract the attention of the unbiassed observer to their adaptation for the function of excavating wood.[1] It indicates a mind unfitted for physiological discovery to deny this adaptation, because the exterior of the valves is sometimes coated by a dried layer of the abundant mucus which is exuded from the pedial aperture during the active movements of the borer. The rasp-like exterior of the shell of the *Pholas crispata*, with the modifications of the adductors and their fulcral apophyses, in like manner suggests the rasping rotatory action by which the valves may produce, or aid in producing, the burrows in the rocks in which the piddocks conceal themselves. To deny this use of the Pholas shell because the shell of some other rock-boring Bivalve is smooth, is another inconsequential deduction. There are, doubtless, other modes of boring besides the shell-action; but the recognition of any such need not involve a negation of every mode save the one so recognised.

Mr Osler[2] has advocated the hypothesis of a chemical solvent as the boring agent, but such solvent has not been demonstrated; and the necessity of its being applied in currents of water to calcareous rocks on which alone it could operate, with the liability of the shell of the animal secreting the solvent to be affected thereby, have been insuperable obstacles to the acceptance of the hypothesis.

Mr Garner[3] has called attention to the streams generated by the extensive surface of ciliated epithelium in the Lamellibranchs, as probable aids to the rasping action of the valves; and since this demonstrated and constantly acting dynamic causes as unceasing a current of water in the holes of the borers, the non-extension of such current between the shell and the rock, where they may be in close contact, is no argument against the influence of the current in the rest of the hole, and especially at the line where it is opposed by such contact. The ingenious idea of the ciliary action as an accessory power in boring may therefore be accepted; from its universal applicability it is, at least, certainly worthy of notice.

The writer of the present article many years ago suggested that the same kind of instrument might be applied by Bivalve Mollusks to boring in rock which had been recognised as the one used for boring in sand. The anatomy of the *Clavagella* offered many points highly suggestive of the inadequacy of the hypotheses of the burrowing agents promulgated at the time when that lithodomous Bivalve was first dissected; and its structure indicated a power that had not been previously suspected in rock-borers. In the first place, it was evident that the valves could not act, as they do in *Teredo* and *Pholas*; for the terminal expansion of the chamber (fig. 15) had an irregular elliptical form in transverse section; and, moreover, one valve was fixed so as to form the lining-plate of its side of the chamber. The animal dissected (*Clavagella lata*) had formed its chamber in a rock of calcareous grit; but a nearly allied species (*Clav. australis*) had bored its way into siliceous grit; whilst specimens of *Clavagella melitensis* were ensconced in argillaceous tufa.[4] A special solvent for each species greatly complicates the chemical hypothesis. The muscular layer of the mantle of the *Clavagella aperta* presented, however, a peculiar modification, being expanded into a thick convex cushion (fig. 20, *l*), where it was applied to the bottom of the chamber, through the development in its substance of a mass of interlaced muscular fibres. The last excavated part of the chamber was, as it were, moulded to the sur-

[1] In the great *Teredo arenaria*, which lives in soft mud, the valves are wanting, according to Dr Gray; or their homologues form the convex cap closing the periodical growths of the calcareous tube.

[2] On the Burrowing and Boring Marine Animals, *Philosophical Transactions*, 1826.

[3] On the Anatomy of the Lamellibranchiate Bivalves, *Zoological Transactions*, vol. ii., 1839.

[4] All these rare species were liberally confided for examination to the writer by Mr H. Cuming.

face of the cushion, which was perforated by a minute slit for the occasional passage of a filamentary foot. In the original account of its anatomy it was thereupon suggested that this muscular development of the mantle must be "one of the principal instruments in the work of excavation.[1] But viewing its attachment to the moveable valve, and the strength of the adductor muscles, it was also supposed that that valve might be applied not only to effect the forcible expulsion of the fluid from the pallial cavity, but probably to assist in the excavation of the abode." Mr Hancock[2] has recalled attention to the excavating agency of soft and muscular masses in other boring Bivalves analagous to that in *Clavagella;* such as *e. g.*, the thickened portion of the mantle in *Saxicava* and *Gastrochæna*, and the foot in *Pholas* and *Teredo*.

If siliceous particles be actually secreted in the superfices of any of the burrowing discs, they must add to their efficiency; and it is certain that the perpetual renewal of a softer surface will render it capable of wearing away a harder one, subject to the friction of such softer surface, and not, like it, susceptible of being renewed.

The admission of the wearing and boring power of muscular discs need not, however, involve the rejection of the allied action of shelly valves and ciliary currents. The diversity of the organization of the boring Mollusks plainly speaks against any one single and uniform boring agent in all.

The action of the foot and thickened border of the pedial aperture may be inferior to that of the valves in *Teredo*, as it certainly is in *Pholas*. A valued correspondent, Mr Robertson of Brighton, informs the writer—"Between thirty and forty Pholades have been at work in lumps of chalk, in a finger-glass, and a pan of sea-water, at my window for the last three months. The *Pholas dactylus* makes its hole by grating the chalk with its rasp-like valves, licking it up, when pulverized, with its foot, forcing it through its principal siphon, and squirting it out in oblong nodules. They turn from side to side, never going more than half round in their hole, and cease to work as soon as the hole is deep enough to shelter them." The Pholades attain their largest size in soft yielding stone; whilst in hard, and especially gritty rocks, they are dwarfed in size, and the rough surface of their shell is worn away. M. Caillaud has shown that the "valves are quite equal to the work of boring in limestone, by imitating the natural conditions as nearly as possible, and making such a hole with them."[3]

The foot of the Pholas affords the requisite external fixed point or fulcrum on which the power of rotation by internal muscular motion depends. In *Lithodomus* (the *Dactylus* or date-shell of the conchologists prior to Linnæus), in *Saxicava* and *Ungulina*, the foot is too feeble to serve as such a fulcrum, and the valves are smooth, and retain the periostracum; yet they bore into the hardest marble, and still harder shells; their holes, like that of *Clavagella*, are not cylindrical, and are doubtless formed, as in that genus, by the agency of the thickened muscular borders of the pedial aperture.

Teredo navalis bores in the direction of the grain, unless it meets another Teredo, or a knot in the timber; they are probably warned by their organ of hearing of such contiguity. The rasp dust is introduced by the foot into the pallial cavity, and is swallowed. The long intestine of the ship-worm is usually laden with this debris.

GENERATION AND DEVELOPMENT OF THE LAMELLIBRANCHIATA.

All Bivalves are richly prolific. Countless myriads of sperm-cells are developed in the one sex; and the ovarium swells with germ-cells as countless in the other sex. When the sperm-cells in the male oyster, *e.g.*, have been developed into moving filaments, and are excluded as such, these are drawn into the pallial cavity of a contiguous female along with the respiratory currents of sea-water; and at this season the oviducts are seen to contain a milky fluid abounding with spermatic filaments. By virtue of the action of the vibratile cilia of the mantle and gills, impregnation is effected in the Bivalves of distinct sex; even when, like the oyster, both male and female are cemented to the rock; just as the pollen of the rooted male of the diœcious palm is wafted by currents of air to the moist stigma of the equally fixed and rooted female tree.

In the *Naiadæ*, as has been remarked, the impregnated ova are hatched in the cavity of the outer gill, as in a marsupial pouch. The germ-mass, in the progress of development, becomes covered by a ciliated epithelium. In the group of four eggs of the *Unio litoralis* (fig. 26), the little arrow indicates the course of the rotation of such advanced germ-mass in the fluid albumen which divides it from the chorion, or transparent flexible "egg-shell."

Fig. 26.
Fry of Unio litoralis.

This singular phenomenon was discovered by Leeuwenhoek in 1695. When the rotation of the embryo is most active, seven or eight revolutions may be observed in one minute. Two parallel fissures next divide the germ-mass, at the bottom of which the visceral mass first appears. As it protrudes, the diverging moieties of the germ-mass assume the character of the "mantle-lobes," or rather of a body potentially including the gills and shell with those lobes, those three parts being subsequently differentiated. The gills make their appearance as ciliated, wavy folds (fig. 27, *b*) from the inner surface of the mantle, near the angle between the pallial lobes and visceral mass. The cleavage of the primitive germ-mass appears at first like an attempt at spontaneous fission. Each embryonal moiety has its own mouth, stomach, and heart; and it is by the subsequent approximation and fusion of the two ventricles that the common rectum of the two originally distinct intestines is intercepted, so as to seem to pass through the heart. The rest of the alimentary canal blends with its fellow as the visceral mass grows up from the bottom of the cleft, which growth is due chiefly to the progressive increase of the testis or ovarium; and thus two sexless individuals combine to form one with sexual organs.

By the phenomena observed in the progressive building up of the embryo Lamellibranch, we learn the cause or chief condition of that most singular anatomical fact, which previously was a mere empirical one, without intelligible explanation—viz., the passage of the rectum through the centre of the ventricle of the heart. Calcification commences at the outer surface of the lobes, and the first layer of the future shell forms a small triangular valve on each side. The development of the adductor muscle, single at the beginning and near the hinge, is indicated by feeble attempts at opening and closing the valves. The albumen during this development is absorbed and assimilated, and the embryo now distends the chorion. The large detached ovum in fig. 26 exhibits the embryo *Unio*, or fresh-water mussel, ripe for exclusion. It escapes from the chorion before it quits the branchial marsupium. Filamentary processes, twisted together, resembling a "byssus," project from the visceral mass. The borders of the valves are broken and armed with spines. The young

[1] *Transactions of the Zoological Society*, vol. i., 1834, p. 271.
[2] *Annals and Magazine of Natural History*, 1848.
[3] Woodward's *Manual*, p. 327.

Encephala.

of all the Naiades anchor themselves, soon after quitting the parent, by this byssus, which is temporary; the full-grown and strong-shelled animals do not need it.

The embryos of many Bivalves have locomotive structures equally temporary. Those of *Crenella marmorata*, *e.g.* (fig. 27), show a broad disc fringed with long cilia *d*, and provided with a slender tentacle *f*, which seems to be an organ of exploration. As the pallial lobes and valves *v*, *v* grow, the swimming disc decreases, and gives place to the labial palpi and the foot. The youthful excursion being ended, a byssus is finally formed to anchor the maturing Crenella to its final place of settlement.

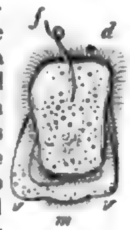

Fig. 27.
Crenella marmorata.

In fig. 28, the embryo of the mussel (*Mytilus edulis*, after Lovén), *e* marks the eye-speck which disappears

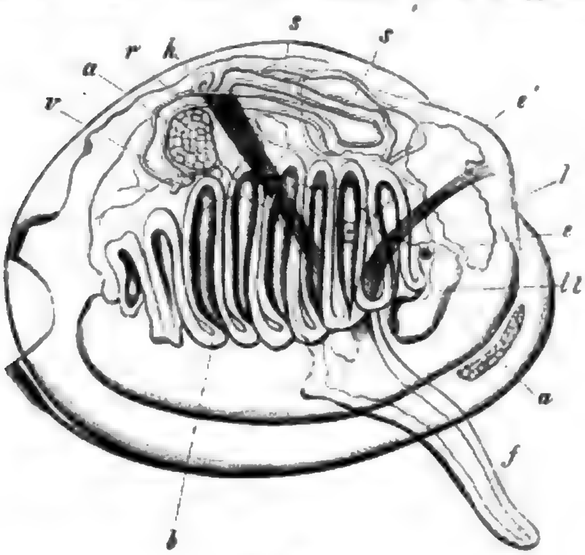

Fig. 28.
Embryo *Mytilus edulis.*

with the locomotive power; *e'* is the acoustic vesicle; *ll* the labial tentacles; *ss* the stomach; *l* the liver; *b* the branchiæ; *h* the heart; *v* the vent; *a*, *a* the anterior and posterior adductors; *f* the foot.

MOLLUSCA ENCEPHALA.

About three-fourths of the *Mollusca* are "Encephalous," or have a distinct head, commonly with eyes and tentacles, and the mouth has a peculiar and complex preparatory organ of digestion.

The mantle, properly so called, is to be distinguished, as in the foregoing group, from the ordinary external tegument. It is the free fold or folds of the skin, produced usually from the dorsal surface, and is in functional relation with the breathing organ and the shell.

Any part of the skin of a Mollusk, even that covering the foot, as in *Lithedaphus*, may produce a calcareous plate, but it is, as a rule, the function of the mantle-lobe or lobes.

In the following descriptions of the Cephalous Mollusks, the part answering to that marked *aa* (in fig. 70), is called the anterior or fore-part; the opposite end is the posterior or back part. *B* denotes the ventral or lower surface, *C* the dorsal or upper surface of the body.

The parts called "horns" or tentacles, but which are organs of sense or of exploration, not of prehension or offence, are in two pairs in many *Encephala*. The anterior pair, in which the olfactory sense may well reside, are usually also less dorsal in position than the posterior pair, with which the eyes are frequently connected.

Encephala.

The accoustic sacs are connected with the subœsophageal or pedial ganglia in most Encephala, but receive their nerves from the superœsophageal ganglia, in some species. In Encephalous Mollusks, as in fishes, the auditory concretions present themselves in one of two forms,—viz., as solitary otolites or as granular otocones.

A very characteristic feature of the organization of the head in the Cephalous Mollusks is the complex dentigerous rasping or boring organ (figs. 29 and 96), called by some the "buccal mass," by others the "proboscis," and by others the "tongue." As it coexists with lateral horny

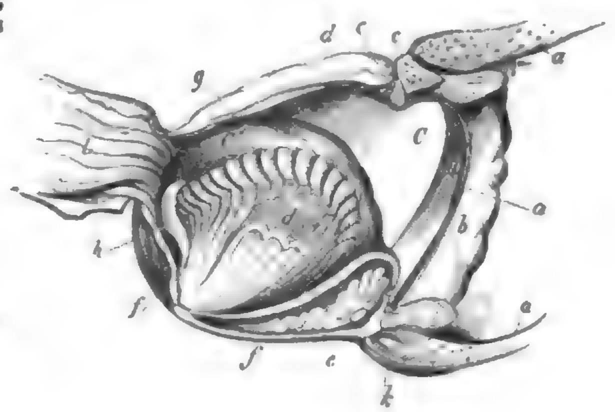

Fig. 29.
Glottidium (Nudibranchiate Mollusk).

jaws in some species, *e.g.*, *Eolis* (fig. 29, *c*) and *Tethys*, and with vertical ones in others (*Cephalopods*, fig. 96), it seems most homologous with the protractile dentigerous tongue in Myxinoid and other fishes; but as precise homology cannot be predicated of the parts of animals developed on plans so diverse as the vertebrate and molluscous, it seems best to designate the apparatus in question by an arbitrary "molluscous" term, *e.g.*, "glottidium."[1]

This is formed by a basis (chondrium)[2] *d*, of usually cartilaginous consistency, composed sometimes of a single piece, as in the *Aplysia*, but more usually of a pair, or with accessory pieces; the limpet, *e.g.*, has four "chondria." The chondrium is convex towards the upper and fore part of the mouth. It is more or less enveloped by muscular fibres; some (*glottidiales*), *e*, passing to the cephalic parietes for the protrusion and retraction of the entire glottidium; others (*radulares*), *f*, inserted into the "radula"[3] *g*. The rasping part, so called, consists usually of an elastic membrane stretched over the convexity of the chondrium, and supporting a spinigerous membrane or "tooth-strap."

The "glottidiales" are protrusors and retractors. The protrusor muscles are usually two on each side, which pass forwards to be attached to the walls of the head or to a more advanced part of the mouth-channel. The "radulares" are usually in two sets, radiating and transverse. The radiating series, *f*, *f* are the thickest, and often present a reddish colour. They arise from the back and under part of the "chondrium," and diverge as they ascend to be inserted into the extremities and sides of the radula. The thinner transverse fibres, when present, combine with the more constant diverging ones, in moving the radula to-and-fro upon the chondrium alternately raising and depressing the denticles by the same rasping or sawing movement.

[1] Gr. γλῶσσα, "tongue."   [2] χονδρίον, deriv. from χονδρος, "gristle."   [3] Lat. for "rasp."

This mechanism seems to have been much misunderstood. Mr Huxley, for example, states that "the resulting action is precisely that of a circular saw;"[1] but the distinctive action of the circular saw is to rotate in one direction: the "radula" of the Mollusk acts like a common saw or rasp, by alternate movements to and fro.

The lining membrane of the mouth commonly protrudes in folds near the glottidium, as at *h* (fig. 29) in *Eolis* and in *Onychoteuthis* (fig. 96). The epithelial covering of the inner side of these folds in the Cephalopod is beset with series of short retractile horny teeth. Another complexity in the higher Mollusks, and one which adds to the lingual analogy of the glottidium, is the development in advance of the "radula" of one or more soft papillose and apparently gustatory lobes *i*. These caruncles have special retractor muscles; and the anterior "radulares" derive in Cephalopods an origin from the base of the lower jaw.

In fig. 29 of the mouth and glottidium of a Nudibranchiate Mollusk, *a* is the outer lip; *b* the inner lip; *a* is the margin of the vertical jaw; *c* the fleshy mass supporting the jaws; *c* the constricting muscle of the mouth; *d* the "chondrium;" *e* the "glottidiales" muscles; *f* the "radulares;" *g* "the tongue-strap;" *h* the buccal fold; *l* the œsophagus.

The teeth are set upon either a broad or a narrow band; in the former a median series of teeth or "rachis" is flanked by two lateral series or "pleuræ," as in the Gastropod called *Bezoardica glauca* (fig. 30). In some the "rachidian" teeth, in others the "pleural" teeth, are absent; and the number of longitudinal rows of these divisions may also differ in different genera. According to these differences, which, from their constancy, are valuable as generic characters, they may be indicated by the terms uniserial, biserial, triserial, septiserial, or multiserial, as, *e.g.*, in *Melania* the rachis is uniserial, the pleuræ triserial. Whether the "chondria" or lingual cartilages consist of a single piece thinner in the middle line, or of two or four pieces united by ligament and muscle, the dental sac is lodged at the back, and the dental band is stretched over the upper and fore part of the chondrium. Herr Troschel[2] has devoted twenty years to the study of the dentition of the Mollusks, which he regards as important as that of any vertebrate class of animals.

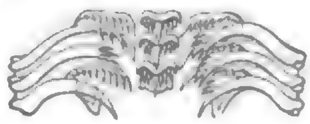

Fig. 30.
Teeth of Bezoardica glauca.

The peculiarities of the circulation in the Encephalous Mollusks, which have given rise to the erroneous ideas of the absence of proper walls to the circulating sinuses, and the conditions originally attributed to that system in certain *Encephala*, under the term "phlebenterism," make it desirable to premise a few observations on the true state of the diffused venous system in other classes of Invertebrata.

John Hunter first observed, that "the veins of the insect would appear to be simply the cellular membrane; but they are regularly formed canals, although not so distinctly cylindrical canals as in the quadruped, &c., nor branching with that regularity. They would appear to be, or to fill up, the interstices of the flakes of fat, air-cells, muscles, &c., and therefore might be called, in some measure, the cellular membrane of the parts." (Hunterian MS. Catalogue, printed in the *Physiological Catalogue*, tom. ii., p. 31 (1834).

Baron Cuvier, as is well known, entertained, with regard to the vascular system of insects, ideas closely akin to those which some of his pupils have more recently expressed by the term "phlebenterism;" for Cuvier supposed that the whole of the blood of insects stagnated in the lacunæ or cellular interspaces of the several organs: he was consequently led to deny that insects possessed a true circulation, or that the dorsal tube ("heart, extending through the whole length of the animal," Hunter, *op. cit.*, 1793, p. 137) acted as a heart. The more truthful views of Hunter, based on the analogy of the already commencing irregularity and extent of the venous sinuses in the lobster and snail, have been amply confirmed by the researches of Professor Carus, on the "Circulation of the Blood in the larvæ of Ephemerides and Libellulæ.[3]

With regard to the Crustacea, Hunter, who left preparations, and a beautiful series of drawings, illustrative of the circulating system in the lobster (*Astacus marinus*), thus describes the latter:—

"The veins in this class of animals, as in the winged insect, &c., are principally in the form of large irregular cells, as if the cellular or investing membrane of the animal contained the venal blood; and, when injected, we find the injection principally in large masses." He then, referring to his figures, describes the different sinuses, as "*a*, a large mass of vein lying on the stomach; *b*, another mass similar to the above, lying principally on the heart, which might almost be considered an auricle, as from it are openings into the ventricle." (Hunterian MSS., in *Physiological Catalogue of the Museum of the Royal College of Surgeons*, vol. ii., 1834, p. 138.)

The conditions of the vascular system in insects, crustaceans, and the snail, enunciated in brief but clear general terms in the work *On the Blood*, 4to, 1793, and exemplified by preparations, drawings, and manuscript descriptions left by Hunter in his museum, at his demise in the same year, appear to have passed unappreciated abroad, until the successive discoveries of analogous structures in other invertebrata, or the re-discovery of the same structures in the same species which Hunter had dissected, had been made.

Baron Cuvier appears to have been the first to recal the attention of comparative anatomists to this diffused and expanded condition of the venous system in his dissection of the *Aplysia*; but he mistook the expanded sinuses which fill the abdominal cavity, like those in the snail and slug, for that cavity itself. Describing the *venæ cavæ*, which perform the office of the branchial arteries, he writes:—"Leurs parois se trouvent formées de rubans musculaires transverses et obliques, qui se croisent en toutes sortes de sens, mais qui laissent entre eux des ouvertures sensible à l'œil, et encore plus à toutes les espèces d'injections, et qui établissent une communication libre entre ces vaisseaux et la cavité de l'abdomen; de manière que les fluides contenues dans celui-ci pénètrent aisément dans ceux-la, et réciproquement."—"Il résulte toujours que les fluides épanchés dans la cavité abdominale peuvent se mêler directement dans la masse du sang et être portés aux branchées et que les veines font l'office des vaisseaux absorbants. Cette vaste communication est sans doute un première acheminement à celle bien plus vaste encore que la nature a établie dans les insectes, où il n'y a pas mêmes de vaisseaux particuliers pour le fluide nouricier."[4]

Jurine, in 1806, observing living specimens of a minute crustacean (*Argulus foliaceus*) which were asphyxiated by a few drops of alcohol added to the water they were in, traced the course of the circulation, which he describes, remarking:—J'ai evité d'employer le mot *vaisseau* pour désigner les conduits dans lesquels le sang circule, et que j'ai remplacé ce mot, tantôt par celui de *colonne*, tantôt par

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[1] Art. "Mollusca," *English Cyclopædia*, pp. 168, 667.
[2] *Das Gebiss der Schnecken*, &c., 4to, 1856.
[3] *Blutkreislaufes in den Larven netzflüglicher Insekten*, 4to, 1827.
[4] Mémoire sur le Genre *Aplysia*, &c., in *Annales du Museum*, tom. ii., 1803, p. 287.

Encephala. celui de *rameau*. Les raisons qui m'ont engagé à le faire reposent sur la manière dont s'opère cette circulation. En effet, le sang chassé dans la partie antérieure du teste paroit s'y répandre et s'y disséminer de ces parties, plutôt que d'être contenus dans des vaisseaux particulières. Je ferai cependant observer qu'il existe dans ce liquide quatre espèces de courans qui ferment les quatre rameaux dont j'ai parlé plus haut, et que, dans les ailes comme dans la queue, la circulation ne se fait pas d'une manière aussi diffuse que dans la partie antérieure du teste, le liquide globuleux paroissant y être renfermé dans une espèce de large canal pratiqué dans le parenchyme de ces parties."[1]

It was probably owing to the misinterpretation of the remarkable facts which Cuvier had observed, that Meckel, notwithstanding the analogous structures, in the meanwhile pointed out by Jurine in the *Argulus*, and by Gaspard[2] in the *Helix pomatia*, was led to deny the existence of the apertures of communication observed by Cuvier in the large muscular venæ cavæ of the Aplysia. In 1832, however, the writer of the present article detected a structure in the venous system in the *Nautilus Pompilius* closely analogous to that which Cuvier had pointed out in the Aplysia; but, having traced the continuity of the proper lining tunic of the great muscular vena cava, through the apertures in that coat, with a similar membrane lining the abdominal cavity, he was led to describe the tunic of the abdominal sinus as the peritoneum. "There are several small intervals left between the muscular fibres and corresponding round apertures in the membrane of the vein and in the peritoneum, so that the latter membrane is continuous with the lining membrane of the vein."[3] And, after referring to the analogous structure in the Aplysia, the author adds, that this correspondence leads to the "suspicion that it may be more generally found on a further and more diligent investigation of the venous system in this remarkable class of animals."

Ten years later, M. Pouchet,[4] professor of Zoology at Rouen, demonstrated in *Limax*, a structure answerable to that which M. Gaspard had described in *Helix*, viz., that the blood passed from the arterial capillaries into the visceral cavity, whence it was received by particular orifices into the veins that carried it directly to the pulmonary chamber, ramifying there like a *vena portæ* before returning to the heart.

In 1834, the same year in which were published the figures and descriptions by Hunter of the circulating system in the lobster, M. Milne Edwards recorded his examination of the same system in the same species, in the *Histoire Naturelle des Crustacés*, vol. i., p. 101. He there describes the expanded venous sinuses, as "plutôt des lacunes situées entre les divers organes que des canaux à parois bien formées." (Op. cit., p. 102.) the term "lacunes" is also adopted for that of "venous sinuses" by the editor of the posthumous edition of the *Leçons d'Anatomie Comparé* of Cuvier, t. vi., 1839, pp. 504, 505.

In 1843 M. Quatrefages[5] believed that he had discovered a Mollusk, his *Eolidina paradoxa*, in which the organs of circulation were reduced to a univentricular heart and a system of arteries. "Le sytème veineux," he writes, "manque entièrement. Il est en quelque sorte remplacé par des lacunes du tissu aréolaire." In the same Nudibranchiate Mollusk the ramifications of the alimentary canal are also described as penetrating the branchiæ, "where the chyle was directly submitted to the atmospheric influence exercised by the surrounding water." To this supposed condition of the digestive, circulating, and respiratory systems, he gave the name, "Phlebenterism," and proposed thereon some Pteropoda. corresponding changes in the classification of the Mollusca.

In the *Report* on this and other memoirs of M. Quatrefages on the Nudibranchiate Mollusks, by M. Milne Edwards, that distinguished professor adopts the mode of interpreting the modification of the venous system, and applies it to the Crustacea. "Il existe (dans le genre Eolidine) un cœur et des artères bien constitués, mais pas des veines proprement dites, et le sang ne revient des divers parties du corps que par un système des lacunes irregulières, disposition tout-à-fait analogue à celle dont les Crustacées nous avaient deja fourni un example. Enfin dans d'autres espèces, que M. Quatrefages a découverte sur les côtes de la Bretagne, le cœur et les artères disparaissent à leur tour; de sorte que la circulation devient des plus incomplètes et resemblent à celle qu'on apperçoit chez les Bryozoaires." Subsequent researches by Messrs Embleton and Hancock demonstrated, however, the existence in the genera *Eolis* and *Actéonia*, of both heart and arteries; and the same careful anatomists confirm the observations of M. Souleyet,[6] that the veins were not wanting in the Nudibranchs, but had only undergone that modification of form to which the term sinuses is more properly given. Not any of these authors have, however, published exact and recognisable representations of the relations of the attenuated *tunica propria* of the veins, to the interspaces or laminæ which that tunic lines in forming the large and irregular sinuses in which the blood is diffused.

In several of the writer's monographs, and especially in plate iii., fig. 1, of that on the organization of the *Brachiopoda*,[7] he has adduced evidence in proof that the diffused and supposed merely lacunar venous system is continuous, *i.e.*, forms a part, by continuity of tissue, with the rest of the circulating system. Thus all ulterior researches rightly interpreted, since the time of Hunter, have served to confirm and establish the accuracy of that great anatomist's appreciation and explanation of the facts he discovered in insects and crustaceans, and to extend our knowledge of the same modification of the venous system as it exists in the series of the Molluscous animals.

CLASS IV.—PTEROPODA.[8]

Encephalous Mollusks with wing-like fins from the sides of the head or neck.

The *Pteropoda* are so called on account of the resemblance of their principal organs of motion to a pair of wings, both as to form and in their mode of action on the surrounding medium. These expanded fins are not, however, the homologues of the part called the "foot" in Gastropods.

The *Pteropoda* are small marine floating Cephalous Mollusks, many of them of minute size. The greatest extremes in variety of form are presented in this order,—some species of *Hyalæa* (fig. 31) and *Euribia* (fig. 40) being globular; others, as certain *Cleodora* (fig. 34), being very long and slender. The body is divided into a "somatal" and "visceral" part.

In some—*e.g.*, *Hyalæa* (fig. 31), *Spirialis* (fig. 42), and *Cymbulia* (fig. 39)—the head is not distinct from the muscular part of the "soma;" in others—*e.g.*, *Clio* (fig. 45), *Pneumodermon* (fig. 46)—it is defined therefrom by a constriction or neck. In the seemingly headless group (*Thecosomata*) the fins are confluent by their bases at the mid-line of the *dorsal* aspect; in those with distinct heads (*Gymnosomata*) the fins spring separately from the sides of the neck.

[1] Sur l'*Argule foliacé*, in *Annales du Muséum*, tom. vii., p. 431, 439 (1806).
[2] Recherches sur la Physiologie de l'Escargot des Vignes (*Helix pomatia*), *Journal de Physiol. de Magendie*, 1822, t. ii., p. 295.
[3] Owen, *On the Pearly Nautilus*, &c., 4to, 1832, p. 28. [4] *Recherches sur l'Anat. et la Physiol. des Mollusques*, 4to, Rouen, 1841.
[5] *Annales des Sciences Nat.*, 1843, t. xix.; *Comptes Rendus*, 1843, p. 1124.
[6] Observations sur les Mollusques Gasteropodes désignés sous le nom de *Phlebentères*, par M. de Quatrefages, *Comptes Rendus des Sciences*, &c., 1844, t. xix., p. 355. [7] *Monogr. cit. Palæontograph. Soc.*, 1853. [8] Gr. "wing-footed."

Pteropoda.

As in most other natural groups of Cephalous Mollusks, some Pteropods are naked, others provided with shells; the former have the best developed and most distinct heads. The mantle presents corresponding modifications, or rather the part of the skin, properly so called, exists only in the testaceous Pteropods. In them the pallial fold is reflected forwards over the visceral mass, leaving a wide anterior opening for the access of water to the gills, which the mantle thus conceals; it sends out processes conformable to those of the shell. Its surface is ciliated. In the naked Pteropods the integument is confined to the surface of the animal, and is perforated only by the alimentary, excretory, and genital orifices. It is thick, and of a firm—sometimes almost cartilaginous (*Euribia*)—texture.

The shell presents as extreme varieties of form as does the body, but is always characterized by the delicacy and transparency of its texture in these little floating Mollusks. It deviates least from the ordinary form of the spiral univalve in the *Pteropod*, called on that account *Spirialis*. In this genus (fig. 42) the shell is discoid, with the last whirl much expanded, and umbilicate; the rest are disposed in from three to five whirls, projecting more or less from the last, with the mouth often angular; and in some (*Sp. ventricosa*) subcanaliculate the shell is sinistral. Some of the species (*e.g.*, *Sp. clathrata*) are provided with an operculum (fig. 43). In *Limacina* the turns of the shell are reduced to one whirl and a half. In *Hyalæa*, fig. 32, the shell resembles a bivalve in which the two valves have been cemented together along the hinge, leaving a narrow fissure in front and at the sides. In *Cleodora*, fig. 34, the shell is narrowed and lengthened out, the two plates being united together along the sides, so as to leave only an anterior aperture. In *Cymbulia*, fig. 39, the shell is internal, symmetrical, shaped like a boat or slipper, and of a gelatino-cartilaginous texture. The cephalic ganglions (fig. 35, *b*, nervous system of *Cleodora*) are united by a commissural band *a*, passing above the œsophagus. The pedial ganglia *c*, and the "branchial" or splanchnic *d*, form a mass which is below the œsophagus.

No Pteropod possesses very distinct or well-developed eyes; but the acousticle, or little sac with calcareous crystals attached to the subœsophageal ganglions, exists in all, and was first discovered in these delicate subtransparent floating Mollusks.[1]

The testaceous Pteropods have two tentacles; the naked ones have four. In these the vent is on the right side of the body, whilst in most of the testaceous Pteropods it is on the left side, the shell where spiral being sinistral. The heart consists of an auricle and ventricle, its position varying with that of the gills, which offer extreme modifications in this circumscribed group.

The organs of the male and female sex are combined in the same individual. The most essential part of the com plex generative organs of hermaphrodite Cephalous Mollusks, which had been alternately described as testis and ovarium by different authors, before accurate microscopic observation had proved that both organs were combined in the same body, will be called in this article the "ovispermal" gland or body. The generative orifices are on the right side, save in *Cymbulia*, where that of the penis is median; the organ so called is for excitation, being imperforate, and is remote from the sperm-outlet

Order I.—THECOSOMATA Bl.

With an external shell; head indistinct
Genus.—Hyalæa,[2] Lamarck.

Sp. *Hyalæa tridentata* (figs. 31, 32).—The shell of *Hyalæa* consists of two plates, which, like the valves of a Brachiopod, are "dorsal," *f*, and "ventral," *g*, in relative position. It bears, indeed, such a resemblance to a Bivalve, that Forskael,[3] its discover, referred it to the genus *Anomia*, as *An. tridentata*. To Cuvier[4] belongs the merit of having determined, by anatomical investigation, the pteropodal affinities of the beautiful little Mollusk, for which Lamarck, after Lamartiniére's remarks on the affinity of the shell to that of Brown's *Clio*, proposed the name of *Hyalæa*.

Fig. 31.
Hyalæa tridentata.

The animal consists of a "somatal" (fig. 33, *C*, *d*) and "visceral" (*g*, *h*) division. The former is a broad, depressed muscular part, from which the head is not distinct, expanding on each side into a fin *C*, with a trilobed margin, the fins being united by a middle plate or lobe *d* (fig. 33), continued from their hinder border across the ventral aspect of the body.[5] The head is indicated by two small clavate tentacles (fig. 33, *b*), and by the mouth *a*, which opens on the ventral aspect, and is provided with two labial appendages (fig. 32, *f*). The visceral division is lodged in the shell; the mantle opens in front, and sends off from its sides variously-shaped extensible appendages (figs. 31 and 33, *e*). The vent (fig. 33, *o*) is on the left side of the body, near the anterior border of the mantle and the left extremity of the gill. The vulva *y* is on the right, behind the base of the right fin; the male outlet is upon the right cephalic tentacle *b*. The gill (fig. 33, *ii*) is horse-shoe-shaped, and circumscribes the visceral mass behind and at the sides, being quite concealed by the mantle. The shell (fig. 32) is vitreous, transparent, and fragile; symmetrical; more or less globose, chiefly by the convexity of the ventral valve *g*; it is tridentate behind, with the angles or teeth *h* (figs. 31 and 32) more or less produced, according to the species, with a fissure-like opening *i*, anteriorly and laterally, not adapted for closure by an operculum. A single retractor muscle (fig. 33, *k*) arising from the median point or apex of the shell, passes forward along the dorsal aspect, expanding, and then bifurcating to spread abroad and interlace with the muscles of the fins. By the action of this retractor the whole "soma" can be retracted within the shell; the lateral prolongations of the mantle have their own contractile fibres for the same purpose.

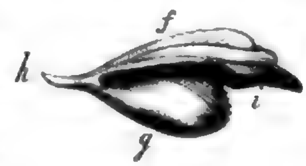

Fig. 32.
Hyalæa tridentata.

For a full description of the nervous system of *Hyalæa* the reader is referred to the *Voyage de la Bonite*, Partie Zoologique, tom ii., 8vo, p. 131, and *Atlas*, fol., pl. 9, figs. 20–24, whence the figures referred to are taken.

The labial boundaries of the triangular mouth are prolonged, and subside in the grooves between the fins and middle lobes of the soma. The glottidium has three diverging series of minute recurved teeth.

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[1] Eydoux et Souleyet, *Annales Française et etrangères d'Anatomie*, tom ii., p. 305.
[2] Gr. for "glassy."
[3] *Fauna Arabica*, p. 124; and *Icones*, tab. xl., fig. B.
[4] *Annales du Muséum*, tom. iv. (1804), pp. 223–234.
[5] "Les nageoires ne forment q'un seule expansion, l'analogue du pied des Mollusques gasteropodes," Souleyet, *Zoologie de la Bonite*, 8vo, p. 104; De Blainville, *Malacologie*, pl. 46, and *Journal de Physique*, tom. xciii., p. 81.

The œsophagus, after traversing the nervous ring and entering the visceral cavity, expands into an ingluvial pouch, lined by an epithelium thickened into four longitudinal horny plates with sharp angles; the stomach, continued from this part, rapidly contracts into an intestine (fig. 33, *o*), which, describing a convolution round the liver *p*, is reflected forward and to the left, to terminate, as above described, at *o*.

The skin of the *Hyalæa* is produced and reflected from behind forwards, so as to form a true mantle, which circumscribes beneath the viscera a branchial cavity opening anteriorly. The branchial plates are attached to the bottom of this cavity, and are disposed, as Cuvier well described, in a crescentic curve, almost circumscribing the viscera. Within the horns of the crescent are two supplementary series of gill-plates, parallel with those terminal parts of the main series, and more dorsal in position. The pericardium lies behind the left supplementary gill; the anus opens in front of it. The gill-plates are like those of the limpet, but are more complex in structure. The urinary sac *q* surrounds part of the auricle *r*, the pyriform ventricle *s* sends off a short aorta, which divides into two main branches. The genital or ovispermal gland *u* is transversely ridged or folded; its duct enters the side of a second larger canal, with glandular walls, one end of which is prolonged into a convoluted blind tube *w*, the other terminates in a kind of matrix *v*, consisting chiefly of compacted convolutions of a tube. The duct or canal of the matrix (vagina *x*) passes forward and to the right, to terminate behind the right fin.

The exciting organ is a muscular tube *b*, whose folds form a prominence to which the upper border of the somatal integument is attached; the tube opens externally in front and to the right of the mouth; its internal dilated end appears to terminate as a closed cavity, connected only with a retractor muscle. It is thus insulated, like the palp of the male spider and the intromittent organ in some Cephalopods, from the remaining and more essential part of the male apparatus.

The *Hyalææ* inhabit the warmer temperate and tropical zones, and have been taken in the Atlantic, Indian, Pacific, and Mediterranean seas. They swim with moderate speed by the action of their fins, but always with the back downwards, which is indicated by the deeper colour of the more exposed convex ventral valve. More than twenty species

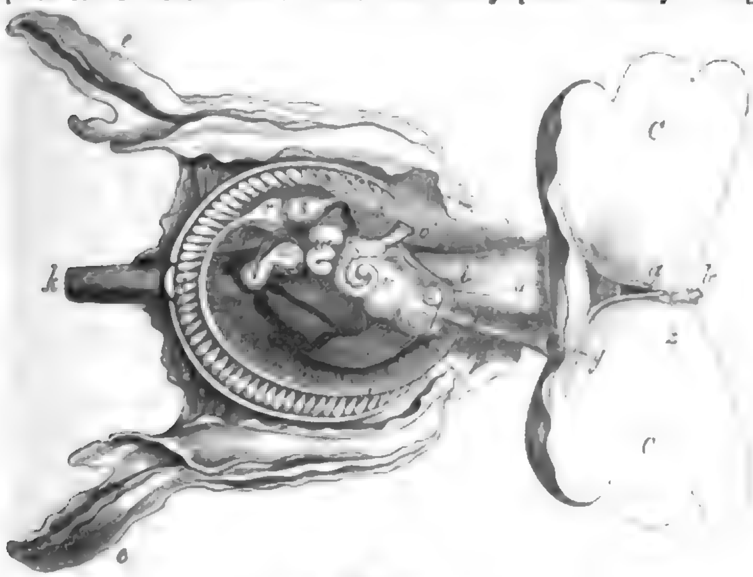

Fig. 33.
Hyalæa tridentata (magn.)

have been defined,[1] of which the *Hyalæa tridentata* is here selected for the special illustration of the genus. The beautiful translucid shell of this species, about 9 lines in length, is of a reddish-yellow, shading off to rose colour, but pale on the dorsal plate. The ventral valve is marked anteriorly by fine transverse striæ. The dorsal valve has five convex aorta, which diverge forwards.

Genus CLEODORA, Péron, Lesueur. A beautiful transition from *Hyalæa* to *Cleodora* is made by the *Cleodora lanceolata*, Lesueur, in which the anterior borders of the shell are so produced as to make its fissured opening in part lateral as well as anterior; the productions of its apex and sides also resemble those of *Hyalæa tricuspidata*. Other *Cleodoræ* gain in length and lose in breadth, until the opening of the shell is wholly anterior, and its cavity prolonged into the tubular or serpuliform shape presented by the *Cleodora aciculata* (fig. 34).

Fig. 34.
Cleodora aciculata.

The mantle sends out no lateral processes or enveloping folds in such *Cleodoræ*. The fins *c* are simply notched or bilobed, and are more distinct from the median fold *d*. The mantle forms a pouch for the branchiæ like that of the *Hyalæa;* its muscular border follows closely the progressive modifications of the shell aperture, and becomes simply circular anteriorly, as at *e* in the species figured; it is beset with tufts of vibratile cilia, as in *Hyalæa*. Save in the modifications of proportion, chiefly of length, conformably to the altered form of the body, the digestive organs closely resemble those of *Hyalæa*. In fig. 35, *a* is the buccal mass, *l* the gullet, *n* the stomach, *p* the liver, and *o* the intestine, which terminates further from the free border of the mantle than in *Hyalæa* at *o*. The gill forms half of a longer and narrower ellipse than in *Hyalæa;* the heart has a similar relative position, and consists of the usual auricle and ventricle, but the urinary cavity is a more distinct pyriform sac than in *Hyalæa*. The ovispermal gland (fig. 35, *u*) is sub-bilobed and transversely plicated. The oviduct is continued directly into the glandular tube *v*, which is not prolonged into a cæcal appendage, but contracts as it terminates in the matrix *w*. The genital outlet *y* is behind the right fin; the excitory organ is disconnected with the essential part of generation, and is more in advance. The retractor muscle *k* closely resembles that of *Hyalæa* in its origin and insertions. Difficult as it is to differentiate in any very essential degree

[1] Many of which are beautifully figured in the *Voyage de la Bonite*, plates 4, 5, and 6.

Cleodora from *Hyalæa*, it is still more so to discriminate from *Cleodora* the more slender conical species which have been removed from that genus under the names *Styliola* and *Creseis*.

In the *Cleodora cuspidata* and *Cleodora pyramidata* the shell is pyramidal, three-sided, striated transversely with the mid-costa, in the dorsal valve, so produced as to give it a keeled appearance. In *Cleodora virgula* and *Cleod. aciculata* the shell shows neither aortæ nor striæ, and is truncate anteriorly. The fins have a small lobe on their inner border.

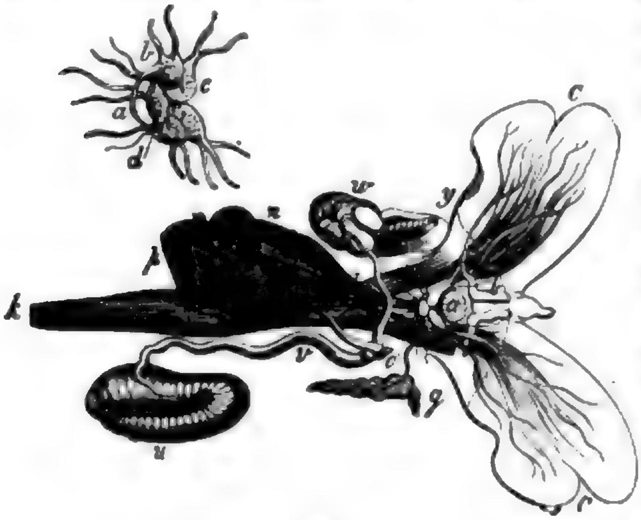

Fig. 35.
Cleodora pyramidata.

The geographical distribution of the species of *Cleodora* agrees with that of *Hyalæa*.

Genus Cuvieria,[1] Rang.—The Pteropods of the genus *Cuvieria* are closely allied to the *Cleodora*, and were ascribed to that genus by their discoverer M. Gaudichaud (as *Cleodora obtusa* and *Cleod. rosea*). The fins (fig. 36, *c*) have the same elongated form and terminal notch; but the intermediate lobe *d*, which some suppose to be homologous with the part *f*, fig. 67, in *Carinaria*,[2] presents also a notch at its middle part.

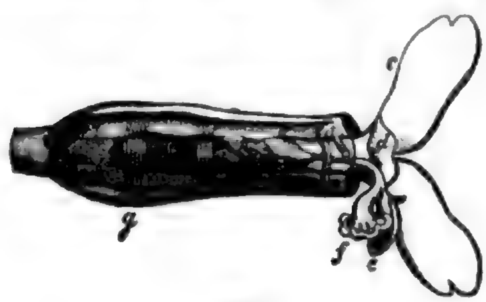

Fig. 36.
Cuvieria columnella.

The *Cuvieriæ* are also more particularly distinguished by an appendage, which is attached to the under part of the neck by a pedicle, and divides into two lobes, one (fig. 36, *e*) elongated and pointed; the other, *f*, expanded, and with a thickened, wavy, or plicated border. From the lower part of the pedicle a fold of skin connects the terminal orifice of the vagina with the neck; and the bifid appendage is probably the homologue of the penis in Heteropods. The mantle does not develop lateral leaflets, as in *Hyalæa*.

The crescentic branchia (fig. 38) is placed deeper in the mantle-bag than in *Cleodora*, and its horns are less symmetrical. The shell (fig. 37) has a septum *s*, which partitions off its hinder end; and its aperture *i* has a rounded, not a trenchant border. M. d'Orbigny affirms that the hind end *g* is originally pointed as in *Cleodora*, and that its usual truncation is due to accident.

Fig. 37.
Cuvieria columnella.

In fig. 38, *i* is the branchia, *r* the auricle, *s* the ventricle, and *t* the pyriform urinary sac.

The *Cuvieriæ* range from the tropics to the latitude of Cape Horn. They are less common than the *Hyalæa* or *Cleodora*, but their mode of life is the same.

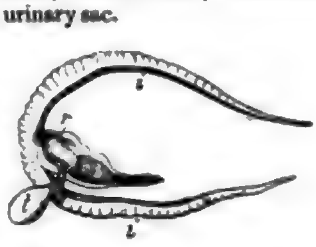

Fig. 38.
Cuvieria columnella.

In the *Cuvieria columnella* (figs. 36 and 37), the shell is subcylindrical, elongated, smooth, contracted, or truncate at the hind end *g*; depressed anteriorly, with an oblique aperture *i* with rounded borders, the dorsal longer than the ventral lip.

Three varieties of form of this shell have been noticed: in the first two the shell is moderately thick, firm, hyaline, sometimes of a feeble rose colour, and with fine longitudinal striæ; in the third variety the shell is thin, fragile, and quite transparent. The latter variety occurs in the Chinese and Pacific Oceans.

Genus Cymbulia, Péron and Lesueur.—In this genus the cartilaginous shell is developed in the substance of the mantle, but is distinct. It is covered by so thin a layer of the mantle that this is often torn, and the animal loses its shell, which slips out; its substance contains chitine. It is transparent, skiff-shaped, symmetrical, pointed in front, truncate behind, with the aperture elongate and ventral.

The body of *Cymbulia Péronii* (fig. 39) is somewhat obscurely divided into a somatal and visceral part, the latter only being lodged in the shell. The fin-like expansions of the soma, *C*, *C*, are unusually large, expanding to beyond the hinder end of the body.

The mouth opens on the ventral surface of the body, at the anterior interspace between the fins. Above and in front of this orifice are two protentacles, in front of which, at the middle line, is the prepuce.

Fig. 39.
Cymbulia Péronii.

The visceral part is not inclosed by a pallial sac opening anteriorly, as in *Hyalæa*, but is covered by the mantle only dorsally; while on the ventral side it rests in a sac, formed by the detachment of the skin from the dorsal surface of the fins, and opening posteriorly. There are no proper or free "borders of the mantle;" that which circumscribes the orifice of the

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[1] In honour of Cuvier, the founder of modern Malacology.
[2] "Fins united by a semicircular lobe, the equivalent of the posterior element of the foot." (Woodward's *Manual*, p. 204.)

visceral cavity is a simple fold, which is reflected thence over the shell, which thus becomes "internal." The gills are two membrano-vascular plates on the sides of the visceral pouch.

Sp. *Cymbulia Peronii*, Lam.—This is the type species, and is met with in certain parts of the Mediterranean.

Two other species have been characterized as *Cymbulia punctata* and *Cymbulia Norfolkensis* by the naturalists of the "Astrolabe." These Pteropods swim, like the *Hyalæa* and *Carinaria*, with the belly upwards. Mr Adams figures a *Cymbulia proboscidea*.

Genus Tiedemannia, Delle Chiaje.—The Pteropods of this genus are *Cymbuliæ*, with the fins and foot-process confluent and forming an orbicular disc; the mouth is at the apex of a long proboscis; the tentacles are elongated and connate; the eye-tubercles minute. The shell is hyaline, gelatinous, slightly excavated; it appears to be soon or frequently shed.

Sp. *Tiedemannia Neapolitana*, V. Beneden (*Exercises Zootomiques*, p. 21, pl. 2).—In this species the proboscis is slender, and the fins have white and yellow spots at the margin.

Genus Euribia, Rang.—The genus *Euribia* is founded on a small and very rare Pteropod, of the shape and about the size of a pea. (See the figure opposite the left hand in fig. 41.) The chief part of the integument, although transparent, is of almost cartilaginous consistency, but anteriorly becomes suddenly thin and flexible, forming a fold, which borders on oblique fossa into which the "soma," or the fore part of the animal developing the fins and tentacles, and covered by a thin and extensible skin, can be retracted with all its appendages. The firm globular hind part of the integument, which thus acts as a shell, retains so much muscularity that it can draw one side of the anterior depression towards the other, and thus close the seeming aperture upon the contracted and retracted cephalic appendages, as in the enlarged figure opposite the right hand in fig. 41. Of these appendages the largest and most conspicuous are the fins (fig. 40, *c*, *c*), which are attached to the sides and under part of the head, meeting and partially blending at the latter aspect; but with a median pedial appendage *f* at the interspace. The fins curve backwards, and are dilated at their extremity.

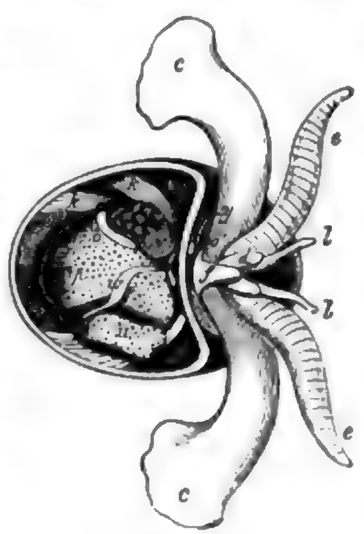

Fig. 40.
Euribia Gaudichaudii.

Anterior and ventrad of the fins come off the long, transversely-striated, and pointed appendages (fig 40, *e*, *e*), and in front of these are the tentacles *l*, *l*. At the fore part of the right fin is the preputium; at the back part is the genital or vaginal orifice *y*. The vent *o* is to the right of the pedial appendage *f*. The mouth *a* is an elliptic aperture, with two labial palps or tentacles *d*. The "glottidium" has a biserial dental plate. The pair of cæcal salivary glands; the large stomach surrounded by the liver *p*; the reflected intestine *o*; and the androgynous generative organs *u*, *v*, *w*,—all accord with the pteropodal type. The retractor muscles of the soma are shown at *h*, *h* in fig. 35.

The *Euribia Gaudichaudii*, Eyd. and Soul., was captured by the accomplished naturalist after whom it is named in the Pacific Ocean, in 20. N. Lat. and 170. E. Long. He noticed in the living animal the vibratile action of tufts of cilia on the anterior border of the fins. These appendages were of a pale rosy tint; the visceral mass was partly brownish, partly of an orange-red.

The *Euribia Norfolkensis* (fig. 41), captured by MM. Quoy and Gaimard, off Norfolk Island, Australia, differs by the rugosities or minute tubercles which roughen the firm integument. Fig. 41 shows this part in its retracted and contracted state magnified; the figure to the left shows the aperture of the quasi-shell, a little widened, of the natural size.

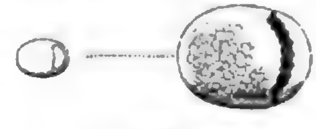

Fig. 41.
Euribia Norfolkensis.

The small Pteropod which forms the genus *Psyche* of Rang appears to differ from *Euribia* only in the softer consistency of the integument. The name *Psyche*, moreover, is pre-appropriated by the Lepidopterists.

Euribia is in some measure intermediate between *Cuvieria* and *Pneumodermon*, and seems to indicate the transition from the naked to the shelled Pteropods.

Genus Spirialis, Eydoux and Souleyet.—Were the long and slender shell of *Cleodora* to be twisted spirally, and its anterior aperture widened and closed by an operculum, it would become transmuted into a *Spirialis* (fig. 42). The soma and its natatory expansions differ only by slight and unessential modifications of form from those of *Hyalæa* and *Cleodora*. Thus the fins (fig. 42, C, C), are elongated, slightly expanded, and rounded at their termination. The intermediate lobe is sub-pedunculate, and bears the opercule *f* on its upper surface. There are two minute tentacles. The preputce is at the front border of the head, a little to the right. The proper genital opening is behind the base of the right fin. The branchial sac is now dorsal in position, as in Gastropods, through the spiral twist of the body. About half a dozen species of *Spirialis* have been defined.

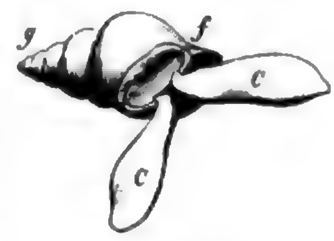

Fig. 42.
Spirialis Bulimoides (mag.)

The *Spirialis Bulimoides* (fig. 42) has an elongated sinistral shell of six whorls, with a sub-acute spire. The mouth is ovaloid, angular at the fore part, with the labrum sharp; the columella is slightly arched. The shell scarcely exceeds a line in length; it is smooth. The operculum (fig. 43, *f*) is chitinous, dextral, and paucispiral.

Fig. 43.
Spirialis (mag.)

In the *Spirialis clathrata* (fig. 44) the surface of the shell shows slightly elevated striæ, decussating so as to intercept lozenge-shaped areolæ. It has three sinistral whorls *g*, with a capacious ventricose last turn or chamber *f*. The minute Pteropods of this genus are abundant, and are widely diffused through the warm latitudes of the ocean.

Fig. 44.
Spirialis clathrata (mag.)

Genus Limacina,[1] Cuv.—This genus was proposed by Cuvier for the *Clio helicina* of Phipps,[2] and probably the generic name was given, as Van der Hoeven suggests, inad-

[1] Lat. for a "small slug."

[2] *Voyage towards the North Pole*, 4to, 1774.

Pteropoda.

vertently for *Helicina*; the slug-like *Clio* being distinguished as the *Cl. Limacina* from the testaceous Pteropod now generally recognised as the *Limacina arctica*.

Limacina has a fragile, discoid, sinistrally spiral shell, deeply umbilicate on one side, and with the spire slightly projecting on the other. It differs from that of *Spirialis* in having no operculum.

Sp. *Limacina arctica*, Cuv.—This species exists in myriads in the arctic seas.

Sp. *Limacina antarctica*, Hooker.—The species in which the shell-whorls are transversely striated, with the fins notched on the hinder border, and with the post-pedial lobe emarginate, is equally abundant in the antarctic seas.

Order II.—GYMNOSOMATA, Blainville.

Without a shell; head distinct; fins attached to the sides of the neck.

Genus Clio, Linn. and Müller.—The earliest form of Pteropod known to naturalists was a species of the genus to which the above name, originally applied by Brown to another form, and by Linnæus to all the Pteropods he knew, is now by common consent restricted. This species (*Clio borealis*, Gmel., fig. 45), the well-known whale's food, or "whale-bait" of the arctic voyagers, is remarkable for the high northern latitudes in which it exists, and for the myriads of its individuals that find subsistence in those icy seas. First indicated by Martens in his *Voyage to Spitzbergen* (1675), and afterwards described, as to external characters, by Pallas;[1] its true nature and affinities were made known anatomically by Cuvier.[2] Eschricht[3] and Gegenbauer[4] have ably completed that work, and a wonderful structure has been unfolded through their patience and skill. A study of the works cited below will well repay the earnest student of Molluscous organization.

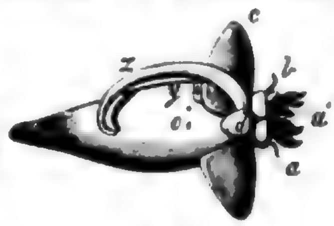

Fig. 45.
Clio borealis.

In the genus *Clio* the body is oblong, acuminate, or appendiculate behind (*Clio longicaudatus*). The head (fig. 45, *a*) is defined by a constriction (*Clio borealis*), or by a neck (*Clio longicaudatus*); it is terminated by two cowls or hoods (*preputia*, Pallas), containing each three appendages (fig. 45, *a'*), and by a pair of retractile tentacles *b*. The fins *c* are more wing-shaped than in most *Pteropods*; their contracted bases are confluent across the ventral aspect of the "neck." In swimming, the *Clio* brings the ends of its fins almost in contact, first above, then below. The rudiment of the foot *d* is bifid. At the back of the neck are two black "ocelli." The preputium in front of the right fin gives exit to an unusually long bent excitory organ *z*, when it is unfolded and everted. The vaginal orifice is behind the right fin. The vent *o* is still more posterior and nearer the ventral surface. The conical appendages of the head, when fully expanded, form a radiated crown; they are of a red colour on the recent animal; which colour depends on the presence of numerous separate superficial points, about 3000 on each appendage. Each point, microscopically examined, is a sheath inclosing a central body composed of a stem terminated by a tuft of about twenty pedunculated discs. Eschricht, their discoverer, calls them suckers, and reckons up about 360,000 of them. Gegenbauer suggest that they may be pedunculated epithelial or pigmental cells or scales.

Sp. *Clio borealis*, Müller (fig. 45).—This species abounds in the neighbourhood of Greenland and Spitzbergen, and though scarcely an inch in length, constitutes, with its common associate, the still smaller Pteropod, *Limacina arctica*, the chief food of the great whalebone whale (*Balæna mysticetus*).

Sp. *Clio fusiformis*, Quoy and Gaimard (*Zoologie du Voyage de l'Uranie*, pl. 66, fig. 2); *Clio longicaudatus*, Eydoux and Souleyet (*Zoologie du Voyage de la Bonite*, pl. 14, figs. 19–21).

Genus Pneumodermon[5] of Cuvier.—A naked Pteropod, about an inch in length, discovered by Péron in the Atlantic, and submitted to Cuvier's examination, was described by the great anatomist in the fourth volume of the *Annales du Muséum*, 1804, under the name of *Pneumodermon*, or "lung-skin," from the circumstance of the gills (fig. 46, *i*)

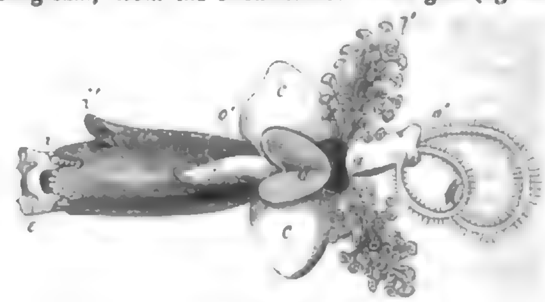
Fig. 46.
Pneumodermon Péronii (mag.)

being distinctly developed from a part of the integument. Other species of this genus have since been discovered.

The head (fig. 46, *a*, and 47, A) projects anteriorly and distinct from the fins *c, c*; the mouth, when the mouth-mass *aa'* is retracted, is a small terminal vertical slit, on each of which is a pit with a small pro-tentacle. The post-tentacles are still smaller, and are bifid. On the right side, in advance of the fin, is the preputial orifice; near the hind border of the fin is the vaginal orifice (fig. 47, *y*). Still further back, but still on the right side, is the vent (fig. 46, *o'*). On the middle of the ventral surface of the anterior constricted part of the body is a heart-shaped disc (fig. 46, *d*), composed of two lateral plates united together and attached along the mid-line, but elsewhere free; from above the back part or base of the above disc a long triangular lobe (fig. 46, *f*) freely projects backwards. These appendages are homologous with the "fin-foot" and "tail" in Heteropods; like the foot-disc in which the *Pneumodermon* uses the discoid part (fig. 46, *d*), to attach itself to the sides of the glass in which it may be placed.[6]

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[1] *Spicilegia Zoologica*, fasc. x., p. 28, tab. i., figs. 18, 19.

[2] *Annales du Muséum*, vol. i., p. 262, pl. 17.

[3] *Anatomische untersuchungen ueber die Cliones Borealis*, Copenhagen, 1838.

[4] *Untersuchungen ueber Pteropoden und Heteropoden*, Leipzig, 1855.

[5] Gr. for "lung-skin."

[6] "Cet appendice est tout a fait analogue, par sa position et par sa forme, au pied des Mollusques Gastropodes—ses usages paraissent être semblables à ceux du pied des Atlantes, des Firoles, &c., qui, comme on le sait, est transformé en ventouse dans une partie de son étendu." (*Zoologie de la Voyage de la Bonite*, tom. ii., p. 257.) The interesting homology above enunciated by MM. Eydoux and Souleyet, whose "beautiful plates, illustrative of the Zoology of the voyage of the Bonite," are referred to in another part of Mr Huxley's *Memoir* (p. 30), is adopted by that writer, who informs the Royal Society,—"It is very remarkable that Cuvier should not have recognised in the 'espèce de menton' and the 'deux petits lèvres' of *Pneumodermon*, the homologues of the foot of the Gasteropoda." ("On the Anatomy of certain Pteropoda", *Phil. Trans.*, 1853, p. 39.) The true discoverers of this homology, with more candour, point out the belief which Cuvier entertained of the existence of a fissure between the folds of the little foot, as the ground for his describing them as 'labial' folds. The anatomical illustrations of the Pteropoda here given are chiefly derived from MM. Eydoux and Souleyet.

Pteropoda. The visceral division *op* (fig. 47) forms the seeming trunk of the animal; it is expanded, ovoid, and terminated behind by membranous plates which support the branchial filaments. There is also a vascular process *i* (fig. 46), where the integument is very thin, from the right side of the body a little in advance of the terminal branchial region *i'*, which process is most intimately related to the vascular and respiratory function.

The only part of the integument that can be properly regarded as "mantle" is the slightly projecting border *e* (fig. 46) from the four-radiate respiratory surface; elsewhere the skin is perforated only by the oral, excretory, and genital outlets.

On each side the buccal cavity is an invertible pouch (fig. 47, *a*), to the surface of which are attached numerous

Fig. 47.
Pneumodermon Péronii (mag.)

pedunculated suckers (fig. 47, *b*, and fig. 46, *l'*). The glottidium is notched before and behind, and each moiety supports four rows of recurved denticles. Beyond the glottidium are the orifices of two long accessory appendages, consisting of an outer sheath (fig. 47, *e*) having a muscular coat of longitudinal and circular fibres, and an inner tube lined by an uncinated membrane, capable of being everted and protruded (as at *d'*, fig. 46) when the hooks become external. The œsophagus has a sigmoid flexure by which it adapts itself to the varying conditions of the buccal appendages. The salivary cæcal glands (fig. 47, *f*, *f*) lie by its side. The stomach *m* is capacious, and seems to be a lining to the hepatic mass *p*; the intestine *o* is short, and is reflected forward to terminate on the right side (fig. 46, *o'*), some way in advance of the respiratory surface of the mantle. This surface is at the posterior part of the body (fig. 46, *ie*), which shows four curved membranous folds; the dorsal and ventral pair turn their convexities to each other, and are united by the shorter lateral folds, which circumscribe an irregular quadrangular space; the longer folds have a pinnate arrangement of branchial lamellæ *i*. On the right side of the body there is a process of the skin also supporting branchial lamellæ. Gastero-poda.

The heart, consisting of an auricle *r*, and a ventricle *s* (fig. 47), is situated at the back part of the visceral cavity, close to the part where the last-mentioned branchial process projects. The aorta divides and sends one branch to the visceral mass, the other to the soma or rudimental foot and its appendages. The renal sac *q*, which Lovén deems homologous with the plicated auricles of *Terebratula*, is closely connected with the venous trunk entering the auricle in *Pneumodermon*. The male and female organs are combined as in other Pteropods. In fig. 47, *u* is the blended testis and ovarium, *u'* and *w* are the combined oviduct and sperm-duct, *v* is the uterus, *x* the vagina, and *y* the genital orifice.

Sp. *Pneumodermon Péronii*. Cuvier (fig. 46.—This species is of a violet-brown colour, deepening towards the head; the fins and branchial membranes are white; it is about an inch in length. The species is common in the Atlantic, in tropical latitudes. The individuals are aggregated in large groups; they swim swiftly, and in their natural position, with the ventral surface downwards, not reversed like the *Hyalæa*. When at rest they can attach themselves pretty firmly to any floating body by their rudimental foot, or by their buccal suckers.

Professor Müller describes the larva of *Pneumodermon* as being girt by three bands of vibratile cilia, one round the fore part, another round the middle, and the third round the hind part of the body.

CLASS V.—GASTEROPODA.[1]

The Encephalous Mollusca grouped together under the above name by Cuvier, include the most typical forms of the province; yet can hardly be regarded as so natural a class as either the *Brachiopoda*, *Lamellibranchiata*, or *Cephalopoda*. The muscular disc for creeping (fig. 48,

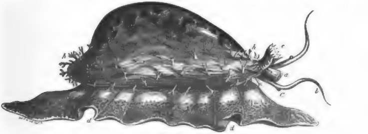

Fig. 48.
Cypræa tigris.

dd), which is developed from more or less of the ventral surface of the body, is the common external character by which the Gasteropods are associated together; and yet there are species (fig. 71, *e.g.*) in which the ventral foot is as little developed, or recognisable as such, as its homologue is in *Pneumodermon* and some other *Pteropoda*.

The snails and slugs exemplify the ordinary mode and characteristic instrument of locomotion in the Gasteropodous

[1] Gr. for "belly-foot."

Gastero-poda.

class, most of the members of which are unsymmetrical, with the visceral division of the body coiled spirally and protected by a shell; the breathing organs of the left side being, as a rule, atrophied. Most Gastropods are marine; some inhabit fresh waters; a few are terrestrial. The species offer corresponding conditions of the respiratory organs in relation to those media, with minor modifications, of which the systematic naturalist has availed himself in distributing the numerous and diversified members of the class into orders.

The air-breathing Gastropods (*Pulmonata*)[1] constitute a tolerably natural group: those that breathe water are much more diversified.

In certain small shell-less marine genera,—*e.g.*, *Rhodope*, *Tergipes*, *Eolidina*,—no distinct respiratory organs have been detected: these form the order *Apneusta*.[2]

Some that breathe by gills have those organs exposed. The genera which support them on the back, such as *Glaucus*, *Scyllæa*, *Tritonia*, form the order *Nudibranchiata*;[3] all the species are without shells in the mature state. Those genera which carry the gills at the lower part of the sides of the body, between the foot and mantle,—as, *e.g.*, *Phyllidia*,—constitute the order *Inferobranchiata*;[4] they are likewise naked when mature. The genera in which the gills have a similar position, but extend around the body, as in the limpet (*Patella*), and in *Chiton*, form the order *Cyclobranchiata*; they are protected by a conical shell composed of one or of many pieces.

In the rest of the water-breathers the branchia are concealed. Those genera,—as, *e.g.*, *Aplysia* and *Bulla*,—which have the gills protected by a fold of the mantle containing a rudimental shell, or by a reflected portion of the foot, form the order *Tectibranchiata*.[5]

In all the foregoing orders of *Gasteropoda* the male and female organs of generation are combined in the same individual.

In the remainder of the class the sexes are distinct. A small order of marine Gastropods, in which the gills are packed in small compass, with the heart in a dorsal mantle-chamber or in a small symmetrical shell, is called *Nucleobranchiata*; and also, on account of their stunted foot, *Heteropoda*. Another small group of marine Gastropods, including *Fissurella* and *Halyotis*, which have their comb-like branchia protected by a wide shield-shaped shell, is called *Scutibranchiata*.[6] A third small group in which similar branchiæ are protected with the entire body by a tubular shell, is called *Tubulibranchiata*. In the last, highest, and most extensive order, called *Pectinibranchiata*, from the comb-shaped gills, which have a special pallial cavity at the fore part of the back, and which, with the rest of the body, are protected by a spiral univalve shell, the males are provided with an intromittent organ. A few species of *Cymba*, *Litorina*, *Paludina*, and *Helix* are ovo-viviparous; most Gastropods are oviparous. The young of the water-breathing Gastropods are excluded with a protecting operculated shell, which in the "naked" species is either shed or concealed by a fold of the mantle. They swim by means of a pair of ciliated fins attached to the sides of the head, and thus move far away from their inactive or sedentary parents. The larvæ, as they may now be called, of all the water-breathers are very much alike, and undergo metamorphoses in the course of attaining their adult, nudibranchiate, nucleobranchiate, or pectinibranchiate forms. The air-breathing Gastropods undergo no such metamorphosis: their shell commences by the deposition of crystals of carbonate of lime in the substance of their skin, above the visceral cavity, and it is persistent.

The soft parts of Gastropods are immediately invested by a soft inarticulated lubricous integument, forming in most a sub-circular fold (fig. 48, *i*) about the neck, behind which it is produced into a sac containing the circulating,

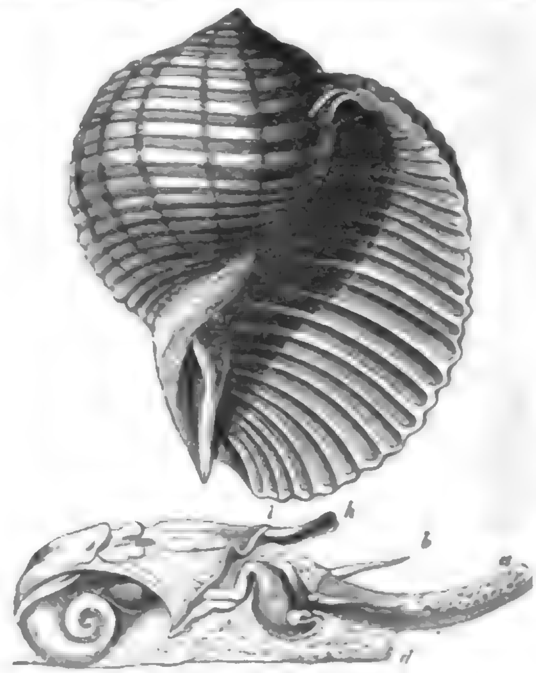

Fig. 48.
Dolium galea.

respiratory, and renal organs, which fold and sac are called the mantle. This is, then, continuous with the thin skin covering the rest of the visceral cavity, which is usually disposed in a spiral form, and adapted to the deep recesses of the shell. In the skin covering the "soma" (*i* to *d*, fig. 49) may be recognised an epidermal, a pigmental, and a dermal layer, the latter being of a musculo-cellular structure and highly contractile. The epiderm is ciliated over nearly the whole body in the aquatic Gastropods, but only in certain spots in the terrestrial species. The white stripe at the sides of the neck and foot of the wood-snail (*Helix nemoralis*) are composed of short, thickly-set calcareous needles; the entire skin of *Polycera* and some other Nudibranchiates is studded with analogous ramified spiculæ.

The shell results from the metamorphosis and calcification of cells deposited in layers beneath the epidermis, in the situation of the rete-mucosum in the human integument. In *Limax* and *Clausilia* the first trace of the rudimental shell is in the form of crystals of carbonate of lime in the substance of the mantle. In most Univalves it is the result of calcification of the nucleated cells of the outer layer of the mantle, and especially of the thickened anterior border. The first-formed part of the persistent shell is called the "nucleus;" the succeeding layers are not, however, formed around this, but are added to the inner surface of the circumference of the previously-formed parts; and the proportions in which the new-formed layers extend beyond their predecessors determine the figure of the future shell.

In some Gastropods, at certain seasons, the margin of the mantle in which the shell-forming process is most active, extends outwards at an obtuse or right angle to the last-formed margin of the shell; and after having formed a calcareous plate in this position, the mantle extends in the ordinary direction, increasing the length of the shell, and is again similarly extended at a right angle with the

[1] Lat. for "having lungs." [2] Gr. for "without lungs." [3] Lat. for "exposed gills."
[4] Lat. for "low-placed gills." [5] Lat. for "roofed gills." [6] Lat. for "shielded-gills."

last-formed part. It is to this periodical growth of the mantle, and plethoric condition of the calcifying vessels, that the ridges on the exterior of the shell in the wentle-trap (*Scalaria pretiosa*) and harp-shell (*Harpa ventricosa*, fig. 85) are due. Should the margin of the mantle, instead of being uniformly extended, send outward a number of detached tentaculiform calcifying processes, these will form a row of spines corresponding in length and thickness to the softer parts on which they are moulded; and as the calcification of the processes proceeds, the spines which were first hollow become solidified, and finally soldered to the margin of the shell.

This development of pallial calcifying processes or filaments, and of the resulting spines, likewise alternates with periods of the ordinary increase of the shell; and thus its exterior surface may become bristled with rows of spines, as in the *Murex crassispina*. The periodical excretion of the excess of calcareous matter in the blood is greatest in the carnivorous Univalves.

The simple form of univalve shell is the cone, which may be much depressed, as in the genus *Umbrella* (fig. 58), or extremely elevated and contracted, as in *Terebellum* (fig. 89), or of more ordinary proportions, as in the limpets (*Patella*). The apex of the cone is always oblique and eccentric; directed, in limpets, towards the head, but in other Gastropods towards the opposite extremity of the body. The conical univalve shell is generally spirally convoluted, sometimes in the same plane,—*e.g.*, *Planorbis*,—but more usually in an oblique direction, as in *Triton* (fig. 50). The apex of the shell *a* is formed by the nucleus, or the part which was developed in the egg; it is mammillated in *Fusus antiquus*. The spiral turns of the shell *ww* are called "whirls," the last, *w*, *ac*, being the "body-whirl." The lines or grooves formed by their junction are the "sutures" *s*, *s*. The "whirls" above the body one form the "spire" of the shell, *pe* to *a*.

Fig. 50. Triton.

As a general rule, the spiral Univalve, if viewed in the position in which its inhabitant would carry it were it moving forwards from the observer, is twisted from the apex downwards from left to right, the spire being directed obliquely towards the right; but in a few genera,—*e.g.*, *Clausilia physa*,—the shell is twisted in the opposite direction, when it is called "reverse" or "sinistral." Some individuals of *Bulinus partula*, and *Pupa*, and a few marine species, as *Fusus sinistrosus*, are sinistral. The part around which the spiral cone is wound is termed the "columella;" it is exposed by removal of part of the shell in fig. 50, *o*. This central pillar is sometimes simple, sometimes grooved, sometimes plicated; in some shells it is solid, in some hollow, as in *Solarium* and *Dolium* (fig. 49), where the narrow elliptical aperture of the columella is seen to the left of the wide shell-aperture; it is termed the *umbilicus*. In *Solarium*, as in *Philippia*, the apex of the shell is inverted, and can only be seen by looking into the umbilicus.

The wide aperture which forms the base of the spiral Univalve is bounded by an "outer-lip" (fig. 50, *pe*, *ac*) and an "inner lip;" the latter offers a smooth convex surface, over which the foot of the Gastropod glides to reach the ground. In many Univalves, including most vegetable-feeders, the aperture of the shell is entire; in others it is interrupted, the left side being formed only by the "body whirl;" or the "peristome" (as the margin is called) may be broken by a notch, like that which separates the outer lip from the umbilicus in fig. 49, or it may be perforated by one or more holes, or a portion of it may be produced into a canal or siphon (*ac*, fig. 50); this is sometimes termed the "anterior canal," and the notch or hole at the opposite end of the peristome is called the "posterior canal" *pe*. These modifications are important, on account of the constancy of their relations to certain conditions of the respiratory organs. Thus all the Pectinibranchiate Gastropods, in which the water is conducted to the shell by a muscular tube or siphon, have the margin of the aperture either notched or produced into a canal; and the posterior channel (fig 50, *pe*) is anal in its function (*Triton*, *Strombidæ*). Sometimes it is represented by a slit (*Scissurella*), or it is a tube (*Typhis*), or a perforation (*Fissurella*), or a series of holes, as in *Haliotis*.

The relations of these modifications of the univalve shell, which anatomy has made known, enable us to judge, from a fossil shell, of the nature of the medium of existence, of the respiratory medium, the food and habits, of its extinct constructor. The Gastropods which first appear in the Palæozoic strata have entire mouths; the siphonated species are not found lower than the Lias, and they go on increasing in numbers in and from the Tertiary series to the actual sea-shores.

In some of the Gastropods the shell consists of one piece, as in fig. 58, when it is termed an "inopercular Univalve;" but the aperture of the shell, in the majority of the species, is closed by a lid or plate, attached to the back of the foot, and called the "operculum" (fig. 86, *f*). This lid is sometimes calcareous, forming a second shelly plate, but it more frequently consists of an albuminous membrane only, or is horny, thus presenting the condition which the shell itself manifests in certain genera, as *Limax* and *Aplysia*; the inner surface is marked by a muscular impression, but unlike that on the shell, and whose lines bear no relation to the external lines of growth. Some opercula increase by the addition of matter to their entire circumference, and these are either "concentric," as in *Paludina*, or "eccentric," as in *Ampullaria* and most of the Pectinibranchs. Other opercula grow by the addition of matter to part of their circumference, and these are either "spiral" or "imbricate." Spiral opercules may be either "paucispiral" (*Litorina*, fig. 52), or multispiral (*Trochus*, fig. 55). In the "imbricate" or lamellar opercules (*Purpura*, fig. 54), the layers of growth succeed each other in a linear series, and the nucleus is marginal. When the nucleus is apical or in front, as in *Turbinellus* and *Fusus* (fig. 53), it is said to be "unguiculate" or claw-shaped; when it has a projection, as in *Nerita* (fig. 51), it is "articulate." No operculum presents an annular form. Deshayes figures the operculum of *Solarium patulum* as composed of many distinct and spirally-disposed lamellæ. Mr E. Layard has discovered a similar complex operculum in the *Cataulus Austenianus*, a little Univalve of Ceylon. In *Torina straminea* the operculum is thick, horny, circular,

Fig. 51. Articulate.

Fig. 52. Paucispiral.

Fig. 53. Unguiculate.

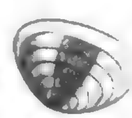

Fig. 54. Imbricate.

Fig. 55. Multispiral.

at the base, which is as large as the mouth of the shell, and concave externally. The rest of the operculum is produced conical, and of many whirls (fig. 56).

Fig. 56.

As the operculum sometimes varies in structure in the same genus, being horny in some species and shelly in others of *Ampullaria* and *Natica*,—as it is present in some volutes, cones, mitres, and olives, and absent in other species of these genera,—and as some genera in a natural family, *e.g.*, *Harpa* and *Dolium*, among the Buccinoids, are without an operculum, whilst the other genera of the same family possess that appendage,—it obviously affords characters of secondary importance in classification. In *Lithedaphus* (*Calyptræa*) *equestris*, the whole base of the foot secretes a calcareous plate, which is cemented to the rock; and the shell appears to consist of two valves. In the *Chiton* (figs. 72 and 73), the shell is divided into eight symmetrical pieces, arranged like scales upon the back. The first of these is the smallest, the last the longest, and most approaching the circular form. In the interior of the shell the muscular impression is usually crescentic, with the horns turned towards the head of the animal.

Most univalve shells are composed of three strata, which differ in the arrangement of the calcareous particles. The innermost layer is nacreous in the fucivorous Univalves,—*e.g.*, *Patella*, *Haliotis*,—and resembles enamel in the marine species. In *Cassis rufa* each layer is composed of many laminæ, which are perpendicular to the plane of the main layer; and each lamina consists of a series of prismatic cells, adherent by their long sides. The laminæ of the outer and inner sides are parallel to the lines of growth, while those of the middle layer are at right angles to them. In the cowries (*Cypræa*) there is an additional layer, which is nacreous, and formed by the overlapping mantle-lobes (fig. 48, *h*, *h*) when the animal has attained its full growth. Such shells are called "cameo-shells," these ornaments being formed by the removal of one layer, and the carving of the next. Hunter[1] discovered that the molluscous inhabitant of a shell had the power of absorbing part of its dwelling. This property, which is now generally recognised, is well illustrated by the thinning of the parietes of the internal whirls of the *cones* and *olives*, from which two out of the three layers of which they were originally composed may be observed to have been removed. The absorption of shell is also illustrated by the removal or smoothing down of the spines of the rock-shells (*Murex*), as the growing whirl expands and overlaps its predecessor by the flattening of the inner lip of the mouth of the *Purpuræ*, by the widening of the focal aperture of the *Fissurellæ*; and it gives rise to various other modifications in the form and structure of shell in the progress of growth.

Another change of form is due to the physical decomposition or destruction of a part of a shell during the lifetime of the inhabitant. This occurs to the apex of certain Univalves after the shell has been excavated by the original occupant in the widening and lengthening the shell to accommodate it to an increase of bulk. Such shells are said to be "decollated," as, for example, the *Bulinus decollatus*, *Cerithium obtusum* (fig. 79).

The inhabitants of univalve shells dispose in different ways of that part of their calcareous abode which they evacuate in the progress of growth. In the decollated shells the vacated space is walled off, prior to its abrasion, by the formation of a thin nacreous plate. In the *Vermetus gigas* the vacated portion of the tube is retained, and successively partitioned off; a series of concave plates or septa being thus developed. In the *Magilus antiquus* the posterior part of the shell, as the soft parts move forwards, is progressively filled up with a dense, solid, subtransparent, crystalline deposite of carbonate of lime.

Univalves which inhabit rocks upon which surf-waves are ever breaking have stronger and denser shells than those that live in calmer seas, or in sandy and muddy bottoms. The shells of air-breathing Mollusks, which, as a rule, are thinner than those of marine species, exhibit analogous effects of external influences. The shells of the burrowing *Bulini*, *e.g.*, are colourless and subtransparent; but the shell is vividly coloured in the species inhabiting plains with scanty vegetation and much exposed to solar light. The shells are largest and thickest in the arboreal *Bulini* of tropical forests, which live amongst an abundance of decaying vegetable matter.

The part of the mantle which invests the viscera in the conchiferous Gastropods—that behind letter *i* in fig. 49—is smooth, thin, and subtransparent, resembling the sac of a hernia, which, with the viscera themselves, appears to have escaped from the common muscular integument of the body. This "visceral mass," as it is termed, is lodged in the upper part of the cone of the shell, the spiral turns of which it follows. The head (fig. 49, *ab*) and foot *d* of the animal can be protruded from the mouth of the shell, and be retracted within its last whirl, by the action of a muscle which has its fixed point in the columella of the shell. This retractor, which is attached to the operculum, seems to answer to the posterior retractor of the foot in Bivalves, much better, at least, than to the great adductor muscle. The form and size of the shell-aperture correspond with, and indicate the size of, the foot. In the pectinibranchiate Mollusks, which are the chief fabricators of the beautiful turbinated shells of the conchological cabinet, the foot is attached to the anterior part of the body by a narrow base, as in *Rostellaria* (fig. 88, *d*), whence they have been termed by Lamarck *Trachelipods*.

The primitive muscular fibre is smooth in all Gastropods. The primitive fasciculi have often numerous nuclei scattered through them, and will illustrate Kölliker's beautiful discovery of the nature of the smooth organic fibre as a much elongated cell-wall. The cutaneous muscular layer consists of oblique longitudinal and transverse fibres, intimately united with the corium. Upon the ventral surface it becomes very thick, and forms a long disc called the "foot," marked *d* in all the figures of the *Encephala*. The fibres of this part contract successively, so as to form wrinkles or transverse waves, following each other from behind forwards, whereby the disc glides over solid bodies or the surface of water. The circular foot of the limpet is used as an adhesive sucker. In some species it expands to a great breadth. In *Siphonotus*, *Gasteropteron*, and other Tectibranchs, it developes lateral swimming lobes, which are analogous to the fins of the Pteropods. In many Gastropods the foot is extended lengthwise, and more or less cleft transversely, as in *Phorus* (fig. 78) and *Rostellaria* (fig. 88). The anterior division *d* forms the chief creeping disc; the posterior one *e* supports the operculum *f* when this is developed. The posterior lobe of the foot in the inoperculate *Harpa* is said to separate spontaneously when the animal is irritated. In *Atlanta* (fig. 65, *e*) it is compressed, but supports the operculum *f*. It seems also to form the tail in the beautiful *Carinaria* (fig. 70, C), in which the middle part of the foot is reduced to a compressed fin-shaped lobe (fig. 70, B) supporting a small suctorial disc *d*. This Mollusk and its allies, hence called *Heteropoda*, swim on their back with their reduced locomotive organ upwards. In most Gastropods the tentacles, buccal mass, and penis, have their special retractor muscles. The opposite extreme of development of the foot is presented by some of the *Neritacea*. The coriaceous foot of

[1] *Phil. Trans.*, 1785, p. 343.

the burrowing *Natica* (fig. 80, *a*) is much developed anteriorly for perforating the sand, and can be reflected so as to protect the tentacle in that act. The sides *d* are produced for locomotion in water. The hind part of the foot *h* is expanded so as to cover the shell like a mantle-lobe.

In the living *Cypræa* (fig. 48) and *Ovulum* (fig. 81), the mantle-lobes *h*, *h* are observed to be in almost constant tremulous motion; but the most vigorous muscular efforts in Gastropods are those of the foot, combined with the retractor-shell muscle. The strombs and scorpion-shells thereby progress by successive jumps. The active olives can turn over when laid on their back, and bury themselves in the sand as the tide retires. The periwinkle advances alternately the sides of its longitudinally-indented foot; *Buccinum arcularia* defends itself by its dentated operculum.

At the grade of the Molluscous organization which the *Gasteropoda* have reached, their capabilities and spheres of action become more extended and diversified than in the *Pteropoda* and *Acephala*; some are terrestrial, some arboreal; whilst the more numerous aquatic species are endowed with power to attain, subdue, and devour organized matter, dead and living. The nervous system of the Gastropods is accordingly not only more complex and concentrated—not only subordinated to better developed masses in connection with organs of special sense and exploration,—but it offers greater variety in its general arrangement, and especially in the position of its ganglions, than in the Lamellibranchiate class; and with these modifications, considerable differences in the outward configuration of the body are associated. A few Gastropods, for example, are symmetrical, more or less flat, or depressed; others are compressed; the majority are contorted, and lose their symmetrical form in an oblique twist. There are other diversities of organic structure which more immediately affect the condition of the nervous system, for some species possess both eyes and tentacles; whilst others are blind and akerous.

The nervous system has a distinct fibrous neurilemma, often charged with pigmental cells. The ganglion-cells are often pedunculated, and have usually a very large nucleus, composed of obscure granules, in the midst of which are two or four transparent nucleoli. Such cells form the sole contents of the neurilemmal canal at some parts of the nerves. (Lewes.) The central part of the system surrounds the œsophagus, and consists of different parts, of which that placed above the tube, and which usually includes two contiguous ganglia, is called the brain (fig. 70, *u*).

In the limpet (*Patella*) and bubble-shell (*Bulla*), we find that the cerebral ganglions, as in the Bivalves and Pteropods, are still distant from each other, and situated at the sides of the œsophagus, connected together by a nervous chord or commissure, which arches over that tube; from these ganglions two nerve-trunks proceed backward on either side; the median and superior pair pass along the sides of the œsophagus, converge, and meet below to form a pair of ganglions in close contact with one another, which supply the foot; these are evidently homologous with the bi-lobed pedial ganglion of the *Mytilus*. The lateral and inferior filaments pass downwards to join two widely-separated branchial or splanchnic ganglions, homologous with those situated on the posterior adductor in the *Mytilus*. There is, however, a considerable difference in the relative positions of the pedial and branchial ganglions in the limpet; the latter have advanced into close contiguity with the pedial ganglions, and are connected with them by the same transverse chords, which in *Pecten* and *Mytilus* serve merely to bring the branchial ganglions themselves into mutual communication. The position of the cerebral ganglions varies according to the degree of extensibility of the mouth and œsophagus. Thus in the snails (*Helix*) they are placed above the mouth; in *Carocolla* at the commencement of œsophagus; in the whelk (*Buccinum*), near the end of that tube; in the *Purpura* beyond the stomach.

As a general rule, we find that the superior ganglions give off tentacular, ocular, and buccal nerves; whilst the inferior masses are the centres of the muscular, respiratory, and visceral internuntiate chords. In the *Carinaria* (fig. 70), the superior or cerebral ganglions are marked *u*; they supply the eyes *C*, the tentacles *b*, the acoustic sacs *u*, and complex parts of the mouth; the buccal ganglions, situated above the glottidium *a*, and developed upon the buccal nerves, may well be deemed the centres for the reception of such degrees of smell and taste as the Mollusk may enjoy. We have here, therefore, indisputably the centres of the nervous system which are analogous to the olfactory, optic, and acoustic divisions of the brain of *Vertebrata*;—Who may say that they are not also the rudimental homologues of such? Upon either basis the part of the Mollusk "above" or "dorsad" of the digestive canal is thus defined.

With a difference so great in the disposition of the locomotive organs and muscular masses in the Vertebrate and the Mollusk, corresponding differences in the ordinary excito-motory nervous centres must be looked for. In the *Carinaria* they are situated at *v*, above the base of the compressed foot *B*; they are connected, as in *Mytilus* by long commissural chords with the cerebral ganglia, and by a short, thick commissure with each other; thus completing a wide and loose œsophageal ring. Nerves or commissural chords pass from both the cerebral and pedial ganglions to the splanchnic or branchial ganglion *x*, situated, like the pedial, below the alimentary canal, and supplying that canal, the liver, heart, branchiæ, and genital glands.

In the spiral Pectinibranchiate Univalves, where the branchiæ and their nerves are twisted to the left side, it is the left branchia which is atrophied, while the right one is of large size. The nerves are similarly affected; the left branchial one being filamentary, whilst the right is a large chord, and has the branchial ganglion developed upon it.

The principal œsophageal ganglionic circle, in most Gastropods, more closely surrounds the gullet than in *Carinaria*, and is defended by a thick membrane, which, in the large Tritons, assumes almost a cartilaginous hardness. A coloured pigment is not unfrequently found occupying a position analogous to that of the arachnoid, between the dense outer membrane and the ganglions. In the *Limnea* and *Planorbis* this pigment gives to the ganglions their orange or roseate hue.

Amongst all the observed diversity in the number, size, and position of the nervous masses of the Gastropods, certain ganglia are obviously homologous with those which have received determinate names in the Lamellibranchiate Mollusks. The branchial or splanchnic ganglions (figs. 18 and 80, *x*) receive impressions from, and transmit them to, the gills, heart, and other viscera; they communicate with the brain, and either through that centre, or by more direct connection with the pedial ganglions, associate the circulating and respiratory forces with all other parts of the body. In the Gastropods which have great expanse of soft mucous integument exposed,—as, *e.g.*, *Aplysia*, *Umbrella*,—accessory small ganglions, supplying such integument, are developed, which are in more immediate connection with the splanchnic ganglions. The pedial ganglions are more commonly distinct than in the Bivalves; and the two divisions are, in some Gastropods, wide apart, in consequence of the great breadth of the foot; in most Gastropods the acoustic sacs receive, as in Bivalves, their nerves from the pedial ganglions. The cephalic ganglions assume the character of optic lobes, concurrently with the constancy and better development of the eyes. Even when the organs of vision are more than usually minute, or are wanting, these ganglions are always larger than in the *Acephala*, and more decidedly superior in position; they supply also the acoustic vesicles in many

Gastero-poda.

Gastropods, *e.g.*, in the whole order of *Nucleobranchiata*, and in some *Nudibranchiata*. The cephalic ganglions, when separate, are united by a thicker communicating chord, and are larger, in proportion to the nerves given off from them, than in the *Acephala*.

Soft, lubricous, and irritable as is the exposed skin of Gastropods, it would seem to possess a very low degree of true sensibility. Baron Férussac affirms that he has seen a slug allow its skin to be bitten by others, and, in spite of large wounds thus produced, it has manifested no sign of pain. Species of *Eolis*, in confinement, will devour each other's branchiæ, which may be reproduced. The vascular inferior surface of the foot may take cognisance of the character of the surface over which it glides; but the special organs of the tactile sense are the tentacles or "horns," which project from the lateral and upper parts of the head. It is most probable that, with the exception of the cephalic ganglia, the functions of the nervous centres are limited to the automatic reception and reflection of stimuli, like those of Hartley's first class of vibrations in man, depending on nervous influence "which is detached down the motory fibres before reaching the brain."[1]

The common snail offers a fair type of the digestive system of a Gastropod. In fig. 63, *a* represents the dentated horny jaw which arms the upper lip; *h* the large white salivary glands that spread upon the sides of the wide gullet; *f* is the stomach; *g* a cæcal production which may represent the rudiment of a pancreas; *u* is the intestine, the part traversing the respiratory chamber, and commonly called rectum, laid open, terminating at *l*; *i*, *i* show the lobes of the liver. That typical bend of the gut, whereby its outlet is brought into communication with the respiratory and renal chamber is also illustrated in fig. 65, at *o* (*Atlanta*); and again in fig. 70, at *no* (*Carinaria*); the nearer approach to the straight course shown by the intestine of *Doris* or *Firola* (fig. 71, *mo*), is an exceptional departure from the Molluscous type, and is due to an equally exceptional position of the breathing organ.

Other well-marked modifications of the digestive apparatus will be noticed in connection with the species of *Gasteropoda* that may present them. The blood of the Gastropod is often opalescent, with a few colourless corpuscles or cells having an indistinct granular nucleus.

The auricle is divided in *Fissurella* and *Chiton* as in *Haliotis*. Both auricles, however, equally receive the oxygenated blood from the respiratory organ, as does the single auricle in *Atlanta* (fig. 65, *x*), in *Helix* (fig. 63, *e*), and in all the other Gastropods. The ventricle (fig. 63, *p*) propels the blood to the viscera and muscular system of the body; and the heart is situated on the right side of the back in the *Pulmonata*, most *Tectibranchiata*, and the dextral *Pectinibranchiata*. It is on the opposite side in *Ancylus*, *Haliotis*, and the sinistral Gastropods. It is to the left of the dorsal median line in *Carinaria*, and near the hinder end of the body in *Firola*. The heart has a distinct pericardium in all Gastropods, save the *Apneusta*, where it is at least not clearly defined. The aorta, continued from the apex of the ventricle, divides into two principal branches in most of the Gastropods. The auriculo-ventricular aperture is usually defended by two semilunar folds (fig. 63, between *o* and *p*). The aorta at its commencement is frequently strengthened and enlarged by a muscular layer similar to the *bulbus arteriosus* in fishes, and which, in the *Aplysia*, is continued beyond the origins of the primary branches of the aorta. The ramifications of the aorta, as in crustaceans and insects, are sooner or later lost in veins which expand to form sinuses, occupying the lacunæ of the viscera and other organs of the body.[2] The anterior aorta terminates,—*e.g.*, in *Patella*, *Triton*, *Haliotis*,—in a large lacunar sinus, containing the brain, the salivary glands, the œsophagus, and retracted tongue. The resumption of the normal vascular character by the venous system is more or less sudden, and is best exemplified near the respiratory organ (fig. 63, *nn*), upon which such venous trunk ramifies like an artery, without any interposed branchial or pulmonic heart. The large venæ cavæ of the *Aplysia* are perforated by minute apertures, communicating with the great sinus that lines the cavity of the abdomen; and the exterior of these veins is provided with decussating muscular fibres, which probably regulate the diameter of such communications.

The diffused condition of the vascular system most prevails in those Gastropods in which the respiratory organs are least developed—*e.g.*, the *Apneusta*. In the rest of the class the general modifications of the respiratory organs are indicated by the characters of the orders already defined. In the terrestrial Gastropods the breathing organ has the form of the simple undivided vascular sac (fig. 62, *nn*), like the lung in the lowest air-breathing vertebrate animals. Its orifice *m* is on the right side near the head. The forms of the aquatic-breathing organ are as various as its position.

In most of the Nudibranchiate species the gills are tufted and ramified, as in the higher Annelides. They are penniform in the *Haliotis*, and pectinated in all the diœcious Gastropods (fig. 77, *i*), as the name of their order indicates. In these they never exceed two in number, which are of unequal size; and the branchial chamber is usually prolonged into a siphon. In a few genera of amphibious Gastropods a pulmonary sac is combined with branchial organs; but in some of these,—as, *e.g.*, *Amphibola* (*Ampullacera*) *australis*,—the branchia are reduced to a mere gland. The branchial surface is ciliated in all the Gastropods, as is also the exterior surface of the body in the small fresh-water species.

As a compensation for the absence of gills, some *Apneusta* (*Actæon*, *e.g.*) have an aquiferous system, consisting of a reservoir filled with water, behind the heart, from which branched canals pass off in all directions, one of which, according to Vogt, opens on the right side behind the vent. Conspicuous aquiferous pores are situated at the centre of the foot in *Cypræa*, *Conus*, and *Ancillaria*; and at its margin in *Haliotis*, *Doris*, and *Aplysia*. Della Chiaje has described a similar system in many of the higher organized Gastropods. Besides the large and well-developed hepatic and salivary glands which are associated with the alimentary canal, certain fucivorous Gastropods present the simplest rudimental condition of the pancreas.

The follicular renal gland, sac, or surface, for the urinary excretion, communicates by the canal called its duct with the external surface near the anus, and by an opposite opening with the pericardial cavity. The sac has been seen to contract rythmically in the transparent Pteropods and Heteropods, and may perform the same movements in other Encephala. Water seems to be freely admitted to this glandular cavity. In some Gastropods the duct dilates to form a small receptacle. A group of follicular glands, sometimes imbedded in a distinct glandular sac, is present in many species for the elimination of some peculiar and characteristic colour. The yellow liquid of the *Bullæ*, and the famous purple secretion of the *Purpura*, are products of saccular modifications of this follicular gland, which is situated between the heart and liver. Numerous simple and scattered follicular glands lubricate the mantle with its characteristic mucus in all the Gastropods. In several

[1] Hartley, *On Man*, &c., 8vo, 1749, vol. i., p. 97.

[2] Pouchet, *Recherches sur l'Anatomie et Physiologie des Mollusques*, 4to, 1842; Milne Edwards, Observations sur la Circulation chez les Mollusques, *Annales des Sciences Naturelles*, tom. viii., 1847.

Gastero-poda.

terrestrial species the median line of the foot is occupied by a straight canal, lined with ciliated epithelium, which ends in a large orifice beneath the mouth. On each side of this canal are rows of follicles, which secrete a granular mucus. A follicle excreting a similar mucus opens on the extremity of each dorsal or lateral lobe in the *Apneusta* which possess those appendages. "Some of the *Gasteropoda* can suspend themselves by glutinous threads, like *Litiopa* and *Lissoa parva*, which anchor themselves to sea-weeds (Gray), and *Cerithidea*, which frequently leaves its proper element, and is found hanging in the air. (Adams.) A West India land-snail (*Cyclostoma suspensum*) also suspends itself. (Guilding.) The origin of these threads has not been explained; but some of the *Limaces* lower themselves to the ground by a thread, which is not secreted by any particular gland, but derived from the exudation over the general surface of the body." (Lister; D'Orbigny.)[1] Some peculiar scent-follicles must exist in the garlick-snail (*Helix alliaria*). A species of slug, called *Phosphorax*, is slightly luminous.

Gastropods have the power of repairing injuries and of reproducing lost parts to a considerable extent. New tentacula soon grow to replace those which may have been amputated. When they support eyes, as in the snail, the organs of vision are reproduced also. The mouth, with the horny jaw, has grown again in this Gastropod; and when the snail has been decapitated, but with the œsophageal ganglions left behind, the head has been restored.

GASTEROPODA MONŒCIA.

Order I.—APNEUSTA.

No distinct respiratory organs. No shell (in the adult state).

Certain soft-bodied, subelongate, subdepressed, vermiform, aquatic animals, with a soft mucous ciliated integument, devoid of heart and respiratory organs, have been placed in the Articulate province of the animal kingdom, and therein have been associated with the *Annelides*, or with the *Entozoa*, or have been kept apart in an intermediate class, under the name of *Turbellaria*. In some of these worms (fig. 1) the alimentary canal, commencing by an evertible proboscis, sends off numerous branched blind-tubes, which radiate into the surrounding parenchyme. The œsophagus is surrounded by a nervous collar, developing two œsophageal ganglia, from which the nerves are sent off to the body. Some species have two cephalic tentacles (*Planaria tentaculata*; *Physanozoon*, Grübe). The ciliated skin appears to perform the function of respiration. No heart has been detected. The male and female sexual organs are combined in the same individual.

Similarly-shaped small marine animals, with a ciliated soft integument, equally devoid of heart and branchiæ, with the nervous system, the digestive and the generative organs, organized according to the same type as in the above-cited *Turbellaria*, have been placed in the Molluscous province. Such, *e.g.*, are the species of *Rhodope*[2] and *Acteon*. The transition from these abranchiate and acardiac worm-like animals to the Eolidians, which have a heart, but are without gills,—*Calliopea*, *e.g.* (fig. 2),—and from these to the true Nudibranchiates,—*Doris* and *Tritonia*,—is so close, that in drawing the line of demarcation in the series progressing from the Tremat‹de Entozoa, through the *Planariæ* upwards, we define the Molluscous boundary as arbitrarily as in the series progressing from the *Bryozoa*, through the *Tunicata*, to the same great province of the animal kingdom.

Gastero-poda.

If the diffused and ramified type of the alimentary canal were taken as a character of *Turbellaria*, as contradistinguished from these Mollusca, we should find it in some,—*e.g.*, *Eolis* and *Calliopæa*,—associated with a distinct heart; and in others,—*e.g.*, *Elysia*,—associated also with a respiratory organ of the type of that of the pulmonated Mollusks. If we were to require definitely-developed respiratory organs as a title to admission into the Molluscous province, we must exclude true Gastropods, like *Glaucus* and *Calliopæa*, which are nevertheless too closely allied to *Scyllæa* and *Doris* to be placed in a distinct primary division of animals from them.

For those naked Gastropodous Mollusks in which the ramifications of the alimentary canal take the place and discharge the functions of a liver, and in which, although there may be productions of the skin simulating the more localized branchial processes in higher Gastropods, those productions receive gastro-hepatic cæca, not branchial vessels—for the reception of such low-organized Mollusks—an order or sub-order is requisite, for which the term *Apneusta* ("gill-less") may be retained. The order may be characterized as one of "Naked Gastropods, hermaphrodite, marine, without distinct respiratory organs; alimentary canal with gastro-hepatic ramifications; anus dextral. The species often swim on the back, with the foot supine."

Genus Rhodope, Kölliker.—Body naked, smooth, subdepressed, without tentacles; organs of circulation unknown. The comparatively simple form of the peculiar digestive appendages of this species[3] is an instructive one. Had it first been observed, instead of the more complex and ramified condition of the same parts, as in *Calliopæa*, it most probably would not have been mistaken for a "gastro-vascular apparatus,"[4] or have given rise to the ideas originally broached and generalized under the term "phlebentérisme." The fry have no deciduous shell; they swim, like the *Turbellariæ*, by means of superficial vibratile cilia.

Sp. *Rhodope veranii*.—About 10 lines in length. Hab. Mediterranean.

Genera *Lissosoma*, Quatrefages; *Flabellina*, Ed.; *Phyllirhoë*, Péron.

Sp. *Phyllirhoë Bucephalum*, Lam.—Body oval, elongate, compressed, pellucid, without a trace of "foot;" coloured, with brown specks, head distinct, with two long, subulate, twisted tentacles; tail truncate, rounded; a pair of horny jaws; glottidium, with 3—0—3 teeth on the tongue-strap. Size of the animal varies from 8 lines to an inch. Hab. common in the Atlantic.

Six species of *Phyllirhöe* have been named and characterized; but the variability in the form of the soft contractile body, and in the superficial punctation and deeper-seated (visceral) coloration of the body, is such as to throw considerable doubt upon the constancy of the differences of colour which have been interpreted as specific.

Genus Fucola, Quoy.

Sp. *Fucola rubra*, Quoy and Gaim. (*Voyage de l'Astrolabe*, pl. 24, figs. 21, 22).

Genus Actæon, Oken (*Elysia*, Risso).—Body subcylindrical, limaciform; head bordered by a depressed expansion, pointed behind; two subclavate non-retractile tentacles, with eye-specks behind them; vent, in some lateral and dextral, in others subdorsal; glottidium, with uniserial dental plate.

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[1] Woodward, *Manual of Mollusca*, p. 103.

[2] Rhodope, *Nuovo Genere di Gasteropodi*; Kölliker, in *Giornale dell' I. R. Instituto Lombardo*, Milano, 1847.

[3] Kölliker, *loc. cit.*, pl. i., fig. 1.

[4] Sur l'existence d'un appareil gastro-vasculaire chez la Calliope de Risso (E) Mollusque de la famille des Eolidiens, par M. H. Milne Edwards, *Annales des Sciences Naturelles*, 2d serie, tom. xviii., p. 330, 1842. It must be remarked, however, that the original discoverer of the gastro-hepatic canals in the Eolidians (Prof. Lowén), entertained from the beginning correct notions of their nature and functions.

Sp. *Actæon corrugatus*, Forbes and Hanley (*Brit. Moll.*, t. ccc., fig. 5).

Sp. *Actæon sinister*, Quatrefages (*Ann. des Sciences Nat.*, 1844, pl. 3, fig. 4; *A. viridis*, ib., pl. 3, fig. 2; *A. elegans*, ib., pl. 3, fig. 3).

Genus Limapontia, Johnstone.—Body oblong, depressed anteriorly, raised and rounded behind; head arched and keeled on the sides; eyes behind the carinæ; no tentacles; vent dorsal, sub-posterior.

Sp. *Limapontia nigra*, Forbes and Hanley (*Brit. Moll.*, t. ccc., fig. 4).

Genus Calliopæa, D'Orb.—Body oblong, subdepressed; head forming a kind of round swelling circumscribing the mouth, with only two (posterior) tentacles, bearing eye-specks at their base; the foot slightly dilated anteriorly.

Sp. *Calliopæa Souleyetii* (fig. 57)—In this species the mouth is subterminal; the glottidium large, slightly protractile, and bearing a uniserial imbricated plate, with many denticles in each transverse row of the series. A slender, elongated, salivary follicle *a* opens on each side of the pharynx. The œsophagus is very short, being defined simply by the nervous collar, beyond which it dilates into a small ingluvies *S*, and afterwards into the stomach *e*, from the termination of which the short intestine and the gastro-hepatic canals diverge. The latter are four in number, are diverging, in two lateral pairs (one forwards, the other backwards, *c*), and sending off the branched gastro-hepatic follicles from their outer side. The heart is situated between the two diverging posterior gastro-hepatic canals; the wide auricle receives the blood from the diffused sinuses which have exposed it to the respiratory influence acting through the delicate integument. The aorta divides into two principal branches. The ovispermal masses are divided into separate rounded bodies with their several canals, which unite into a trunk traversing an ovoid glandular enlargement; beyond this the oviduct separates from the sperm-duct, the former terminating in a long convoluted uterus with glandular walls, and the latter terminating in a long, tubular, evertible penis.

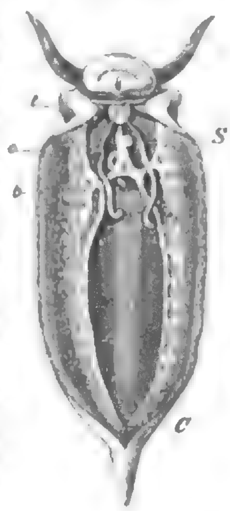


Fig. 57.
Calliopæa Souleyetii.

Genus Cenia (Syn. *Ictis*), Alder and Hancock.

Sp. *Cenia Cocksii*, Forbes and Hanley (*Brit. Moll.*, t. ccc., fig. 6).

Genus Pelta, Quatrefages.

Sp. *Pelta coronata*, Quatrefages (*Annales des Sciences Nat.*, 1844, pl. 3, fig. 6).

Genus Glaucus, Forster.—Body elongate, slender, posteriorly filiform; foot linear, channelled; tentacles 4, conical; jaws horny; teeth in single series, arched and pectinated; gastro-hepatic cæca prolonged into three pairs of lateral, digitate, or palmate tegumentary sacs. Colour blue; length between 1 and 2 inches. Hab. Atlantic Ocean, between the tropics.

Mr Bennett, who captured some of these beautiful little pelagic Mollusks in Lat. 2. 26. N., Long. 19. 51. W., has recorded some interesting observations on their living colours, movements, and food, in the *Proceedings of the Zoological Society*, 1836, p. 113. The gastro-biliary and tegumentary productions, which some have called "gills," he terms "fins." As they floated upon the surface of the water (in the glass), the light silvery blue of the lateral parts contrasted with the deeper blue of the upper surface. This surface seemed to be most sensitive or irritable. When touched the animal coils itself up, then dashes out into the linear form; again coils itself up, and so remains for a short period, apparently exhausted by its efforts. "But on the cessation of the irritating cause, the animal quietly resumed its original position, perhaps dropping one or two of its wearied fins, according as its own sensations of ease or comfort might dictate.

"When nothing irritated this tender Mollusk, it would remain tranquilly floating upon the surface of the water, with scarcely any movement but that which proceeded from the undulating movements of the digitated extremities of the fins, as well as an occasional slight twisting motion of the same organs.

"I felt much interest in the beautiful display of a circulating fluid on the dorsal surface of these animals, which was afforded me by the assistance of a microscope. Through the semi-transparent membrane of the back a fluid could be readily perceived close to the surface, evidently flowing in two directions, one taking a course downwards, and the other returning upwards; but I was unable to distinguish two distinct vessels for these separate actions.

"These animals seemed to be very torpid in their movements, although sometimes, when floating upon the water, they would be seen busily engaged in moving their fins about; but those actions were soon suspended, and their fins were suffered to hang lazily down, as if fatigued with the short exertion, which did not move them one inch about the glass of water; and even when the little indolent creatures did take the trouble to move themselves from one side of the glass to the other, it was effected by a tardy motion, stirring themselves first with one fin and then with the other, according as circumstances might require.

"I placed some small specimens of *Porpita* in the glass of water containing the *Glauci*, to observe if they would attack them; for some time one of the *Glauci* was close to a *Porpita*, and was even annoyed by the *tentacula* of the latter touching its back; yet the *Glaucus* bore this, although with the usual characters of impatience, yet without attempting to attack it. At last it seized the *Porpita* between its jaws; and by aid of a powerful lens, an excellent opportunity was afforded me of closely watching the devouring process, which was effected by an apparently sucking motion; and at this time all the digitated processes of the fins were floating about, as at other times when the animal was at rest. But I did not observe in one single instance that they were of any use to the animal, either to aid in the capture or to securely hold their prey when in the act of being devoured; for the animal seems to depend merely upon the mouth in capturing its prey; as in this and other instances, which I had opportunities of observing, they seized their prey instantly with the mouth and held it by that power alone, whilst by a kind of sucking motion the prey was devoured. The digitations may therefore only be regarded as appendages to the fins to aid the animal perhaps in the direction of its movements, as it was observed that they turned and twisted them about during the progressive motion (that is, when this tardy animal is pleased to progress, which appeared to me very rarely to meet with its inclination), as if in some way or other to direct the movements of the animal.

"The *Glaucus*, after eating the tentacles and nearly the whole of the soft under surface of its prey, left the horny portion, and remained tranquilly reposing upon the surface of the water after its meal, the only motion visible in the animal being the playing of the digits of its fins. The mutilated remains of the *Porpita* sank to the bottom of the glass.

"Soon after another *Glaucus* began a devouring attack upon another *Porpita* which had been placed in the glass, eating a little of it, and then ceasing after a short meal, occasionally renewing the attack at short intervals. On

examining the *Porpita*, which had been partially devoured by the ravenous *Glaucus*, I found the disc had been cleared of the tentacles and other soft parts; a small part of the fleshy portion only remaining upon the disc. Only one part of the horny disc exhibited any injury, and that appeared to be the place where the animal was first grasped by the *Glaucus*.

"When any of these animals came in contact with another in the glass, they did not display any annoyance, or coil themselves up, nor did they evince any savage propensities one towards the other; and they would often float about, having their digitated processes in contact one with the other, without exhibiting any signs of annoyance. Even when placed or pushed one against the other they did not manifest any irritation, but remained undisturbed, as in their usual moments of quiet repose.

"These animals soon perished. I could not preserve them for any length of time in the glass of sea-water, although the water was changed as often as it was thought necessary; the digitated processes of the fins were observed to shrink up on the death of the animal, and the process of decomposition rapidly took place, the whole body becoming a shapeless mass, having a bluish colour of deadly hue for a short period, and then became of a blackish or brownish-black colour. I have seldom seen a gelatinous animal which appeared so firm whilst in the water, that proved so speedily to decompose when removed from it. Even the beautiful purple of the back, the silvery or enamel of the abdomen, and the silvery blue of the sides, all speedily vanish, indeed instantly disappear, upon the death of the animal, as if it had been washed off; the expansive, delicate, and beautiful fins and digitated processes are no longer seen; they shrank up to nothing."

Order II.—NUDIBRANCHIATA, Cuvier.

Branchiæ extending more or less freely from various parts of the body.

Genera *Scyllæa*, *Doris*, *Thetis*, *Polycera*.

Genus Scyllæa, Linnæus.—Body elongated compressed; foot long, narrow, furrowed longitudinally; head furnished with two retractile tentacles; back with two expansions or membranous and flexible wing-like lobes on each side; branchiæ penicillate, composed of filaments, scattered over back, especially crowded in the wings.

Sp. *Scyllæa pelagica*, L., Cuv. (*Ann. du Mus.* vi., pp. 416, 417, pl. 61, figs. 1–7; *Mollusq. Mém.* vi.; Blainv., *Malac.*, pl. 46, fig. 5).—This species attaches itself by its furrowed foot to *Fucus natans*, and is found in the Atlantic Ocean. The glottidium has a triserial rasp, with 24–1–24 teeth; the gizzard is armed with chitinous trenchant plates.

Genus Tethys, L.—Body somewhat long, depressed, furnished anteriorly with a broad, funnel-shaped, fimbriated disc, behind which it contracts into a sort of neck; mouth proboscidiform, retractile. Two conical tentacles at the base of the disc retractile into broad cup-shaped sheaths. Apertures of generation and vent at the right side in the anterior part of body. Two rows of branchiæ at the sides of back; cirrose pectinate branchiæ alternating with smaller bundles.

Sp. *Tethys leporina*, L. (Rondelet, *Pisc.*, p. 526, *tertia leporis marini Species*; Cuvier, *Ann. du Mus.* xii., pp. 259–270, pl. 24, *Mém. sur les Moll.* vii.; Blainv., *Malacol.*, pl. 46 bis, fig. 9).—This species sometimes attains a foot in length. Hab. the Mediterranean.

Genus Doris,[1] L., Cuvier.—Body oval, flat, or gibbous above, with abdomen flat, covered by a loose membrane, and plicato-marginate. Vent posterior, dorsal, in the mid line of body, surrounded by branched or plumed branchiæ disposed in a circle. Apertures of generation at the right side. Two dorsal tentacles retractile within tubes, annulate with transverse lamellæ; two quasi-tentacular productions from near the mouth. Mouth armed with two horny plates (fig. 29, *a'*), united near the front, and having two projecting points; glottidium (fig. 29, *d*) having lingual teeth numerous, central small, laterals similar, hooked, and sometimes serrated.

Genus Tritonia, Cuvier.—Body elongate, subtetragonal or compressed, anteriorly rotundate, posteriorly acuminate; apertures of generation and of rectum at the right side, with vent situated behind the genital orifice. Two tentacles with branched filaments retractile into a sheath. Circular velum, tuberculated or digitated, in front of mouth. Two lateral jaws, acute, with margin denticulate. Branchiæ arborescent at the sides of back. Glottidium with triserial tooth-strap, one central, and numerous lateral teeth in a row.

Order III.—INFEROBRANCHIATA, Cuvier.

Branchiæ at the lower part of the sides of the body between the foot and mantle. The heart lies in these Mollusks in the middle of the body on the dorsal surface, and receives the blood from the gills placed on each side. Both "Prosobranchiates" and "Opisthobranchiates" are contained in this very natural group.

Genus Phyllydia, Cuvier.—Body oblong, with a tuberculated mantle; head with four tentacles, the two dorsal retractile within a cavity; the other two labial; anus in posterior and middle part of back. (Cuvier, *Ann. du Mus.*, v., pp. 266–276, pl. 18; *Mollusq. Mém.* viii.)

Sp. *Phyllidia trilineata*, Cuvier; *Phyll. varicosa*, Lam., Cuvier, l. c., figs. 1–6; Blainv. *Malac.*, pl. 47, fig. 1).—Hab. Indian and Red Seas.

Genus Pleurophyllidia, Meckel. (*Diphyllidia*, Cuvier; *Linguella*, Blainv.)—Body oblong, with ample mantle, acuminate posteriorly; head with two tentacles placed towards the back at the anterior margin of mantle; frontal veil with angle produced on each side; gills limited to the hinder two-thirds of the body; vent on right side, behind genital foramen.

Sp. *Pleurophyllidia lineata* (*Diphyll. lineata*, Otto, *Nov. Act. Acad. Cæs. Nat. Cur.* xviii.; Delle Chiaje, *Memorie* i., p. 128, tab. 10, figs. 12–20; Meckel, *Archiv. f. d. Physiol.* viii. 1823, taf. ii., figs. 1–7, s. 190–207).—Hab. the Mediterranean, and, according to Lovén, the North Sea also.

Order IV.—TECTIBRANCHIATA, Cuvier.

Branchiæ resembling pinnatifid leaves, restricted to one side, and covered by the mantle and a small shell, which is sometimes exposed. Most are phytiphagous; all have a complex gizzard.

Genus Aplysia, L., Gmel.—Body oblong, limaciform, mostly margined by a broad velum reflected from the sides of the foot over the back; two contractile tentacles, conical, sulcated, in upper part of the head; two productions of the velum surrounding the mouth, forming as it were, a second pair of inferior tentacles; eyes sessile, in front of base of superior tentacles; branchiæ dorsal, covered by a production of mantle, including a flat membranoso-corneous or calcareous shell, and folded posteriorly so as to form an excretory siphon.

Sp. *Aplysia depilans*, L.—The tooth-strap of *Aplysia depilans* is broad, short, brown. Teeth brown, many on each diverging cross series; central tooth truncate, triangular, dilated beneath, with an arched base, and tridentate apex; lateral teeth 12—12, in an oblique line, each tooth arched, with the tip recurved, with three rounded

[1] *Doris*; see the critique of Cuvier on this name and on the confusion of this genus by Gmelin and others in *Ann. du Mus.* iv., p. 447 and foll.; *Mollusq. Mém.*, No. 5; also Rapp, Ueber das Molluskengeschlecht Doris, *Nov. Act. Acad. Cæs. Leop. Carol.* xiii., pp. 513–522, tab. 26, 27.

lobes on the lower edge; the crown of the anterior teeth worn, so as to leave the reflexed and lobed part. The gullet dilates into a large crop; the thick coats of the gizzard are beset with firm horny processes, some in the form of hooks, others of rhomboid crushing plates. Near the pylorus there is a long pancreatic cæcum.

The *Aplysia depilans*, or "sea-hare" of the Mediterranean, sometimes attains a foot in length. (For the other species of this singular genus, see Sander Rang, *Hist. Nat. des Aplysies*, Paris, 1828, folio.)

"The sea-hares are mixed feeders, living chiefly on seaweed, but also devouring animal substances; they inhabit the laminarian zone, and oviposit amongst seaweed in spring, at which time they are frequently gregarious. (Forbes.) They are perfectly harmless animals, and may be handled with impunity. When molested they discharge a violet fluid from the edge of the internal surface of the mantle, which does not injure the skin, has but a faint smell, and changes to wine-red. (Goodsir.) In old times they were objects of superstitious dread, on account of their grotesque forms, and the imaginary properties of their fluid, which was held to be poisonous, and to produce indelible stains." (Woodward.)

Genus DOLABELLA, Lam.—Operculum of branchiæ towards the posterior part of back, including a calcareous shell. Body mostly truncated posteriorly with an orbicular declining area.

Sp. *Aplysia Rumphii*, Rang (*Dolabella Rhumphii*, Cuvier; Rumph, *Amb. Rariteith.*, tab. x., fig. 5, tab. xl., fig. *n* the shell); Cuvier, *Ann. du Mus.* v. p. 437 and foll., pl. 39, figs. 1–4, *Moll. Mém.* 12.

Genus SIPHONOTUS, Adams.—Body elongated; gills covered by the mantle and shell; foot with the sides dilated into swimming lobes; respiratory orifice prolonged into a siphon. Shell nearly membranaceous.

Sp. *Siphonotus geographicus*, Adams.—Whitish-brown, covered with minute dark specks, and large, irregular, green, reticulated patches, margined with opaque white; under surface of foot of a bright yellow, left side of foot with a projecting lobe, which overlaps that of the opposite side; siphon of the mantle prolonged into a tapering, subcylindrical tube. Hab. Java Sea, among masses of floating sea-weeds.

Genus UMBRELLA, Chemnitz.—Body chiefly composed of a large, thick, tuberculated foot, deeply notched anteriorly; mouth (fig. 58, *a*) proboscidiform, retractile into the pedal notch, overhung by a small velum; tentacles two, with plicated cavities at their base; eyes sessile between the tentacles; genital orifice in front of the tentacles; excretory orifice posterior, tubular. Shell orbicular, almost flat, with a subcentral low apex.

Sp. *Umbrella mediterranea* (fig. 58).—The tooth-strap

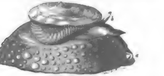


Fig. 58.
Umbrella mediterranea.

of *Umbrella mediterranea* is broad, longitudinally plaited; teeth in numerous oblique series, each containing numerous small, closely pressed, compressed, sharp-edged, transparent teeth.

Genus BULLÆA, Lam.—Velum of head large, separated from the mantle by a transverse furrow (fig. 59, *m*), which invests the shell *s*. Vent, orifice of generation, branchiæ, and heart placed at the right side. Foot broad, shorter than body, with the lateral margins *l* produced, but not enveloping. Tooth-strap with two or four series of sickle-shaped teeth. Shell thin, convolute, with aperture large.

Sp. *Bullæa aperta*, Lam. (fig. 59).—The tooth-strap of this species is thin and narrow, with brownish transparent teeth; two in each transverse row, close together at the base, long, slender, compressed, arched, nearly in half a circle, with the inner edge finely denticulated. The gizzard is armed with three long, partly horny, partly shelly plates. The eggs are in a single series, in long spiral gelatinous filamentary capsules. The fry are furnished with ciliated vibratile swimming lobes, and have a spiral, operculated shell.

Fig. 59.
Bullæa aperta.

Genus SCAPHANDER, Montf.—In this genus the shell is oblong, convolute, spirally striated, with the aperture much expanded in front; the spire concealed.

Sp. *Scaphander lignarius* (*Bulla lignaria*, L.).—The teeth are in two longitudinal series, claw-shaped; crenulate on the convex margin near the point, with a crest on the same margin near the base. The gizzard is provided with two large triangular calcareous plates, united together by strong transverse muscular fibres attached to their circumference, except at the upper part, where a third small oblong plate is interposed between the two lateral ones.

The *Scaphander lignarius* feeds upon the *Dentalium entale*; five of these have been found in the gizzard, with the shells partly crushed and digested.[1]

Genus TORNATELLA, Lam.—Body ovate, white; head broad, notched in front, with a pair of eye-specks (fig. 60, *c*), and two retroverted tentaculiform lobes *h*; the foot has two small anterior productions *b*; slightly developed lateral lobes support the shell, and an opercular appendage *f*.

Fig. 60.
Tornatella.

Sp. *Tornatella tornatilis*, Lam. (fig. 60).—Hab. British seas, in deep water.

Genus BULLA, Lam. (fig. 61).—Head in the form of a large disc *a*, truncate, and often mesially notched in front; produced above into lobes *b'*; laminated beneath, and sometimes with lateral appendages *b*: two subcentral

Fig. 61.
Bulla vexillum.

eye-specks; side lobes of the foot large. Shell ventricose, convolute, partially exposed; aperture long, lip sharp.

Bulla vexillum, Chemnitz (fig. 61) after Adams).—This most beautiful species was captured in sea-weed, in

[1] Madame Power in *Annals and Magazine of Nat. History* for November 1857.

about a fathom water, near Ambolan, Mindoro, by Mr Adams. The animal was of a delicate pink colour, with the cephalic disc and lobes, and the foot, edged with white and red. The foot, when not expanded for swimming, is folded upon the shell. The inner margin of the mantle forms a thick fleshy lobe, which partially fills the hind part of the shell aperture; the outer margin lines the outer lip.

Fig. 62 gives the character of the dentition in the *Bullidæ*, the central teeth being small and few, as in *Akera bullata*, or wanting; the laterals single, slender, and recurved.

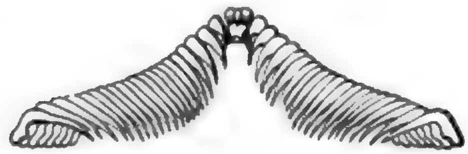


Fig. 62.
Teeth of *Akera bullata* (magn.).

According to Cuvier, the cephalic lobes *b* of the *Bullidæ*, represent the fused oral and dorsal tentacles. In the common "bubble-shell" (*Bulla Hydatis*) they consist of a central stem bearing numerous lateral plates, and are conjectured by Mr Hancock to serve as olfactory organs.

Order V.—PULMONATA, Cuvier.

Part of the mantle-cavity forming a vascular air-sac or lung.

This well-marked order of Mollusks is treated of at length in the illustrated work of Baron Férussac, *Histoire Natur. des Mollusques terrestres et fluviatiles*, Paris, of which the first part appeared in 1819. M. Deshayes, after the death of Férussac, began the continuation, which was completed in 1851.

Most *Pulmonata* are terrestrial; those which are aquatic rise to the surface of the water to breathe. A few are naked; most are testaceous; and the latter are distinguished as having, or wanting, the operculum. The inoperculated Pulmonates have a tongue-strap, paved with rows of very numerous similar teeth, with broad bases; the operculated Pulmonates have a tongue-strap with arched rows of seven teeth, the median tooth differing from the three on each side.

Section 1.—INOPERCULATA, Férussac.

Family I.—HELICIDÆ.
(*Snails.*)

Shell external, usually well developed, closed by an epiphragm during hybernation.

Genera *Helix, Vitrina, Succinea, Bulinus, Achatina, Pupa, Clausilia.*

The common garden-snail (*Helix nemoralis*, L.) exemplifies the present family. The species selected by Bruguières from the wide Linnæan *Helix* to form his more restricted genus, have since been much subdivided by Conchologists. The following indicate some of the leading modifications of the shell:—

† *Aperture turned upwards, dentate on each side.*

Genus Anostoma, Fischer, Lam.

Sp. *Helix ringens*, L. (D'Argenv. *Conchyl.*, pl. 28, figs. 13, 14; Blainv. *Malac.*, pl. 39, fig. 4.)—Hab. East Indies.

†† *Aperture inclined downwards; shell at the periphery carinate or subcarinate, mostly depressed. Labrum often reflected, sometimes dentate.*

Genus Carocolla, Lam.

Sp. *Helix Lapicida*, L. (Pfeiffer, *Schn.* i., tab. ii., fig. 26); *Helix Carocolla*, L. (D'Argenv. *Conch.*, tab. 8, fig. D; Guérin, *Iconogr.*, pl. 6, fig. 1).—Hab. East Indies, &c.

††† *Aperture inclined downwards. Shell rounded at the margin, most frequently subglobose.*

Genus Helix, Lam.

Sp. *Helix Pomatia*, L. (Sturm, *Deutschl. Fauna*, vi., Heft i.; Pfeiffer, *Schn.* i., tab. ii., fig. 9; Cuv., *R. Anim.*, ed. 2, t. iii., p. 40, *Moll.*, pl. 21. The Vineyard-Snail, le Grand Escargot).—The name *Pomatia*, from Πῶμα, cover (*Cochlea opercularis*), was given to this animal on account of the closure of the aperture of the shell in winter that occurs in this and other species. In autumn the animal retracts itself within the shell, and then a false operculum (*epiphragma*) is

Fig. 63.
Helix pomatia.

secreted, which is pushed off in spring, when the snail again creeps out of its house. During the winter these snails in our temperate climate "hybernate," *i.e.*, take no food, but lie torpid; in like manner, in tropical regions the species of this genus in the hot and dry months "æstivate," or fall into a similar state of torpidity.

The anatomy of this large species of snail has been admirably described by Cuvier, from whose monograph the preceding figure (fig. 63) is taken. The parts relating to the digestive, circulating, and respiratory systems have already been pointed out. The modification of the singularly-combined male and female apparatus, in this most highly developed of the monoecious Gastropods, calls for a more detailed notice.

The complexity and bulk of the combined organs in the vineyard-snail are truly extraordinary. The essential organs, testis and ovarium, are associated together in the form of a small compact gland (fig. 63, *q*), composed of many parallel cæca imbedded in the substance of a lobe of the liver *i*, and occupying the apex of the shell. Each cæcum consists of an external layer, producing ova, and an internal sac, folded in the first, producing semen.[1] The walls of

[1] Meckel, H., Ueber den Geschlechtsapparat einiger hermaphroditischer Thiere, in *Müller's Archiv fur Physiologie*, 1844, p. 376.

these invaginated sacs are usually in contact, but become separated at the points where the ova push the ovarian sac outwards, and the sperm-cells the testicular one inwards. The common ducts from those series of combined sacs are also invaginated, the oviduct being external, the sperm-duct internal, and usually undulated. The testicular cæca and sperm-duct are lined with ciliated epithelium; this is not present in the ovarian sacs.

Both invaginated tubes *r* enter the albuminiparous sac *s*, and separate where they quit that part. There is a dilatation or sperm-reservoir where the sperm-duct quits the base of the albuminiparous sac, and this latter may be regarded as a more special dilatation of the oviduct, with follicular walls. The sperm-duct, enlarged and with more glandular walls *u*, now proceeds, with many short folds parallel with the uterus, to the base of the penis. This is a long and slender organ *v*, usually retracted and concealed within the visceral cavity, but, like the finger of a glove, capable of being everted and protruded externally. The so-called "uterus" *t* is a long canal, with transversely-plicated glandular walls, terminated by a vagina opening into the common genital vestibule, the external orifice of which is near the mouth of the respiratory sac, on the right side of the head. With the vagina there communicates the duct *z'* of a small pyriform vesicle *z*, which is a sperm-reservoir for the fecundating element of another individual received *in coitu*. A small cæcum is developed from the duct in *Helix pomatia*, and a very long one in *Helix arbustorum*; the duct is short and simple in the slug (*Limax*). The genital vestibule receives the terminal outlets of two groups of branched cæca *x*, *x*, or "multifid vesicles," the function of which is unknown. But the complexity of the generative apparatus does not end here; the snail is provided with a pyriform muscular sac *y*, the aperture of which terminates close to the generative outlet. The expanded base or head of a slender conical calcareous style or dart is attached to the fundus of the sac: its sharp apex extends close to the orifice, and by the contraction of the sac it can be protruded outwards. With it the snails pierce each other's skin; and the function of this curious organ would seem to be to cause a preliminary excitement to the reciprocal union of the two androgynous individuals. The dart, like the epiphragm, is annually reproduced.

Of the rare *Helix vittata* (fig. 64), which inhabits Balambangan, Borneo, Mr Adams, its discoverer, remarks, that

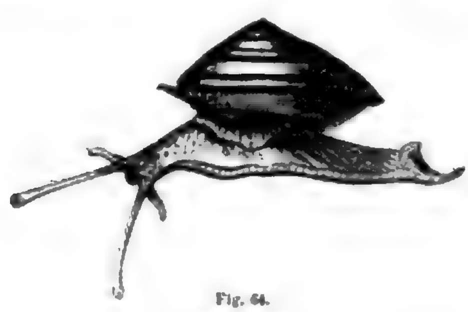


Fig. 64.
Helix vittata.

the animal is of "a delicate subtransparent pinkish colour, the free lobes of the mantle moveable, and often extended from the fore part of the shell; eye-peduncles long, the truncatures for the eyes very broad, tentacles rather long and clavate; foot compressed, finely crossed with oblique lines, and margined inferiorly, the end with a large hollow muciparous follicle, ending below in a sharp, moveable, rather recurved process."

"This beautiful and singular species lives among the foliage of the low trees, about which it crawls with surprising rapidity, reminding one of the movements of the *Vitrinæ* more than those of the *Helicidæ*." (*Zool. Samarang*, p. 60.)

Family II.—LIMACIDÆ.

(*Slugs.*)

Shell rudimental, internal.

Genera—*Limax, Arion, Parmacella, Testacella.*

Genus Limax, Lam. (*Ground-Slugs, Path-Slugs*).—Body oblong, naked, convex above, furnished anteriorly with a coriaceous, subrugose mantle, and below with a longitudinal flat disc or foot, which is not distinct from the body; branchial cavity under the shield or small mantle, in the anterior part of back; respiratory orifice and vent placed in the right side; generative orifice beneath the right tentacles. The mantle in some contains a calcareous grit, in others a small shell; when alarmed, they withdraw the head beneath the mantle. At the hinder end of the body is a small aperture, from which adhesive mucous threads proceed. The slugs often climb trees in quest of the decaying vegetable matter on which they feed, and they lower themselves to the ground by means of those threads.

Family III.—ONCIDIADÆ, Woodward.

No Shell.

Genera—*Oncidium, Vaginulus, Peronia, Oncidoris.*

The slugs (*Limaces*) and land-soles (*Arions*) of temperate climates are represented in the East by the *Oncidium*, *Veronicella*, and *Peronia*, as they are in the Western Hemisphere by the *Vaginulus*. The *Veronicella* lives upon the trees in the forests, and is active after showers; the *Oncidia* live on aquatic plants in marshes and ditches; while *Peronia*, like *Oncidoris*, lives among the stones on beaches, but, unlike the latter genus, above high-water mark, a little beyond the influence of the tide.

One species (*Oncidoris celtica*) is found on the coast of Cornwall, congregated in little groups, about a foot or two from the surface of the sea, where the waves break over them. They ascend and descend, so as to maintain their distance as the tides rise and fall; but will not bear long immersion in sea-water. (Couch.)

Family IV.—LIMNEIDÆ.

(*Pond-snails.*)

Head with a short dilated muzzle; tentacles two, broad, short, compressed, not retractile; eyes sessile between their bases; mouth armed with an upper mandible; tongue-strap with teeth similar to *Helix*. Shell thin, horn-coloured; capable of containing the whole animal when retracted; aperture entire longitudinal; lip sharp, ascending towards the columella; apex sometimes eroded.

Genera—*Limnea, Physa, Ancylus, Planorbis.*

In the common pond-shell (*Limnea stagnatilis*) the apertures of the sexual organs lie far apart. Under the right feeler is the prepuce, everting the penis; under the respiratory aperture is the vulva, or that of the female organs. To this it is to be ascribed that, in copulating, one individual is connected with two others, one of which impregnates it, whilst the other is impregnated by it. In this way, hanging together, they often form long chains. Von Bäer has, however, observed self-impregnation also in *Limnea auricularis*. (Müller's *Archiv*, ii., 1835, s. 224.) The Limnean anatomy is well illustrated in Swammerdam, *Bijbel der Nat.* i., bl. 164–169, tab. ix., fig. 4; Cuvier, *Ann. du Mus.* vii., pp. 185–193, pl. x., figs. 2–11; *Mollusq. Mém.* No. 14; Stiebel, *Dissert. inaug. sistens Limnei stagnatilis Anatomen*, Gottingæ, 1815, 4to, c., tabulis 2.

"The Limnæids inhabit fresh waters in all parts of the world; they feed chiefly on decaying leaves, and deposit their spawn in the form of oblong transparent masses on aquatic plants and stones. They frequently glide beneath the surface of the water, shell downwards, and hybernate or estivate in the mud." (Woodward.)

FAMILY V.—AURICULIDÆ, Woodward.

Mouth with a broad and short muzzle, tentacles two, cylindrical, the eyes sessile behind them; mantle-margin thickened; orifices as in the snails; foot oblong; sexes united; mouth with a horny upper jaw. Shell spiral, covered with horny epidermis; spire short, body-whirl large; aperture elongated denticulated; internal septum progressively absorbed.

Genera—*Auricula*, *Conovulus*, *Carychium*, *Marinula*, *Cassidula*, *Polydonta*, *Pedipes*.

Mr Adams remarks,—"The habits of this family are somewhat variable. *Marinula* affects salt water only, and *Pedipes* lurks in the cavities of rocks and under stones exposed to the sea. *Cassidula* is amphibious, having been observed crawling on a sandy bottom in clear water at a depth of nearly two fathoms, as well as in mangrove-swamps and on the sea-beach. *Curicula* and *Melampus* live in damp situations near the sea, and on the muddy banks of rivers. *Polydonta* inhabits moist situations in woods near the sea, but is wholly of terrestrial habits, living on decayed vegetable matter, and crawling about actively after showers of rain. *Alexia* and *Carychium* abound in salt-water marshes." (*Zool. Samarang*, p. 55.)

Section 2.—OPERCULATA, Férussac.

"The operculated land-snails are exceedingly like periwinkles (*Litorinæ*), and chiefly differ from them in the situations they inhabit and the medium respired. They have a long truncated muzzle, two slender contractile tentacles, and the eyes are sessile on the sides of the head. The mantle-margin is simple, and the pulmonary cavity is situated on the back of the neck, and quite open in front." (Woodward.) The sexes are distinct.

FAMILY I.—CYCLOSTOMIDÆ, Woodward.

Shell spiral, and spirally striated; aperture sub-circular, with a simple peristome; operculum spiral.

Genera—*Cyclostoma*, Lam.; *Pupina*, Vignard; *Helicina*, Lam.

Only one British species of *Cyclostoma* (*C. elegans*) is known, but upwards of 80 exotics have been characterized from the south of Europe, Africa, and Madagascar. Nearly half of these have the whirls spirally keeled, and have been subgenerically separated under the name of *Tropidophora*.

FAMILY II.—ACICULIDÆ.

Shell elongated, cylindrical, with a subspiral operculum, in most pellucid.

Genera—*Acicula*, *Geomelania*.

The two diœcious pulmonate families make a transition, in regard to generative characters, to the next great section of the *Gasteropoda*; but the modifications of the parts of the complex combined organs of the Androgynous Gastropods are manifold. In regard to their ultimate terminations or outlets, a common genital orifice is found in *Doris*, *Thetis*, *Bulimus*, *Clausilia*, and *Limax*, as in the *Helix* above described. In *Limnea* the sexual orifices are wide apart; in *Planorbis* and *Physa* they are situated side by side,—the male orifice in front, on the left side of the neck, behind the tentacle. In *Bulla*, *Bullæa*, and *Aplysia*, the male orifice is under the right tentacle; the female one much further back. In *Doridium* the male orifice is beneath the left tentacle; the female one on the same side, but near the opposite end of the body. In *Oncidium* the female orifice is situated close to the anus, at the posterior end of the body; the male orifice is beneath the right tentacle. In all cases where the male and female organs are separate, a furrow may be traced from one to the other; the penis, when erected, projects from the male orifice.

GASTEROPODA DIŒCIA.

ORDER I.—HETEROPODA,[1] Lamarck.
(*Nucleobranchiata*, Blainville.)

Locomotive organ compressed, resembling a fin, but single and ventral in position; branchiæ, when distinct, pectinate and pinnate, packed in a small compass, with the heart in a dorsal sac or in a symmetrical shell. Sexes distinct. These Mollusks all live in the sea, and usually swim with the fin-shaped foot upwards and the back downwards. They progress rapidly by the vigorous movements of their compressed tails, or by a fan-shaped ventral fin; and adhere to sea-weed by a small sucker placed on the margin of the latter. Forskael, to whom we owe the first description of this family of animals, gave them the name of *Pterobranchia*. De Blainville, associating with them certain Pteropods, called the group *Nucleobranchia*.[2] The existence of distinct sexes was discovered by Lesueur, Laurillard, and Milne Edwards.[3]

There are two families of Nucleobranchiate Mollusks—the *Firolidæ*, with large bodies and small or no shells, and the *Atlantidæ*, which can retire into their shells and close them with an operculum. Both animal and shell are symmetrical, or nearly so; the nucleus of the shell is minute and dextrally spiral.

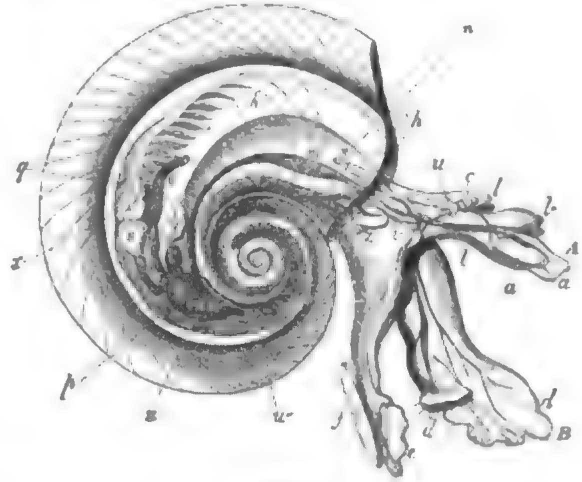


Fig. 65.
Atlanta Keraudrenii (magn.)

FAMILY I.—ATLANTIDÆ, Woodward.

The shell large enough to protect the body.

Genera—*Atlanta Porcellia*, *Bellerophon*, *Cyrtolites*.

Genus ATLANTA, Lesueur.

Sp. *Atlanta Péronii*, Les. (figs. 66 and 67); *Atlanta Keraudrenii*, Les. (fig. 68); *Atlanta gibbosa*, Soul. (fig. 69).—The soft parts of *Atlanta* are divisible into a "somatal" and a "pallial" region. In fig. 65 the former or chief fleshy part of the body is out of the shell; the pallial or visceral part is in the shell, which latter is an appendage to it. The "soma" is divided into the cephalic A, pedial B, and the lid-bearing tail or operculigerous lobes *e*, *f*; the two latter having that distinct degree of development which characterizes the *Heteropoda*. The head, or cephalic lobe, includes the mouth-mass *a*, the tentacles *b*, and the eyes *l*; the foot is divided into the "fin" B and the "disc" *d*; the tail includes the "leaf" *e* ("expansion foliacée"), and the "lid" or opercule *f*, with its surface of attach-

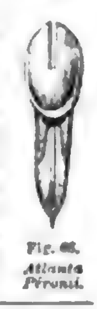


Fig. 66.
Atlanta Péronii.

[1] Gr., signifying an "odd or imperfect foot."
[2] So called because the respiratory and digestive organs form a sort of *nucleus* on the posterior part of the back.
[3] See also Leuckart, *Zoologische Untersuchungen*, Drittes Heft, Giessen, 1854, *Der Bau der Heteropoden*, pp. 1–68.

Gastero-poda.

ment. The shell of the *Atlanta*, besides the beauty and symmetry of its shape, purity of colour, and delicacy of texture, is remarkable for combining two conditions of shell-tissue; retaining a large proportion of the mouth, or last-formed part, in a soft flexible quasi-cartilaginous state, the rest of the shell being vitreous. The whole is thin and translucent. It is suborbicular, compressed (fig. 68), and convolute on the same plane; umbilicate on each side, broadly keeled, and striated subtransversely. The whirls are usually three in number, and are visible in each lateral umbilicus; the last whirl, much larger than the rest, is that from which the keel is developed. This is a single plate, with a fine groove of uncalcified matter along its free border, which subsides towards the shell-aperture. The lid or opercule (fig. 67) is vitreous, transparent, very thin, and marked by transverse striæ of growth, of a shape conformable to that of the shell-aperture. The mantle includes the visceral mass, and lines the shell which it has developed. Round the base of the visceral mass it forms a broad fold corresponding with the shell-aperture, and dilated anteriorly into a large breathing-pouch. The thickened border of this pouch is provided with tufts of vibratile cilia, and in the species,—*e.g.*, *Atlanta Keraudrenii*, in which the shell-aperture is canaliculate, the border is similarly produced (fig. 65, *h*), as in the siphonobranchiate Univalves.

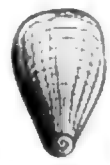


Fig. 67. *Atlanta Péronii.*

Fig. 68. *Atlanta Keraudrenii.*

For a knowledge of the anatomy of the *Atlanta* science is mainly indebted to MM. Eydoux and Souleyet, from whose beautiful illustrations of it in the *Zoologie of the Voyage of the Bonite* the scheme in fig. 65 is chiefly derived.[1] The viscera occupy the spire and spiral half of the last whirl of the shell; the rest of that whirl contains the branchial sac and mantle, and into it the whole of the soft parts of the animal can be retracted, and be there shut in by the operculum. In this respect the *Atlanta* differs from other Heteropods; and the opercule is a correlative peculiarity to the protective size and office of the shell.

The subspiral retractor muscle (fig 65, *k*) arises from the convexity of the innermost whirl, expands as it approaches the outlet, and then divides into fasciculi, which diverge to the head, to the foot-fin and foot-disc, and to the tail; the parts are retracted in the same order, the head being first pulled in. The mouth *a* is terminal, with a circular lip; the glottidium *a'* is covered by a tooth-strap supporting a median row of imbricated tridentate plates and lateral rows, each row including a transverse plate with a hooked apex and two sickle-shaped denticles; the teeth increase in size from before backwards; the glottidium is partially protruded by short protractor muscles, and retracted by antagonistic fibres; the dental plates being alternately raised, divaricated, and depressed in the alternate movements of the rasp-like organ. The secretion of two long cylindrical salivary glands *n* is poured into the beginning of the œsophagus. The œsophagus dilates into a fusiform preventriculus *m*, from which the alimentary canal, bending round the inner whirl, penetrates the liver, and expands into a subquadrate stomach *n*, receiving the wide bile-ducts; the intestine *o* is reflected upon the dorsal aspect of the stomach, passes forward into the branchial sac, and terminates there on the right side, at some distance from the anterior border of the mantle. The short intestine is lined by ciliated epithelium. The chief mass of the blood, which, from the translucent delicacy of the tissues, seems to be diffused through the common cavity of the body, is contained in venous sinuses so disposed as to regulate the flow of the venous blood to the respiratory surface, to the filaments or laminæ *i* of the branchial chamber *h*. Thence it is transferred and subjected to the action of the renal emunctories *q* before it enters the auricle *x*, which is at the bottom of the branchial cavity. The ventricle *s* distributes the depurated blood by two principal arteries,—one to the visceral mass, the other reflected forwards beneath the alimentary canal, and supplying the foot and the head.

Gastero-poda.

The nervous system includes two cephalic or superœsophageal, two pedial or subœsophageal, and a small visceral ganglion; the acousticles are connected with the cephalic ganglia or auditory sacs.[2] The eye is lodged in its proper tentacle, whose clear convex end forms the cornea. The optic nerve, penetrating the inner wall, expands into a retinal ganglion, in front of which is a spherical lens; the ganglion and back part of the lens are covered by black pigment, and the whole is inclosed by a sclerotic which is continuous with the corneal part of the tentacular eye-sac. The acousticle has a small rotatory otolite. In the male the testis *w*, usually more or less lobulated, occupies, with the liver *p*, the spire of the shell. It contains spermatozoa and spermatozoids. Its duct communicates with a dark-coloured accessory gland *v*, and a glandular dilated part or vesicle *y*, whence the sperm-duct is continued a short way forwards, and terminates in a ciliated groove leading to the base of the penis *z*, which is attached to the right side of the body. In the female the ovary occupies a corresponding position to that of the testes; the oviduct is continued from the fore part of the ovary: it is wide and convoluted, and terminates near the vent in the pallial cavity. Of this genus, presenting the organization above defined, many species have been characterized, chiefly by modifications of the shell. In some—*e.g.*, *Atlanta Keraudrenii*, Lesueur (fig. 68)—the keel is continued to the aperture of the shell which is canaliculated anteriorly, with a corresponding siphonic modification of the mantle. In others—*e.g.*, *Atlanta Péronii* (fig. 66)—the keel subsides before attaining the aperture of the shell, which is deeply fissured.

In a few species—*e.g.*, *Atlanta gibbosa* (fig. 69)—the symmetrical form begins to deviate into the more common type of spiral Univalves; the shell of the embryo forming several obliquely spiral whirls before the particular generic type is resumed by the last large whirl of the adult. Thus the spire projects from the right side, leaving an umbilicus only on the left side; and the apex of the spire is turned forwards.

Fig. 69. *Atlanta gibbosa.*

To this interesting type belong also the *Atlanta involuta*, E. and S.; *Atl. fusca*, E. and S.; and *Atl. turriculata*, D'Orbigny. Nomenclative naturalists have not been wanting in the imposition of distinct subgeneric names upon the groups of the genus.[3]

These small, delicate, and beautiful Mollusks are common in the high seas of tropical and temperate latitudes, floating or swimming by vigorous strokes of their fin above unfathomable depths. Such of their frail shells as may reach the bottom will form one of the few evidences of life that deposits from deep seas are likely to reveal; and certain delicate, finely-striated shells, analogous, if not allied, to *Atlanta*—such, *e.g.*, as *Ecculiomphalus Bucklandii*, Portlock, and *Bellerophon bicarinatus*, Léveille—have been found fossil in both Cambrian and Silurian rocks,—the most ancient

[1] The details given in the *Philosophical Transactions* for 1853, p. 36, are little more than confirmations of the facts made known by the able French naturalists whose anatomical labours are passed over, except in regard to "a small ganglion," which the writer states is "not figured by Eydoux and Souleyet," but which they nevertheless have not omitted to specify and figure in allied *Heteropoda*.

[2] The auditory vesicles were first pointed out in *Heteropoda* by Souleyet; *Annales Françaises d'Anat. et de Phys.*, tom. ii., 1841, p. 305;—afterwards by Leydig; *Anatomisch. Bemerkung. üb. Carinaria, Firola und Amphicora*; *Zeitschr. fur wissensch. Zool.* iii., 1851, p. 228.

[3] See *Zoologie de la Bonite*, p. 362.

Gastero-poda.

of fossiliferous formations. Lamanon, the naturalist of La Peyrouse's unfortunate voyage, believed that he had discovered, in the *Atlanta*, the living type of the *Cornua Ammonis;* and the resemblance to the compressed and carinate species of Ammonite is undoubtedly very close; but it is one of analogy merely.

FAMILY II.—FIROLIDÆ, Woodward.

A small branchial shell or none.

Genus CARINARIA, Lam.—The next step in the departure from the common type of Univalves is made by the *Carinaria*.

Sp. *Carinaria cymbium*, L. (fig. 70).—In this species the somatal (fig. 70, A, B, C) far exceeds the visceral (D)

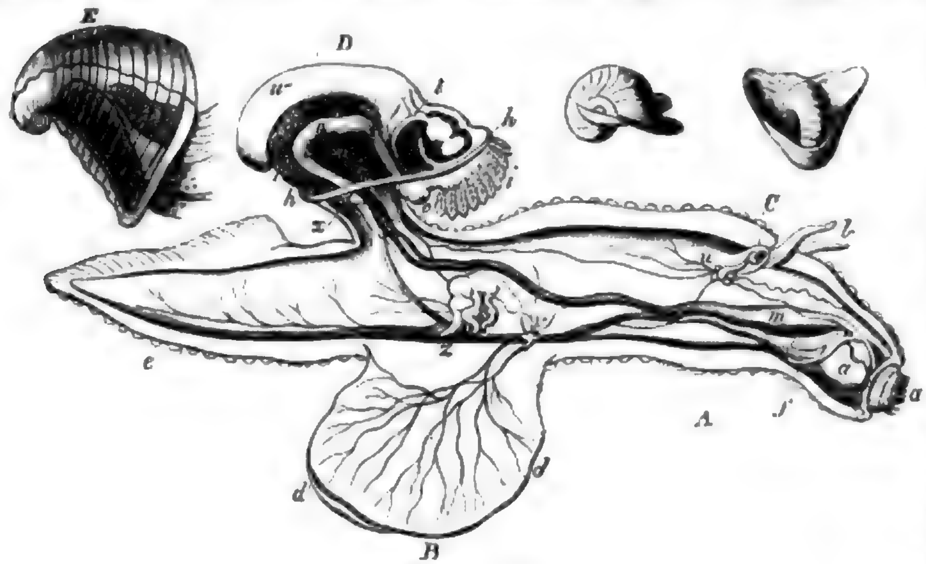


Fig. 70.
Carinaria Mediterranea.

division of the body, and the shell E is correspondingly reduced in size and adapted only to cover the visceral sac circumscribed by the free border of the mantle *h h*. Of the three divisions of the "soma," the cephalic A is the largest, the pedial B the least. The discoid portion *d'* of the foot is less distinctly separated from the pinniform part *d* than in *Atlanta*, and the tail C bears no opercule, the small shell being closely filled by the pallial and visceral mass, and affording no protection to the soma. The somatal integument is lined by a strong layer of decussating muscular bands, which layer is much more distinct and better developed than in other Heteropods; in the fin the muscular bands constitute four distinct layers: those of the two deeper-seated ones crossing the superficial layers obliquely. In the mid-space between the right and left layers lies the cellular tissue with the pedial vessels and nerves. The cephalic ganglions *u* are connected with the pedial ganglions *v* by commissural "cephalo-pedial" cords of a length corresponding with that of the cephalic division of the body, and consequently forming a so-called "œsophageal collar" of much greater extent than in *Atlanta*. Besides branches from this collar to the fin and tail, one is sent to the visceral ganglion *x*, and this brings the fin in relation with the branchial, circulating, and cephalic influences. The cephalic ganglions supply the same parts as in *Atlanta*, communicate with the small buccal ganglion, and send a nerve to the visceral ganglion *x*, situated at the base of the pallial division of the body.

The mouth is provided with a large rasping glottidium *a'* armed as in *Atlanta;* the œsophagus presents a fusiform dilatation *m*, in its course to the liver *p;* the intestiniform stomach *n* describes a curve in that organ; the intestine is reflected dorsad and forward to terminate (*o*) at the fore-part of the pallial division, a little to the right of the median plain. The salivary glands *f* form a pair of cæcal tubes, relatively shorter than in *Atlanta*. The liver *p*, of a violet colour, fills the hinder half of the shell. The branchiæ *i* are more constant and are relatively larger than in *Atlanta;* in the form of pinnate processes projecting from the fore-part of the shell-aperture. The heart is composed of an auricle and ventricle, the latter overlying the former, and giving origin to a large aorta *t*. The testis *w*, of a gray colour and granular texture, lies in the upper and back part of the visceral mass, sends off a sperm-duct, which dilates at its commencement into a nodular receptacle *y*, lodged on the substance of the liver, and then extends, to terminate in the groove which leads along the right side of the animal, to the base of the penis *z*. This consists of two non-retractile appendages, hanging from a common base of attachment to the right side of the body; one of these is grooved lengthwise, and is the true intromittent part; the other has a granular structure within, and seems to be an excitory organ.

The *Carinaria Mediterranea* of Lamarck (a synonym probably of *Car. cymbium*, Linn.) takes its name from the sea which it inhabits. The *Carinaria vitrea* is a native of the Indian ocean; its shell is highly prized.

In a closely allied genus, called *Cardiopoda* by D'Orbigny and *Carinaroïdes* by Eydoux and Souleyet, the shell is flexible, convolute, with the cartilaginous peristome expanded and bilobed in front, and enveloping the spire behind. The two figures above the part of cut 70, opposite the right hand, exemplify the shell, that on the opposite side is the shell of *Carinaria*.

Genus FIROLA, Péron and Les.—As amongst the land Gastropods the snails have a house-shell, the slugs a mere heart-shield, whilst in *Oncidium* and *Philomycus* even this rudiment of a shell disappears; so in the present sea Gastropods, so singularly modified for a free swimming or floating life in mid-ocean, while one genus has a shell developed to include the whole body, and another has it reduced to a mere protective covering of the heart and a few other viscera; a third genus, with scarcely any other organic modification of importance, shows no trace of shell.

These parallel conditions of variability in the testaceous appendage of the skin in different natural groups of the Molluscous class show plainly the low grade of that appendage in the scale of organic characters, and the relative standing of pure Conchology in Zoological science.

The genera *Firola* and *Firoloïdes* exhibit the zero phase of shell development in the Heteropodous group. The pallial or visceral division of the body presents its least proportion, the cephalic as contradistinguished from the pedial part, its greatest proportion. The foot is now a mere appendage to the somatal division, from which the cephalic part, properly so called, can no longer be distinguished as in *Atlanta*. The general form of the body, the transparency of the integument, and its muscular layer, are very similar

Gastero-poda.

to those in *Carinaria;* but some species of Firoloïds have no tentacles (fig. 71), and in none is the disc developed on the foot; this is exclusively a fin in form and function. The mouth (fig. 71, *a*), and mouth-mass *a b*, extend far in advance of the cephalic ganglions *u*, and eyes *c*. The commissural cords connecting those ganglions with the pedial ones *v*, cross the sides of the ingluvial dilatation of the gullet *m*, and form a very long œsophageal collar. The alimentary canal extends to near the caudal end of the body before it begins to make its molluscous inflection, and to expand into the gastro-biliary sac, with the substance of the liver *p*. The very short intestine *o* ascends, forming merely a right angle with the axis of the trunk before it terminates in a vent *o*′, just behind the renal sac and heart. From the ventricle a large aorta proceeds, and divides into a visceral and a somatal part; the latter advances forwards, sends off a small branch to the tail, a larger one to the foot, and is itself continued to the head. The pedial artery terminates abruptly in the reticulate venous sinus of the foot, and is said to exhibit a strong contractile power at its termination;[1] whence it is probable that, when the foot is in vigorous action as a swimming organ, the flow of blood into it is free; but when the muscles are at rest, the current may be decreased or checked. From the general transparency of the tissues of the Firoloïds the delicate *membrana propria* of the wide and effused sinuses by which the venous blood is guided, and finally returned to the auricle, has been overlooked. That such an essential part of the mechanism of circulation should therefore be absent, and the blood-corpuscles be doomed to wander back to the heart "as best they may,"[2] is an inference characteristic of the school which repudiates final causes (or purposive adaptations) in organic structures.

From the delicacy of the somatal tissues it may well be supposed that the oxygenated sea-water re-acts upon the generally diffused venous blood; and it is certain that in *Firoloïdes* proper, as in some species of *Atlanta*, branchial filaments are not developed, and the ciliated subspiral band represents the sole localized or special breathing organ. The renal sac is contractile, and alternately receives and expels sea-water. Two small salivary cæcal tubes communicate with the mouth.

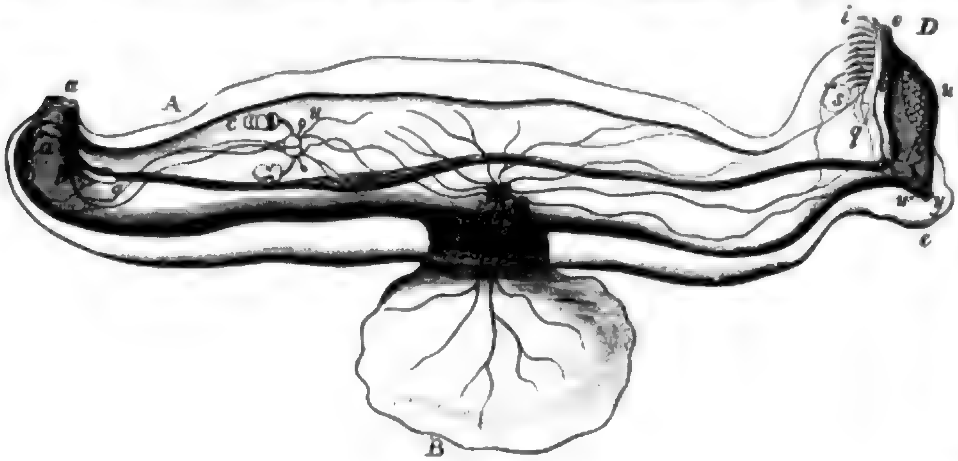


Fig. 71.
Firoloïdes Lesueurii.

Lesueur[3] first discovered the distinction of the sexes in the Firoloïds. The testis (fig. 71, *u*), is a whitish granular body, situated at the upper and back part of the visceral mass. Its duct dilates into a receptacle (*w*) on quitting the gland, then contracts to a tube of capillary tenuity opening into the groove that is continued into the intromittent and excitory appendage. This depends from the right hinder and lower angle of the body, and divides into two parts; the glandular portion terminating in a globular body. The ovary in *Firoloïdes*, as in *Firola*, terminates the small visceral mass behind; it usually presents ova, with a well-marked germ-cell and nucleus. The albuminous sheath of the excluded eggs is frequently seen hanging from the outlet of the short oviduct like a filamentary appendage.[4]

The Firoloïds are amongst the most abundant of the pelagic Mollusks; they float in myriads on the surface of the Mediterranean, and in the warmer zones of the Atlantic and Pacific Oceans.

In *Firola* proper, the visceral mass, answering to the pallial division of the body in *Atlanta*, is situated, as in *Carinaria*, at about one-fourth from the hinder end of the somatal division. This end terminates in a filamentary appendage, varying in size and shape in different species.[5] The branchial filaments, from twelve to fifteen in number, project from the slight border or fold of the small mantle, which leaves the upper and back part of the visceral mass exposed. The transparent integument of the body has a few coloured tubercles scattered over it. A rudiment of a disc has been seen on the compressed foot of some *Firolæ*, but is not constant. A pair of small tentacles are present in some species, not in others; they appear, however, not to be constant in all the individuals of the same species. In fact, the determination of a species is by no means an easy or satisfactory operation in these soft, contractile, transparent Mollusks.

The *Firola Keraudrenii* has a finely granular skin, and a long filamentary caudal appendage; it is about 2 inches in length.

In *Firoloïdes* the visceral mass is terminal; only the short filamentary appendage projects beyond it; in *Fir. Desmarestia*, and in *Fir. Lesueuria*, the appendage is multiarticulate, or antenniform. These delicate little Heteropods rarely exceed an inch in length; they occur in both the Pacific and Atlantic Oceans.

Order II.—TUBULIBRANCHIATA, Cuvier.

Branchiæ two, symmetrical, behind the heart; inclosed with the other soft parts of the animal in a long shelly tube.

Gen. *Dentalium*, Linn.

[1] Prof. Huxley, *Phil. Trans.*, 1852.

[2] Ibid., p. 32.

[3] *Journal of the Academy of Natural Sciences of Philadelphia*, vol. i., p. 3; Firoloïdes is diœcious, Huxley, *Phil. Trans.*, 1852.

[4] The idea of the posterior termination of the body being homologous with part of the foot of gasteropods has been brought forward as a novel one by the author of the paper published in the *Philosophical Transactions* for 1853. But I concur in the justice of the following remarks by the distinguished naturalists of the *Voyage de la Bonite*:—"C'est la fausse analogie que l'on a ainsi établie entre de simples expansions de la peau et les véritables organes locomoteurs, qui à surtout fait méconnaitre les rapports naturels de ces Mollusques." *Zoologie de la Bonite*, 8vo, 1841-1852, p. 346. The part *e* (fig. 71) may be homologous with the hind part of the body from which the hind lobe of the foot is developed in *Limax* and *Doris*, but not with that lobe itself.

[5] *Zool. de la Bonite*, plate xvi., fig. 1.

ORDER III.—CYCLOBRANCHIATA, Cuvier.

Branchiæ usually a series of lamellæ, surrounding the body between the foot and mantle.

FAMILY I.—PATELLIDÆ, Woodward.

Shell with the apex turned forwards.

Genus PATELLA, Linn. (*Limpets*).—Head with two acuminate tentacles, ocelli sessile, on the outer side of their base. Pallial margin fringed; branchial series continuous. Shell covering the body, oval, with a subcentral apex.

The tongue of the common British limpet (*P. vulgata*) is rather longer than its shell; it has 160 rows of teeth, with 12 teeth in each row, or 1920 in all (Forbes).

The intestinal canal is very long and forms many convolutions, the rectum being reflected, so that the vent is placed under the head on the right side, whilst in *Chiton* it lies in the mid line at the posterior extremity of the body.

"The limpets live on rocky coasts, between tide-marks, and are consequently left dry twice every day; they adhere very firmly, by atmospheric pressure (15 lb. per square inch), and the difficulty of detaching them is increased by the form of the shell. On soft calcareous rocks, like the chalk off the coast of Thanet, they live in pits half an inch deep, probably formed by the carbonic acid disengaged in respiration; on hard limestones only the aged specimens are found to have worn the rock beneath, and the margin of their shell is often accommodated to the inequalities of the surrounding surface. These circumstances imply that the limpets return to the same spot to roost. On the coast of Northumberland we have seen them sheltering themselves in the crevices of rocks, whose broad surfaces, overgrown with nullipores, were covered with irregular tracks, apparently rasped by the limpets in their nocturnal excursions." (Woodward.)

The limpet is much used by fishermen for bait; on the coast of Berwickshire nearly 12,000,000 have been collected yearly, until their numbers are so decreased that collecting them has become tedious (Dr Johnston). In the north of Ireland they are used for human food, especially in seasons of scarcity; many tons weight are collected annually near the town of Larne alone (Pattison).

On the western coast of South America there is a limpet which attains the diameter of a foot, and is used by the natives as a basin (Cuming).

(For the anatomy of the limpet see Cuvier, *Mém. sur les Mollusq.*, No. 18, pp. 15–19, pl. ii., figs. 8–19, and the fig. of *Patella algira*, Desh. in Cuv. *R. Ani.*, éd. ill., *Moll.*, pl. 66.)

FAMILY II.—CHITONIDÆ.

Shell subdivided into eight pieces.

These pieces or valves form an imbricate series on the middle of the back (fig. 72, *a*). Each has a more or less wide plate of insertion sunk into the mantle, with a deep lateral notch on each side: the anterior and posterior valves

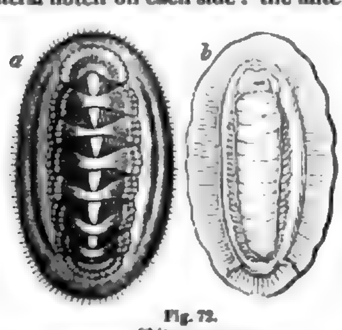


Fig. 72. *Chiton squamosus.*

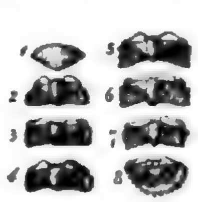


Fig. 73. *Chiton.*

often with other notches on the terminal edges. The first seven plates have posterior apices (fig. 73, 1–7), the eighth has its apex nearly in front. The six middle plates are each divided into a dorsal and two lateral areas. Gills conic, lamellar, in two series, one on each side the hinder part of the body. The heart is elongated like a dorsal vessel. Mantle not covered by shell at the circumference, with the margins hard, coriaceous, often aculeate or squamose. Ventral disc elongate, narrower than the body (fig. 72, *b*). Eyes and tentacles none; head crested by a wavy veil. The combined genital organs are symmetrically repeated on each side, and have two orifices.

More than 200 species of Chitons are known; they occur in all climates throughout the world; are most abundant on rocks at low water, but frequently obtained by dredging in 10–25 fathoms water. Some of the small British species range as deep as 100 fathoms (Forbes.)

The species of this genus are very numerous and difficult to distinguish otherwise than by accurate measurements of the comparative length and breadth, the greater or lesser inequality, &c., of the pieces of shell, and by the nature of the margins of the mantle which are not covered by the dorsal shields. In some species these margins of the mantle cover, as though they came together by continued growth, the dorsal shields, so that the shell is concealed within them. Of these Middendorff[1] forms the sub-genus *Cryptochiton* (Sp. *Cryptochiton Stelleri*, Middend., l. l. Taf. i., figs. 1, 2, *Chiton amiculatus*, Sowerby, *Conchol. Illustrations, Chitones*, fig. 80, Reeve, *Conchologia system.* ii., Pl. 132, 133, fig. 80; from which *Chiton amiculatus*, Pall., according to Middend., does not differ). The remaining species form the sub-genus *Phænochiton*, Middend., in which the branchiæ are sometimes situated backwards, and the row of pieces of shell is interrupted by the mantle (*Dichachiton*, Middend., *Chitonellus*, Lam., Sp. *Chitonellus lævis*, Lam., Blainv. *Malac.*, pl. 87, fig. 5); or the pieces of shell close upon one another, and the branchiæ are placed round about at the sides of the mantle (*Hamachiton*, Middend.) To this last division belong most of the species of the genus *Chiton* of Lamarck.

Dr Gray has called attention to the value and constancy of the modifications observable in the inserted part of the plates, and this experienced naturalist remarks:—

"It has been objected that the character derived from the form of the plate of insertion of the valves can only be seen by the destruction of the specimens as they are usually kept in cabinets; but they can generally be seen from the under side, or through the substance of the mantle. When this is not the case, the form of the plate of insertion can be easily developed by paring away the under surface of the mantle, so as to show part of the edge of the valves, without injury to the specimen; and they may be easily made more visible through the inner side of the mantle by being soaked for a few hours in a weak solution of caustic potash; but care should be taken that the specimen is not left too long in soak, nor the solution be too strong, otherwise the margin will be dissolved.

"The form of the plate of insertion may also be easily predicted by inspecting the inner surface of the valves, for the notches in the margin leave an impressed line from the vertex of the valve, as they are gradually filled up by the growth of the valve.

"The valves are best separated from the coriaceous skin of the body, called the mantle, by soaking them in a strong solution of caustic potash; as then the plates of insertion are cleaned, and not broken, which they are likely to be if they are taken by force from the mantle.

"The number of notches in the plates of insertion is sometimes, but very rarely, liable to variation. In one specimen of *Chiton Bowenii* in the Museum Collection, the plate of

[1] *Mémoires de l'Acad. Imp. des Sciences*, Petersbourg, tom. vi., 1848.

insertion of the last valve but one has two notches on one side, but the normal single notch of the genus on the other."

The anatomy of the *Chiton* has been illustrated in the great work of Poli, *Testacea utr. Siciliæ* i. *Multivalv.*, pp. 1–10, tab. iii.; by Cuvier, *Mém. pour servir à l'Hist. nat. et à l'Anat. des Mollusques*, No. 18, pp. 22–28, pl. iii., figs. 8–14; and, more recently, in an exhaustive manner, by A. Th. Middendorf, *Beschreibung u. Anatomie neuer Chitonen, Mém. de l'Acad. impér. des Sc. de St Pétersbourg*, 6e série, tom. vi., 1848, pp. 67–215, av. 14 pl.

The chief peculiarities of organization have been strikingly summed up, with perhaps some overstraining of the similies, by Dr T. Williams, as follows:—

"A *Chiton* has a carapace like an isopod Crustacean, a dorsal vessel like an Annelid, bilateral symmetrical reproductive viscera like an acephalous Mollusk, a head and foot like a patelloid Gastropod, a posterior anus like the *Fissurellidæ*, and branchiæ like those of the brachyurous Crustacea! Such manifold affinities at once unite and sever this odd group from several most dissimilar classes." (Dr T. Williams, *Ann. & Mag. Nat. Hist.*, xvi., 408, 1855.)

The fry of the *Chiton* are not provided with a deciduous shell: they swim by a cincture of long vibratile cilia, near a constriction which divides the oval embryo into two subequal parts; a tuft of filaments and two dark eye-specks denote the head. The hinder half elongates, becomes marked on the back with seven transverse furrows, between which the first rudiments of the shell-plates appear as granules of carbonate of lime in the integument, which coalesce into narrow bands or bars, with an irregular wavy outline: they increase by the addition of layers on the under surface: and their development gives no countenance to the idea that the hindmost valve is the homologue of the univalve shell of the limpet, and the seven in front supplementary pieces. Lovén, who has described the development of the Chiton, regards the girdle of cilia as answering to those on the velum of other Gastropods; the homology of the head of the embryo, with its tuft of filaments, to the prominence supporting the flagellum in some embryo bivalves (fig. 27), is more doubtful.

Order IV.—SCUTIBRANCHIATA, Cuvier.

Branchiæ plumose or pectinate, and, with the entire body, protected by a widely-open shield-shaped inoperculate shell. Heart with two auricles, and traversed by the rectum.

Family I.—HALIOTIDÆ.

(Ear-shells.)

Head with two long and slender tentacles; eyes on short pedicles at the outer side of their base; proboscis short; branchial cavity with a fold or siphon occupying the slit or perforation of the shell; retractor muscle large, subcentral.

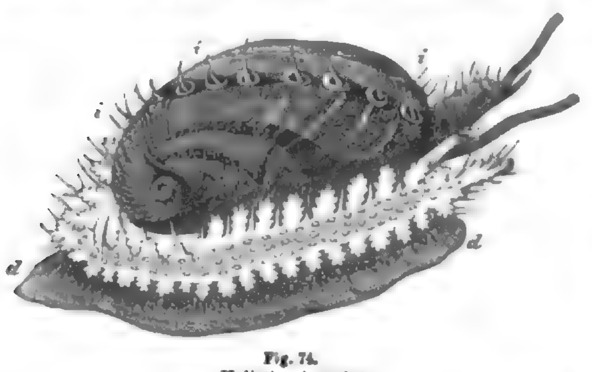


Fig. 74.
Haliotis tuberculata.

Genus Haliotis, Lam. (*Ormers* or *Ear-shells*).—Shell ear-shaped, with a spiral ridge on the left side, and a series of holes over the pallial fissure. These holes are closed as the animal grows from near the apex of the shell onwards, new ones being formed near the aperture, where the notch becomes changed into a hole. The foot (fig. 74) *dd* is expanded and sub-circular, its side lobes support a double row of cirri and crenate processes; cirri project through the perforations of the shell *i, i*.

Haliotis tuberculata (fig. 74) abounds in the Channel Islands, where it is used for food; the hard tissue of the muscular foot, *d d*, and retractor being pounded before the animal is cooked.

Species of *Haliotis* range from Kamtschatka to New Zealand. In the latter island is a sub-genus (*Padollus*), in which the multi-perforate shell has two parallel spiral ridges.

The lining nacre of the ear-shell is beautifully iridescent; most richly so in *Haliotis iris* and *Haliotis gigas*, which latter shells are imported in vast numbers for that substance.

Genus Janthina, Lam. (fig. 75).—Head with a large ventricose proboscis *a*; two subulate tentacles *b*, with short eye-stalks *d* at their base; foot *f* small, with lateral folds

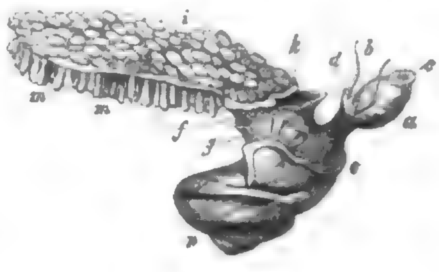


Fig. 75.
Janthina fragilis.

g continuous behind. It secretes (in the female?) a series of albuminous air-vesicles *i*, constituting a floating raft, to the under surface of which the ovi-capsules *mm* are attached. M. Rang states that this float is cast adrift after the egg-bags are attached. The shell *n* of the Janthinæ is like that of a land-snail, and commonly of a beautiful purple colour; it is ventricose, thin, and sub-pellucid, with the aperture triangular, and the columella straight and produced beyond the margin of aperture. Myriads of these beautiful and delicate oceanic snails float in the Mediterranean, Atlantic, and Indian Oceans; specimens are occasionally drifted to the S.W. coasts of England. They are said to feed on the small floating *Velellæ*. The anatomy of *Janthina* has been given by Cuvier in the *Ann. du. Mus.* xi., pp. 121–130; and in the *Mollusques*, Mém. 15, pp. 2–10, figs. 1–8.

Family II.—FISSURELLIDÆ, Woodward.

Head with a short proboscis; with two subulate tentacles, having sub-pedunculate eyes on the outside of their base. Mantle with a siphonal aperture in the back, and containing two symmetrical pectinate gills. Foot expanded, with a series of short cirri above its sides. Shell symmetrical, but with a spiral nucleus, which is covered in most by later growths of the shell; the apex perforated corresponding to the branchial opening.

Genus Fissurella, Lam. (*Key-hole Limpets*).—Shell oval, conical, radiately ribbed; apex subanterior or central; perforation oblong, subapical; aperture wide, oblong; cavity simple, muscular, impression with the points incurved. The shell of the young animal is subspiral, with a perforation in front of the apex. If the branchial excretory fissure were extended so as to bisect the shell, and the two symmetrical halves were connected by a hinge and adductor muscles, the *Fissurella*, with its symmetrical pair of gills, would closely resemble a Lamellibranch, with a head and a very large and broad foot.

In *Emarginula*, Lam., the vent is anterior, and the shell presents a slit at its front margin; the foot supports a single cirrus on its back part. In some species of *Emarginula* the

shell can be partially covered by the mantle. The young of *Emarginula fissura* have a very minute, recurved, spiral shell, with rapidly enlarging and finely striated whirls without any slit. (Lovén.)

Order V.—PECTINIBRANCHIATA, Cuvier.

Branchiæ composed of plates so formed and united as to resemble a comb, usually two in number, very rarely obsolete; contained in a dorsal pallial cavity opening widely above the head. This order of diœcious Gastropods is the most numerous in genera and species; it includes nearly the whole of the spiral Univalves, and also many with shells simply conical. All the Pectinibranchiata have two tentacles and two eyes, in many supported upon pedicles; the mouth is produced into a proboscis; the males have the intromittent organ attached to the right side of the neck, and, in most, it is folded back within the pallial cavity, but in *Paludina* is retracted into a prepuce opening at the right tentacle. The female has a nidamental gland excreting the albuminous matter of the nidus for the eggs, which is often large and complex. In some Pectinibranchs the branchial aperture is entire; in others a portion of it is fissured or produced into a siphon; the mouth of the shell presents conformable modifications: in some the shell is without an operculum, but most Pectinibranchs possess one. In the selection, compelled by the limits of the present article, the chief modifications of the soft parts or "animal" of the univalve shells will be illustrated.

Section 1.—ASIPHONATA.

Family I.—CALYPREIDÆ, Woodward.
(Bonnet and Slipper Limpets.)

Head with two tentacles, having small sessile eyes on the outside of their base; branchia single and long; sides of the body in front of the foot more or less expanded and produced; tooth-strap elongate; teeth 3-1-3; the central simple, recurved, toothed at the tip; the inner lateral broad, with a triangular toothed tip; the outer lateral tooth claw-like; the second lateral minutely toothed at the end. The eggs are inclosed in a thin membranous bag in small groups under or in front of the foot of the animal. The shell in the egg is subglobular, of one or two gradually enlarging whirls, which rapidly enlarge as soon as the animal is hatched. Shell limpet-shaped, but with the apex more or less spiral, and with a variously-shaped calcareous process from the inner surface to which the retractor muscle is attached.

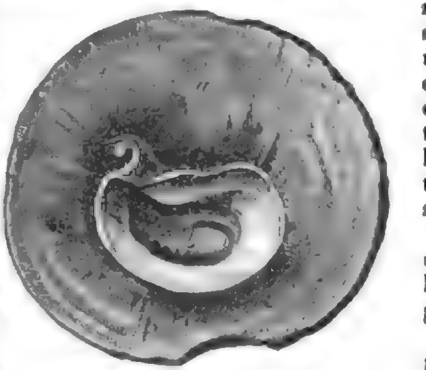


Fig. 76.
Calyptræa Byronensis.

Genus Calyptræa, Lam.—Head with a short and broad muzzle (fig. 77, *a*), truncate, and with the angles slightly produced; tentacles *b* rather short; aliform expansions *d* from the sides of the neck (in *Calypeopsis*). Shell with the inner process half-cup-shaped (*Calyptræa*), or cup-shaped (*Calypeopsis*) (fig. 76, *b*), or with a second calcareous plate formed by the surface of the foot, and adherent to the foreign base of attachment (*Lithedaphus*). The anatomy of a male *Calpytræa Byronensis* is shown in fig. 77. *a* is the mouth, *k* the glottidium with the tongue-strap and teeth as above described; *ll* the simple elongated salivary follicles; *m* the œsophagus girt by the nervous collar before its ex-

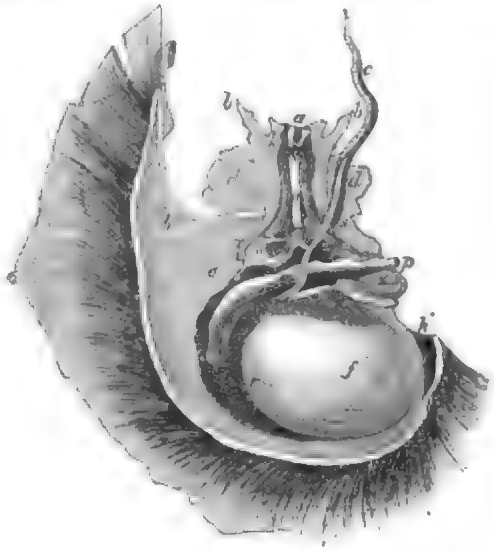


Fig. 77.
Calyptræa Byronensis.

pansion into the stomach *n*; this cavity is almost concealed by the liver, in the substance of which the intestine makes an abrupt bend upon itself and returns, crossing the dorsal side of the stomach to terminate in the right side at *p*, close to the branchial or pallial aperture *h*. The pallial cavity is laid open and spread out to show the extent of the single comb-shaped gill *ii*. The great branchial vein *x* enters the auricle *w*, and the small, dark, muscular ventricle propels the blood through a short bifurcating aorta. The testis *r* sends its product by the duct *d* to the base of a long and slender grooved intromittent organ *e*, projecting from the right side of the head. *ff* shows the smooth convex mass, chiefly muscular, which fills the "cup" (fig. 76, *b*); the dark colour indicates the shape and position of the insertion of the adductor muscle. These singular "cup-and-saucer" limpets adhere to rocks or shells, to the inequalities of which the margin of the "saucer" adapts itself, indicative of their sedentary habits. *Lithedaphus* is a fixture.

In one group the shell is elongated, and the inner process is a partition covering the hinder half of the cavity like a slipper, whence the name *Crepidula* (little slipper) given to this group or genus.

The shells of all the *Calyptreidæ* are peculiar for their great range of adaptive modifications, which have given rise to many nominal species. The experienced naturalist Dr Gray remarks:—

"*Crepidula fornicata* varies in shape according to the body on which it rests; four or five different ages are frequently found riding upon each other. When growing on *Pecten concentricus* it is found to have ribs corresponding to those of the *Pecten*. When found in the cavities of shells it is white and flat, with a convex diaphragm; the younger specimens are rounded, but generally become elongated by age; and it is otherwise very variable in shape, conforming itself to the position it occupies in the throat of the shell. When found among stones at the roots of seaweed, it is generally of a small size, with a convex diaphragm.

"*Crepidula dilatata* changes its form and character according to the body to which it happens to be fixed:—

"1. If attached to a broad stone or other body, the shell is smooth, circular or ovate, and moderately convex; it is then *C. dilatata*, *C. peruviana*, *C. depressa*, *C. patula*, *C. lineolata*, *C. Adolphæi*, *C. chilensis*, and *C. strigata*.

"2. On the contrary, if fixed to a small round stone, and

Gastero-poda.

the shells are obliged to group themselves on one another, it is then narrow, very convex, and *C. nautiloides*.

"3. When the young shell happens to be in deeper water, and fixes itself between the roots of sea plants, it becomes irregular, thick, and of a uniform colour; it is then *C. pallida*.

"4. If it happens to be fixed on the inside of a dead spiral shell, especially if that shell is inhabited by a soldier crab, it becomes flat or even concave externally, and is of a white colour; it is then *C. plana* or *C. unguiformis*.

"*Crepidula patagonica* and *C. aculeata* occur attached to stones on the coast of South America; the former often chooses situations much beaten by the waves.

"*Crepidula dilatata* forms large rounded massive groups, the lower shell being attached to a stone or shell, and the others all placed on the back of it."[1]

Family II.—TURBINIDÆ, Woodward.

In this family, as in the *Bullidæ*, the head and sides of the foot bear lobes, but they are fringed and tentaculate, as in *Haliotis*; the eyes are pedunculate outside the base of the tentacles. The gill-comb is single; the tongue-strap is very long, extending into the visceral cavity. Like the limpets, the Gastropods of the present family feed on sea-weeds; they include the fabricators of the top-shells (*Turbo* and *Trochus*) and pheasant-shells (*Phasianella*) of the Conchologists; nearly all of which have a brilliant nacreous lining. The operculum is either shelly, or is horny and multispiral. The *Trochus conchyliophorus*, Born., Gm. (Cuv. *Règne Animal*, éd. ill., *Moll.*, pl. 41, fig. 3), causes little stones and pieces of bivalves from the bottom on which it creeps to adhere to its shell; these foreign bodies in time grow to the shell, which thus acquires a very irregular appearance. Lamarck confounded with this species, from the West Indian Seas, a fossil species from the tertiary formations, which presents the same peculiarity, under the name of *Trochus agglutinans*. The anatomy of the *Trochus* is given by Cuvier, in *Ann. du Mus.* xi., pp. 184, 185; *Mollusques Mém.* 16, pp. 15, 16, fig. 13.

Family III.—PALUDINIDÆ, Woodward.

The Gastropods of this family inhabit fresh waters, and have a world-wide distribution. Our well known river-snail (*Paludina vivipara*, Lam.) may be regarded as the type; the females are full of young in spring. The ova are hatched in a long and wide oviduct, and the young escape with shells, the periostracum of which bears spiral rows of cirri. The shell of the adult is smooth, of a dull-green colour, with red-brown bands and very convex wreaths. The right tentacle is perforated in the male individuals with an aperture which gives passage to the penis. The gills consist of three series of filaments. It is found in rivers, canals, and other fresh waters; in the mud, or hiding under stones; also creeping under water-plants. The anatomy of the *Paludina vivipara*, Lam., is given by Swammerdam, *Bibl. Nat.* i., pp. 169–180, tab. ix., figs. 15–18; by Cuvier, *Ann. du Mus.* xi., p. 170, *Mollusques Mémoire* 15; and it has recently been admirably completed by Leydig, *Ueber Paludina vivipara, ein Beitrag zur nähern Kenntniss dieses Thieres in embryologischer, anatomischer und histologischer Beziehung*, in Siebold u. Kölliker's *Zeitsch. f. wissench. Zoologie*, bd. ii., 1850, pp. 125–197, pls. xi., xii., xiii.

Family IV.—LITORINIDÆ, Woodward.

Head proboscidiform (fig. 78, *a*); tentacles *b* subulate, with the eyes sessile on the outside of their base; foot of moderate size, with a linear duplication in front, and a groove along the repent surface; gill single; mantle with a rudimentary siphonal canal. Shell spiral, turbinated, or depressed; aperture entire; operculum horny.

Genus Litorina, Férussac (*Periwinkles*).—Shell turbinated, thick, with few whirls, and no nacreous lining; operculum paucispiral.

Sp. *Litorina litorea* (Common Periwinkle).—This well-known univalve lives in the lowest zones of sea-weed between the tide-marks; it is oviparous, and is used for food.

Litorina rudis.—This species is viviparous, and as the young acquire a calcareous shell before exclusion, it is not eaten; it frequents a higher zone than the common periwinkle. The sides of the grooved foot advance alternately in progression.

Genus Solarium, Lam. (*Stair-case Shell*).—To a sub-genus of this group (*Torinia*, Gray) belongs the Mollusk with the spiral turriform operculum, fig. 56.

Genus Phorus, Montfort (*Carrier-Shell*).—The propriety of separating the "carrier-shells" from the *Trochi*, which they resemble in shape, has been proved by the discovery of two living species, in both of which the soft parts are distinct from those of *Trochus* proper. Except in that the eyes are not raised on pedicles, the outward form of the animal is similar to that of *Strombus*, which *Phorus* resembles also in its mode of progression, but its true affinities are with the *Litorinidæ*.

The animal of *Phorus* (fig. 78) is very slender in pro-

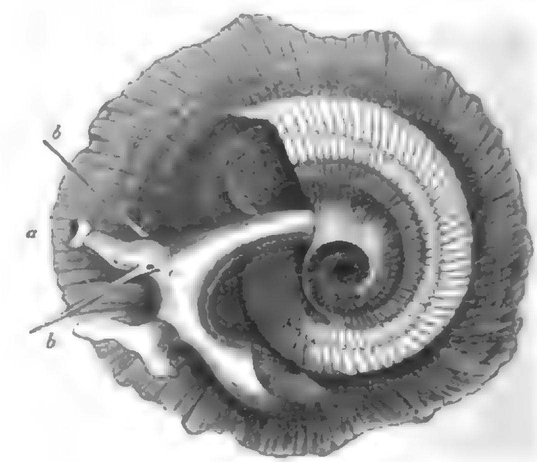


Fig. 78.
Phorus exutus.

portion to the size of the aperture of the shell. The foot is divided into two parts, of which the anterior one *d* is expanded, subservient to the purposes of locomotion, and the hinder one supports a large horny operculum *f*, which is partially free, as in *Solarium*. The proboscis *a* is very prominently developed and annulate; and the tentacles *b* are long and tapering, with the eyes *e* sessile on the outside of their base. The portion of the mantle lining the aperture of the shell is vascular, thin, and delicate, extending over the front and outer lip, which is often much produced and uneven in outline, especially in *Phorus exutus* (fig. 78).

"The *Phori* invariably inhabit rough places incapable of accommodating a gliding motion, and their mode of progression, like that of the *Strombi*, is by little jumps. Each species has its own peculiar manner of collecting the debris of shells or pebbles which cover the ground it inhabits, and each has, to a certain extent, its peculiar kind of debris." (Adams.)

In *Phorus Solarioides*, Adams, the animal is character-

[1] *Guide to the Systematic Distribution of the Mollusca in the British Museum*, 8vo, 1857, p. 117.

ized by numerous circular striæ, the tentacles are laterally compressed and rather prismatic, the proboscis is long and transversely wrinkled, yellow at the tip and on the under surface, but pink between the tentacles, which are straight, rigid, and opaque dead-white; the eyes are black and conspicuous. Hab. China Sea.

As compared with the *Calyptreidæ* the carrier-shell have a divided *Stromb*-like operculated foot, are of active habits, and produce a regular convoluted shell, whilst the cup-and-saucer shells have a simple foot, live attached to foreign bodies, seem rarely to perform the act of progression, have no operculum, unless the rare secretion of a calcareous plate to the place of attachment can be regarded as the homologue of one, and the spiral type is not carried out in the completion of the adult shell.

Family V.—TURRITELLIDÆ, Woodward.

Head with a short proboscis; eyes sunk in the outside of the base of the tentacles; margin of the mantle fringed; foot short; branchia single. Shell tubular or spiral, apex partitioned off; aperture circular, entire; operculum horny multispiral. To this family belong the "turret-shells" (*Turritella*, Lam.), the "worm-shells" (*Vermetus* and *Magilus*), and the wentle-traps (*Scalaria*, Lam.), of which the once rare and highly-prized *Scalaria pretiosa* is a beautiful example. The wentle-traps exude a purple fluid when molested.

In the *Vermetus* of Adanson (the *Serpula lumbricalis* of Linnæus) the tubular shell is thin, divided by partitions, with the spire adhering at the apex; elsewhere it is loose. The aperture is orbicular, with the margins connected. The head supports two tentacles, which are oculiferous externally at the base. The posterior appendage of the body is bent downwards, and is mostly furnished with an operculum. The branchiæ are arranged in a conical series, at the left side of the respiratory cavity.

The peculiar solidification of the elongated shell of the adult *Magilus* has already been mentioned. In both the above genera of tube or worm shells the shell has the form of a regular spiral univalve when the animal is young. *Magilus* inhabits madreporic masses in the Red Sea; by its anatomy it is nearly allied to the whelk family (*Buccinidæ*).

Family VI.—CERITHIADÆ, Woodward.

Head with a short non-retractile muzzle; tentacles with the eyes at their apex (fig. 79), or supporting them on short peduncles; margin of the mantle with a rudimentary siphonal fold. Shell spiral, elongate, and many-whirled; aperture oval, oblique, with a short truncate or recurved canal in front; operculum horny and spiral. About 100 living species of *Cerithium* are known; they have a world-wide distribution, but flourish best in the tropics. They live in great part in the sea, partly in brackish water or at the mouths of rivers. The fossil species, which are still most numerous (upwards of 400 have been defined), are almost all limited to the Tertiary formations. Amongst these *Cerithium giganteum* deserves to be noticed, a species found in France near Grignon.

Fig. 79.
Cerithium obtusum.

The animal of *Cerithium obtusum*, Lam. (fig. 79), captured by Mr Adams at the mouths of rivers in Borneo, "has a broad, suborbicular, and expanded foot, and and an elongated, subcylindrical annulated trunk of a light brown colour, with three rather broad, well-defined, opaque, yellow lines extending along its upper surface, the central one of which extends from the head to very near the extremity of the proboscis, where it is bifid, the two forks diverging; the two lateral lines are shorter, not bifid at their extremities, and reach forward on the head to within a little distance of the origin of the tentacles; the tentacles are very short, annulated, with the eyes (which are small, though with a distinct iris and pupil) situated at their tip, whereas they are mostly placed on tubercles situated on the outer side of the base of the tentacles, or on the tentacles themselves at a little distance from their origin. The foot is of a light pinky brown on its upper surface, mottled with a deep rich brown, and on the under surface is lilac."

The *Cerithia obtusa* live in brackish water in mangrove-swamps and the mouths of rivers in Singapore and Borneo. Sometimes they crawl on the stones and leaves in the neighbourhood, and are not unfrequently found suspended by glutinous threads to boughs and the roots of the mangroves. The operculum is round, horny, with a central nucleus and concentric elements; it is semitransparent, and borne upon the posterior part of the foot at its extreme end. When the animal hybernates it retracts itself into the shell, and brings its operculum to fit closely into the aperture, after having previously affixed sixty or seventy glassy, transparent, glutinous threads to the place of attachment, when they occupy the outer or right lip, and extend half-way round the operculum.

"A species of *Cyclostoma* (*Megalomastoma suspensum*, Guilding) was found by the Rev. Lansdowne Guilding at the Island of St Vincent, suspended in like manner from the trees; and *Rissoa parva* has been observed by Mr Gray, upon our own shores (*Pro. Zool. Soc.* 1833, p. 116), to have the power of emitting a glutinous thread by which it attaches itself to floating sea-weeds.

"There is a very handsome *Cerithium* closely allied to the foregoing, which I have frequently found crawling languidly on the leaves of the *Pontedera* and sedges in the fluviatile marshes on the banks of the rivers in many parts of Borneo, and many miles in the interior where the water is perfectly fresh, and which has the eyes likewise terminal and the proboscis marked with crimson and yellow; the foot is very dark brown, and has a vivid scarlet line extending round the lower margin. The position of the eye varies considerably in this group. In an amphibious Bornean species, allied to *C. decollatum*, they are terminal at the end of peduncles; in other words, the tentacles are connate with the eye-peduncles for the whole of their extent. In *C. microptera* the tentacles extend a third beyond the eye-peduncles; in *C. decollatum* the eye-peduncles are truncated, with the eyes at the end, while the tentacle extends beyond them in the form of a minute filament; all these species have circular multispiral opercula."[1]

The foregoing evidence of the living habits of the *Cerithia* has much interest in relation to the tertiary extinct species.

Family VII.—PYRAMIDELLIDÆ, Woodward.

Head with broad ear-shaped tentacles, often connate, with the eyes at their base; proboscis retractile; foot truncate anteriorly. Shell spiral, turreted; aperture small; columella with one or more prominent plaits; operculum horny, imbricated.

Genus Eulima, Risso.—"The head of *Eulima* is small, with the tentacles subulate and close together at the base, where they are rather swollen. The eyes are situated at the back of the head, behind the tentacles. The foot is rather expanded, especially at the sides, and is furnished with an ovate subspiral operculum. The polish of the shell is occasioned by the front edge of the mantle being

[1] *Zoology of the Samarang*, p. 43.

extended over it; the lobes are, however, difficult to observe, in consequence of the extreme timidity of the animal in speedily retracting them when disturbed. The soft parts of *Eulima major* are, like the shell, of an opaque pearly white, except that the tentacles are delicately tinged with orange in the middle and with yellow at the tip. The eyes, which are black, are usually concealed beneath the front of the shell, the tentacles only protruding. The foot is in advance of the head when the animal is creeping.

Genus STYLINA, Fleming (*Stylifer*, Brod.)

Sp. *Stylina astericola*.—This little Gastropod is remarkable for its parasitic habits, being commonly found immersed in the body of living star-fishes, or attached to the spines of sea-urchins. The mantle is thick and reflected over the body-whirl of the shell. The foot is much produced beyond the head, but is very little extended behind.

FAMILY VIII.—NATICIDÆ, Woodward.

Animal with a long retractile proboscis; tentacles often connate with an expansion of the head; foot large; mantle-lobes reflected over more or less of the shell; this is globular and with few whirls. Spire short and obtuse; aperture semilunar.

Genus NATICA, Lam.—The *Natica melanostoma* (fig. 80) is furnished with a strong coriaceous foot *d*, well de-

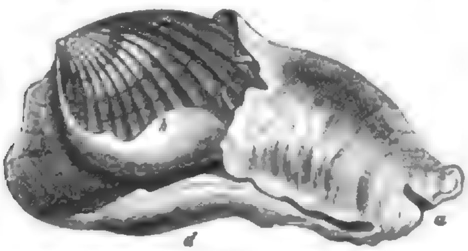


Fig. 80.
Natica melanostoma.

veloped in front, where it forms a fold *a*, which can be reflected back upon the head. By means of this the animal perforates the sand, while its tentacles are protected; but when the tide rises and covers the sands, the large side lobes and dilated hind part of the foot are expanded, and the *Natica* flaps along above the sand. A great peculiarity in the animal of this family is the existence of an operculigerous lobe *h*, which in the polished species nearly covers the shell, and is seen in our figure mounting up behind and partly covering the sides. In *Sigaretus* this lobe is extended entirely across, and covers the shell, while the operculum is rudimentary; in *Lamellaria* it not only incloses the shell, but extends beyond it in front.

Section 2.—SIPHONOSTOMATA, Cuvier.

Margin of the mantle prolonged into a siphon, by which water is conveyed into the branchial chamber. Shell spiral; aperture notched or produced into a canal in front; operculum horny, lamellar, rarely wanting. Most of this section are carnivorous.

FAMILY I.—CYPRÆIDÆ.
(*Cowries.*)

Head with a proboscis (fig. 48, *a*), two long subulate tentacles *b*, with the eyes *c* usually at some distance from the base; foot *d* long and broad, truncate in front; mantle with side-lobes which can be reflected over the shell. These lobes, in most species, are beset with tentacles, often branched. The shell is richly enamelled by the secretion of the pallial lobes. It is convolute, with the spire concealed in the adult; the aperture narrow, enamelled at each end; the outer lip, in the adult, thickened and inflected; often transversely crenate; no operculum. In the young of *Cypræa* the shell has a thin and sharp outer lip, a short but conspicuous spire, and a thin periostracum; the spire becomes concealed by the subsequent enamel deposits from the reflected mantle-lobes; the line along which these meet at the back of the skull is usually indicated by a pale line on the shell.

Gasteropoda.

Sp. *Cypræa tigris* (Tiger Cowry) (fig. 48).

Sp. *Cypræa moneta* (Money Cowry).—Of this little shell many tons' weight are annually imported into England, for the purpose of barter with the negroes of the west coast of Africa.

Genus OVULUM, Brug.—This group of cowries has been separated from *Cypræa* proper on some characters of the shell which are barely of sub-generic value. In the *Ovulum volva*, or "weaver's shuttle shell," the mantle is furnished near the edge with a row of dark tubercles. A living specimen was taken by Mr Adams from a rocky coral bottom off the Island of Basilan, in the Mindoro Sea. It was languid in its movements, with the foot narrow, and folded longitudinally upon the slender coral branches along which it slowly glided.

The *Ovulum verrucosum* (fig. 81) approaches nearer to the type of *Cypræa*, having the mantle *h* partially lobed on each side; but it does not wholly cover the shell. The foot *dd* is flat and expanded; it is spotted black, on a white ground like the mantle. The tentacles *b* are subulate, of a pure white, with black extremities; the eyes are on the outer side of their base. The longest slope and narrowest end is the fore-part of the shell.

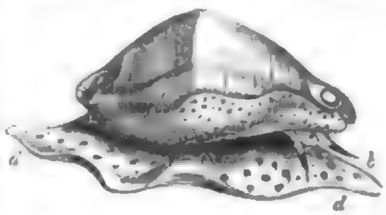


Fig. 81.
Ovulum verrucosum.

This species is a sluggish, slow-moving Mollusk, not more sensible to alarm than the true cowries.

The specimen figured was captured at Mindoro, one of the Philippine Islands, on a sandy bottom, by Mr Adams.

FAMILY II.—VOLUTIDÆ, Woodward.

Head with tentacles supporting eyes near their base; foot very large, partly covering the shell when out of water; mantle in some genera reflected upon the shell; siphon recurved. The shell turretted or convolute; aperture notched in front; columella obliquely plaited; no operculum.

Genus MARGINELLA.—In this genus, as in *Cypræa*, the outer lip of the shell becomes thickened at the border (fig. 82), the spire becomes nearly or quite concealed, and the outer surface is enamelled.

Sp. *Marginella undulata*, Deshayes (fig. 82).—This species was taken alive by Mr Adams from a sandy bottom in the east coast of Africa. The proboscis *a*, tentacles *b*, the siphon, the foot *d*, and the mantle, are mottled with carmine on a yellowish ground, the border of the mantle bearing large crimson spots.

In the *Marginella diadochus*, Ad., the tentacles are yellowish with a row of marble crimsoned spots, the eyes black and minute, the mantle pale, semi-transparent, of a pinkish yellow, with a row of semioval crimson spots round the thin free edge, the remainder being covered with radiating linear spots and short waved lines of a crimson colour; siphon marbled with crimson; foot of a delicate yellowish-pink, marked with deep crimson rays. The shell is of a bright olive carnelian hue, conspicuously encircled at irregular intervals with broad black lines, having almost the

consistency of bands. This species was captured in the Straits of Sunda, from a sandy bottom, at a depth of about three fathoms.

The tentacles of the *Marginellæ* appear to vary in different species. In those observed by M. Deshayes on the shores of the Mediterranean the tentacles are described as being short, whilst in this and the preceding species they are slender and elongated. The eyes of the *Marginella diadochus* are more pedunculated than those of *M. undulata* (Adams).

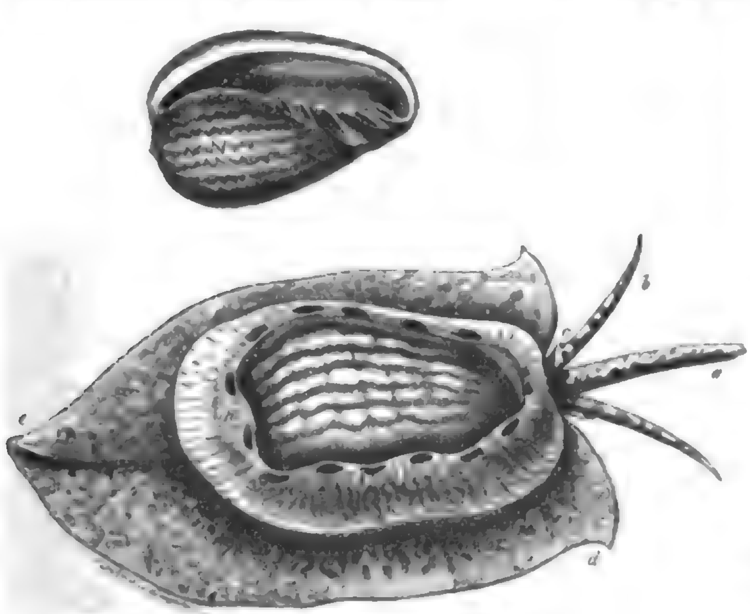


Fig. 82.
Marginella undulata.

Genus VOLUTA, Linn., Lam.—In this genus the siphon has a lobe on each side near the base; the shell is ventricose, thick, with a short spire, having a mammillated apex. The aperture is large, deeply notched in front; columella plaited.

A beautiful species (*Voluta abyssicola*) was discovered by Mr Adams at the Cape of Good Hope.

"This elaborately carved species is one of considerable interest in a geological point of view, from the circumstance of its being the first living representative yet discovered of a group of highly sculptured Volutes abounding in the Eocene portion of the Tertiary beds of the British Isles. The principal of these, *V. lima*, *elevata*, *crenulata*, and *digitalina*, were distinguished by Mr Swainson as a sub-genus, under the name *Volutilithes*. The *Voluta abyssicola* is not identical in species with the fossils, being characterized by a closer and more sharply-defined pattern of lattice-work, which comprises as many as thirty transverse, and forty longitudinal ridges in a whirl. The upper edge of the whirls is depressly flattened at the sutures, forming a narrow ascending canal. The ridges are slightly nodulous at the point of crossing, and round the upper extremity impart a coronated aspect to the shell. The columellar plaits, four in number, are sharp and delicate. The outer lip is thin, and does not appear to be mature. The only specimen collected was dredged from a bank of dead shells and rounded iron-stones, at the depth of 132 fathoms." (Adams.)

Genus MITRA, Lam. (*Mitre Shells*).—The animal of *Mitra* has in general a very short foot, straight and continuous from side to side in some species, but in others notched and produced, with a thickened anterior margin. It is commonly narrow and rounded, or acuminated posteriorly, and it bears a very small semi-transparent horny operculum, in some instances scarcely visible. The siphon is mostly directed forwards, and the somewhat short tapering tentacles have the eyes either situated about half-way, or they are placed on the outer side of the base. The head is long and very flat, and the tentacles are very close together at their bases. The proboscis is rarely exserted when they are crawling and lively, but as they become languid after capture it becomes distended with water and protrudes considerably. The animal of *Mitra flammigera*, one of the deep-water species, is very prettily marked. The body is gray, varied with round, well-defined white spots, and dark-brown blotches, of a pyramidal form, arranged in a row round the lower edge in a Vandyke pattern, and below that a white rim with a row of small, linear, horizontal black spots; the head is white, marbled with gray-brown; the eyes black, and the tentacles white, with a large oval black spot in their middle; the siphon is brown, edged with black, and with a broad white band at its free extremity. The operculum is very minute, horny, and transparent. Hab. Caramata Passage; 14 fathoms, hard muddy bottom, mixed with sand and broken shells.

Another species, with the same habits, the *Mitra interlirata*, is semiopaque, white, faintly mottled with light brown, with the eyes at the outer base of the tentacles, and black. Hab. China Sea; 10 fathoms.

"The animal of that division of the genus which Swainson included under *Conohelix* is the same as in the typical species. I have found the *Mitra conus* buried rather deep in the soft black mud under the roots of trees in mangrove swamps, above high-water mark, in the Island of Basilan. The *M. conica* is found in company with other species of mitres, crawling slowly over the sandy mud in shallow places, among the islands of the Philippine group.

"Although M. Quoy has rightly termed the *Mitra* an 'animale apathique,' I have seen the small longitudinally-ribbed species crawl about pretty briskly over the smooth sand among the low coral islands. The *Mitra episcopalis*, probably on account of the small size of its locomotive disc, and the ponderous nature of its long shell, is a very sluggish Mollusk. I have observed some of the *Auricula*-shaped mitres that live among the Philippines, in the shallow pools left by the receding tide, crawling about the stones out of the water, in company with *Planaxis* and *Quoyia*. The Mitres, like many of the large Volutes, prefer, however, to associate together, and may be seen in dozens crawling over the sandy mud-flats in shallow water, being most active just as the flood-tide makes. When the tide recedes, they bury themselves superficially in the yielding soil, and are with difficulty discovered. Some of the small-ribbed species cover themselves entirely with the sandy mud, and in that disguised condition travel about with comparative security. On one occasion, on the small island of Ambolan, at the south end of Mindoro, I was walking up to my ankles over a firm sandy mud-flat, taking little notice of the *Cones*, *Strombi*, *Meleagrinæ*, and *Volutes*, which people the water in great numbers, but looking about anxiously for the rarer mitres, when I first perceived these small species, under their ingenious disguise, marching in towards the shore as the tide flowed rapidly over the level surface. Persons, by the way, should never venture in places of this description barefooted, as there is a species of *Pinna* which buries its sharp end in the mud, but leaves the thin trenchant edges of the gaping

Gastero-poda.

extremity exposed, and when trodden on, inflicts very deep and painful incised wounds. Both myself and several of the boat's crew suffered in this way."

"The Philippine Islands would seem to harbour the greatest number of these elegant and beautiful shells, although a great many species were obtained by Mr Cuming in tropical America. They appear to be chiefly confined to the equatorial regions, scarcely any being natives of cold climates. I have met with several among the Meiaco-shima Islands, at Loo-Choo, at Japan, and at the Keeling or Cocos Islands. They are most frequently to be met with in somewhat shallow water among the ledges of rocks, between small islands where the water barely covers the land, and within the shelter of coral reefs; sometimes preferring a clear sandy bottom, and sometimes affecting a hard muddy sandy soil. The transversely ribbed species are frequently found in very deep water, and many were dredged by us in 20 and 30 fathoms at Sooloo and in the China Sea." (Adams.)

Family III.—Buccinidæ.
(Whelks and their allies.)

Branchiæ two. Predatory on other Mollusks.

Genus Ancillaria, Lam.—"The animal of *Ancillaria* (fig. 83) is voluminous, covering the entire shell, with the exception of the spire. The head, which is entirely concealed by the reflected portions of the foot, consists of a short, inflated, cylindrical, annulated proboscis, above which is a semilunar veil formed by the

Fig. 83.
Ancillaria obtusa.

dilatation and union of the tentacles; there is no indication of eyes. The mantle lines the shell, and is produced anteriorly into a long siphon. The foot is large and bursiform, the side-edges being greatly extended and reflected over the shell, meeting in the middle on the back. As in *Oliva*, it is deeply fissured anteriorly, forming a semilunar disc before the head, divided by a deep longitudinal groove into two lateral, triangular lobes, acuminated transversely; posteriorly it is bilobed, and is either without an operculum, or is provided with a thin, horny, unguiform one, with apical nucleus, semilunar striæ, and an oval muscular impression.

"Sp. *Ancillaria obtusa* (fig. 83) (Swainson, *Journ. Sci. Lit. and Arts*, vol. xviii., p. 282; Sowerby, species *Conchiliorum, Anc.*, p. 5, fig. 24, 25).—Hab. east coast of Africa, below Port Natal. The specimen taken alive at the above-named locality was of a dirty white colour, marked with dull brown elongated blotches, distributed with scarcely so much regularity as represented in our figure. The operculum is shown above the chief figure.

"The *Ancillariæ* resemble the *Olivæ* in their habits, dwelling among the smooth sands in which they frequently bury themselves. They crawl with a quick sliding motion, and, as they glide briskly along, the tubular cylindrical siphon only is visible, directed backwards and upwards, and even laid flat upon the back; the alar expansions of the foot slightly overlap each other in the middle, and, extending considerably beyond the spire, form posteriorly a loose open sac. It is possible that the dilated lobes of the foot are sometimes extended and serve for swimming, as D'Orbigny has observed in *Oliva Tehuelchana* (*Voy. Amér. Mérid. Moll.*, p. 419, A. A.)." (Adams.)

Genus Dolium, Lam. (Tuns).—Head with a long proboscis (fig. 49, *a*); tentacles *b* subulate, with the eyes at the outer side of their base; siphon *h* slender, canaliculate; intromittent organ *y* in the male very large, grooved, bent, with a plicate glans; foot *d* produced in front of the head without an operculum; pallial border *i* entire. Shell ventricose, spirally furrowed; spire small; aperture very large; outer lip crenate.

Gastero-poda.

Sp. *Dolium galea* (Helmet-Tun), fig. 49.—Shell and soft parts. About fourteen species have been characterized. The helmet-tun is a native of the Mediterranean; but most of the species are from warmer seas, as those of Ceylon, China, Australia, and Polynesia. They affect reefs and rocky beds, and some of the species acquire a great size.

Genus Columbella, Lam.—The animal of *Columbella* has a long and somewhat narrow vertically depressed head, with the eyes sometimes placed on the outer side of the base of the tentacles, and sometimes on the outer side of reflected prominences, situated at some little distance from the head. The siphon, long and directed forwards, is considerably dilated at the anterior extremity. The foot is short and pointed posteriorly, and bears a small, semi-transparent, horny operculum, with concentric elements. Anteriorly the foot is often considerably produced beyond the head, where it forms a long, thick, flattened, fleshy, finger-like process. Sometimes it is expanded laterally, when it is truncate anteriorly and furnished with two lateral angular processes.

Sp. *Columbella tæniata* (fig. 84).—Hab. Borneo.

Fig. 84.
Columbella tæniata.

There are two fillets of square red-brown spots on each whirl, the lower of which is concealed in all but the last whirl. The Columbellæ live in shallow water, on sandy flats, or congregating about stones.

Genus Harpa, Lam. (Harp-Shells).—The animal of *Harpa* has a very large foot (fig. 85, *d*), semicircular ante-

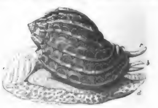


Fig. 85.
Harpa ventricosa.

riorly, divided by lateral fissures from the posterior part *e*, which does not bear an operculum, and is said to be spontaneously detached when the animal is molested; tentacles *b* conical, with the eyes at the outer side of the base; siphon *h* cylindrical, elongate. Shell ventricose, with ribs at regular intervals; spire short; aperture large, notched in front.

Sp. *Harpa ventricosa*, Lam. (*Buccinum Harpa*, Linn.)—Hab. Mauritius. The harp-shells are natives of tropical zones, occurring in the Indian and Pacific Oceans. They are generally brought up from deep water and soft or sandy beds.

Genus Buccinum, Lam. (*Whelks*).—The whelks have a lamellar operculum, with the nucleus external, or subcentral within the outer margin. Shell ovate; spire moderate; mouth oblong; outer lip rather sinuous; pillar

Gastero-poda.

rounded; operculum ovate. The silicious teeth of the long tooth-strap are arranged in transverse rows of three, the central or "rachidian" tooth having seven points; the lateral teeth hook-shaped, with the scape tridentate. The animals of *Buccinum undatum* and *Chrysodomus antiquus* are both vended for food in the streets of London under the name of "whelks." They are also dredged for bait. The nidamental capsules of the *Buccinum undatum* are figured in cut 92. (For the anatomy of the whelk see Cuvier, *Ann. du Mus.* xi., pp. 447–457; *Mém. s. l. Mollusq.*, No. 17.)

Genus EBURNA, Lam. (*Ivory-Shells*).—An instructive drawing was made of the living *Eburna areolata*, Lamarck, during the voyage of the Samarang. It is described as follows by Mr Adams:—

"Sp. *Eburna areolata*, Lam. (fig. 86) (*Eburna tesselata*, Swainson).—Head flat, extended; tentacles very long and slender; eyes *c* consisting of a yellow iris and black pupil, mounted upon pedunculated swellings on the outer base of the tentacles; siphon *h'* large, fleshy, and slightly curved; foot *d* long, fleshy, and robust, acuminated behind and carrying a horny operculum *f*. Colour dull pinkish-white, sprinkled with large, light brown, irregular blotches; siphon and tentacles mottled with spots of the same colour." (Adams.)

The shells of the *Eburnæ* are dense and smooth, having usually lost their periostracum. When recent they bear dark-red spots on a pure white ground. They have been dredged from fourteen fathoms, and are pretty

Fig. 86.
Eburna areolata.

widely distributed; occurring at the Cape of Good Hope, the Red Sea, the Indian Ocean, Japan, China, and Australia.

FAMILY IV.—MURICIDÆ, Woodward.

Animal with a broad foot, much expanded in some; eyes sessile on the tentacles at or near their base; branchiæ two. Shell with a straight anterior canal; aperture entire behind.

Genus MUREX, Linn. (*Rock-Shells*).—"Shell ornamented with three or more continuous varices; aperture rounded;

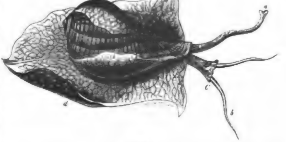


Fig. 87.
Ficula lævigata.

beak often very long; canal partly closed; operculum concentric; nucleus subspiral. The Murices appear to form only one-third of a whirl annually, ending in a varix; some species have intermediate varices of less extent. The ancients obtained their purple dye from species of *Murex*; the small shells were bruised in mortars, the animals of the larger ones taken out. Heaps of broken shells of the *M. trunculus*, and caldron-shaped holes in the rocks, may still be seen on the Tyrian shore (Wilde). On the coast of the Morea there is similar evidence of the employment of the *M. brandaris* for the same purpose (M. Boblaye)." (Woodward.)

Genus PYRULA, Lam. (*Ficula*, Swainson, Fig-Shells).—Head (fig. 87, *C*) elongated, slender, flattened; tentacles *b* long, subulate, placed at the sides of the front, separated by a wide interval at their base; eyes large, black, and sessile on the outer side of the base of the tentacles; siphon *a* elongated, subcylindrical, and produced; mantle thin and membranous, produced on each side into a rounded lobe *h*, equally reflexed on each side over the shell; foot *d* large, expanded, rounded in front, rather produced on each side of the front edge, expanded, broad and tapering, and not furnished with any operculum.

Sp. *Ficula lævigata* (fig. 87), (Reeve, *Conch. Icon.*, *Ficula*, pl. i., fig. 4; *Bulla ficus*, Linn.; *Pyrula ficus*, Lamarck).—Head and neck pink, varied with scattered yellow spots; mantle bright pink, mottled with white and darker pink; under surface of foot dark purple chocolate, varied with yellow scattered spots. Hab. Sooloo Sea, at the depth of 35 fathoms. The dark chocolate colouring of the under surface of the foot presents a rich contrast with the bright freckled pink of the upper.

Sp. *Ficula reticulata* (Reeve, *Conch. Icon.*, *Ficula*, pl. i., fig. 1; *Pyrula reticulata*, Lamarck).—Head and tentacles white; mantle light pink, marbled and reticulated with darker pink; foot pink, with six large opaque white spots at about equal distances. Hab. west coast of Borneo; from mud at a depth of about 17 fathoms. The head of this species differs from that of the former in being colourless. The mantle is characterized by the same pink reticulated marbling as the foot.

"The *Ficula* is a very lively animal when observed in its

native element, crawling along with considerable velocity, and, owing probably to the lightness of its shell, able to ascend the sides of a glass vessel, in which I had it captive, with facility. The proboscis is rarely exserted when the animal is in motion, but the long slender tentacles are stretched out to their full extent." (Adams.)

FAMILY V.—STROMBIDÆ, Woodward.

Animal (fig. 88) with pedunculate eyes *c*, and tentacles *b*, from a common elongated base; foot *d* narrow and small, but produced, and subservient to active leaping movements, during which the shell oscillates from side to side; operculum *f* narrow, pointed, and serrated on the outer edge.

Genus STROMBUS, Linn. (*Wing-Shells*).—Shell subventricose; spire short; outer lip dilated into a very ample wing excised towards the canal by a sinus; canal straight, or inflected by the columella obliquely outwards; canal short, emarginate, or truncated; sinus of outer lip distinct from canal; in older shells this lip is expanded into a wing, simple and entire. *Strombus*, Lam.

Sp. *Strombus gigas*, L. (Lister, *Conch.*, tab. 863, fig. 18).—Hab. West Indies. This species forms the largest known univalve shell, weighing sometimes four or five pounds; its apex and spines become solidified by calcareous deposits with age. From its occasional use as a garden ornament it has been called "fountain-shell." Vast numbers are annually imported from the Bahamas for the manufacture of cameos and for porcelain works. Canal elongate; sinus of outer lip not contiguous to canal; the lip produced into digitate laciniæ. *Pterocera*, Lam.

Sp. *Strombus Chiragra*, L. (Lister, *Conch.*, pl. 870, fig. 24); *Strombus scorpius*, L. (D'Argen., *Conch.*, pl. 14, fig. n.)

Genus ROSTELLARIA, Lam. (fig. 88).—Shell with a long spire; whirls numerous; canal subulate, extending behind up the spire; sinus of outer lip contiguous to the canal. The Eocene fossil species have the outer lip enormously expanded.

Sp. *Rostellaria rectirostris*.—The subcylindrical annular proboscis (fig. 88, *a*) has a broad central dark-

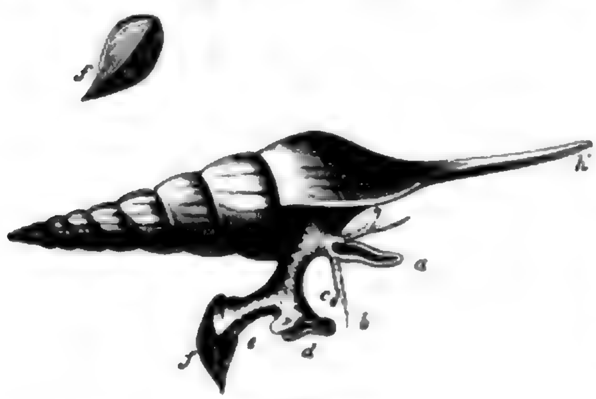


Fig. 88.
Rostellaria rectirostris.

bronze line, the edges of which are yellow, bordered with vermilion; eyes *c* deep blue, with black pupils, surmounted on long cylindrical peduncles; tentacles *b* white, with a narrow vermilion streak along their anterior surface; body cylindrical and much elongated, marked with red-brown on the outer surface, white beneath; foot *d* narrow, rather dilated and rounded in front, with a thickened anterior margin, small and subquadrate behind, separated by a deep notch from the lid-bearing part *e*; operculum *f* ovate-triangular, annular, horny, semitransparent.

The *R. rectirostris*, like the rest of the *Strombidæ*, progresses by bending the foot under the shell and suddenly straightening, which enables it to roll and leap over and over. (Adams, *loc. cit.*)

Genus TEREBELLUM, Klein., Lam.—The discovery of the living *Terebellum* has occasioned the removal of that genus to this family, on account of its affinity with *Strombus*. The eyes are pedunculated, and the mantle is characterized by the same peculiar divided edge. In the narrow form of the foot and proboscis-like head it is allied to *Struthiolaria* and *Aporrhais*, and, like *Oliva*, the mantle has a long filamentary cord winding into the sutures of the shell.

Sp. *Terebellum subulatum* (fig. 89), Lamarck (*Anim.*

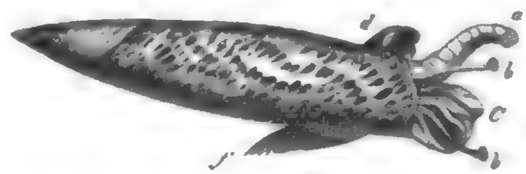


Fig. 89.
Terebellum subulatum.

sans vert., Deshayes' edit., vol. x., p. 584).—Hab. China and Sooloo Archipelago.

"The animal of *Terebellum* may be thus described: Head proboscidiform *C*; tentacles connate with the long cylindrical eye-peduncles, at the ends of which are placed the eyes *b*, *b*; mantle with the right edge reflexed over the outer lip, produced in front into a short siphon *a*, and furnished behind with three or four filaments, the inner edge spread over the columella, and ending behind in a long slender filament, which occupies, as in *Oliva*, the channelled suture of the spire; foot large, ovate, fleshy, laterally compressed, with a lobe at the fore part, rounded behind, and bearing a minute, horny, triangular operculum *f*.

"The eye-peduncles of this species are finely dotted with brown, the proboscis and the fore part of the body is punctulated with the same; the rest of the body is opake white, with three large irregularly-shaped red-brown blotches on the fore part; the under surface of the foot is light brown, with a white subcruciate marking.

"The *Terebellum* is extremely shy in its movements. Poising its shell in a vertical position, and cautiously protruding its longest telescope-eye from the truncature in the front of the shell, it will remain stationary until assured of security. It will then use its pointed foot as a lever and roll its shell over and over, progressing by a series of irregular leaps. When removed from the water, before dying, it will jump several inches from the ground. Mr Cuming assures me his knowledge of the animal coincides with my own experience, and that on one occasion he lost a fine specimen owing to its suddenly leaping from his hand into the water. I have observed both the varieties of this species alive. In the spotted variety, the muzzle is reddish towards the tip, the body is opake pearly white, the eye-peduncles mottled with dark red; in the common variety there are three large red-brown blotches on the fore part of the body." (Adams.)

With these active forms of carnivorous Gastropods, we seem to reach the summit of this branch of the great Molluscous tree.

The ova of the marine Gastropods are enveloped, before exclusion, in mucous capsules, prepared by a special gland situated near the termination of the oviduct. The secretion in some species is soft, flexible, and transparent; in most it hardens by contact with the sea-water, and assumes various definite and characteristic forms; the nidus is sometimes simple, sometimes compound, but each compartment contains

many ova; and the development of the embryo proceeds in the nidamental chamber until its own little defensive shell is acquired.

In the terrestrial Gastropods the ova are usually spherical and opaque, and separately extruded: snails and slugs oviposit in the earth. The tropical *Bulini*[1] cement leaves together to form an artificial nest for their large eggs.

Fig. 90 is an outline of the egg of the *Bulinus ovatus* of the natural size. The shell of the embryo is an inch in length when it is excluded. Specimens of both egg and young of the species are preserved in the Cumingian collection.

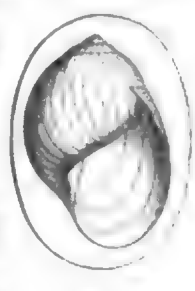


Fig. 90.
Bulinus ovatus.

The ova of the sea-slug (*Tritonia*) are expelled together in the form of a long thread, and are arranged in a spiral manner in the tenacious transparent covering of the thread. In the *Doris muricata* the ova are aggregated in a flattened spirally disposed albuminous band when excluded from the oviduct.

The harder albuminous capsules which defend the ova of other marine Gastropods offer a great variety of forms, some of which are remarkable for their complexity, others for their symmetry and beauty. The nidamental sacs of the frail *Ianthina* (fig. 91, *b*)

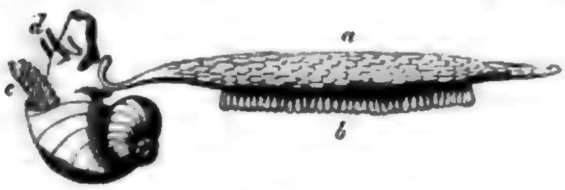


Fig. 91.
Ianthina.

are of a flattened pyriform shape, composed of a delicate reticulate film of albumen, and are attached by one extremity to a float *a*, formed likewise by a secretion of albuminous matter, dilated into a discoid group of cells filled with air. To this float the parent *Ianthina* commits her little progeny, and having securely fastened their several cradles or nursery cells she detaches the float, which bears the ova to the surface, and sustains them where they may best receive the full influence of solar light and heat. The nidamental capsules of the *Pyrula rapa*[2] are attached in regular linear series to portions of decayed wood; they are of a flattened sub-conical figure, adhere by their apex, and have their base emarginate. The nidamental capsules of the whelk (fig. 92), are common objects on our sea-shore; they are aggregated in large irregular masses, often attached to portions of oyster-shell; each capsule presents a depressed ovoid figure, with one side convex, the other flat or concave. The upper figure opposite the left hand shows the round hole in the inner side of the capsule, whence the young has escaped; the figure to the right is the shell of the embryo magnified four diameters. (Woodward).[3] The small nidamental cells of the cowry (*Cyprea*) are aggregated in a flattened group. In the *Turbinella* the cells are of a flattened subpentagonal form, and adhere

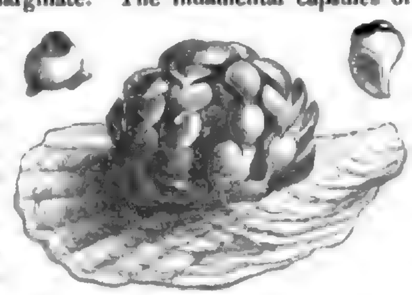


Fig. 92.
Egg-capsules of the Whelk (*Buccinum*).

together, superimposed one upon the other, forming what is termed a camerated nidus. Each chamber contains between twenty and thirty embryos. The rudimental shell is completely calcified and fitted to defend the little Gastropod before it emerges from the temporary shelter provided for it by the parent. Numerous other modifications of these secreted nests of the Gastropodous Mollusca might be enumerated.

The development of the Gastropods has hitherto been traced in a few apneustal, nudibranchiate, tectibranchiate, pulmonate, and pectinibranchiate species; and the results show considerable modifications in its course and phenomena. Most Gastropods are oviparous; some species of *Litorina* are ovo-viviparous; *Paludina* and *Clausilia ventricosa* are viviparous.

With the singular exception observed in *Buccinum*, in which the segmental or granular germ-mass from which the embryo is developed results from a confluence of numerous, perhaps fifty, previously distinct germ-masses in the nidamental capsule, that germ-mass is due to progressive segmentation of the yolk, the result of the usual multiplication of germ-cells, which clothe themselves with the so subdivided but coherent yolk-substance. One cell in *Pulmonata* and *Aplysia*, indeed, is from the beginning conspicuously larger than the rest, and has been called the directive cell (*richtungs-blaschen*).

In all Gastropods the germ-mass takes the form of a large round embryo, one end of which becomes indented and clothed by ciliated epithelium, by which it rotates on its axis in the albumen of the egg. Sars, who noted the oviposition of the *Tritonia Ascanii* on the 1st of February 1840, traced the segmentation of the yolk to the 8-fold division on the 4th day, and the completion of the germ-mass on the 8th day. The indentation producing the bilobed end of the embryo took place on the 15th day; after which the ciliated lobes extended outwards, and assumed the form of wings or vela (fig. 93, *c*, *c*). Dr Grant had long before discovered the corresponding ciliated vela in the embryos of *Purpura*, *Trochus*, *Nerita*, *Doris*, and *Æolis*. On the 20th day the rudiment of the foot appeared beneath the bases of the vela, and on the 22d a transparent shell *s* was developed, which covered all the body save the ciliated vela and foot. "I could scarce believe my eyes," writes Sars, "when I made this discovery." As the body and shell enlarge and elongate, the cilia become stronger on the lobes, and the active movements of the embryos, crossing each other like midges in the clear albumen of the nidamental band, offer a most singular spectacle; the vela now move by muscular contraction, alternately approximating and stretching outwards. On the hinder part of the foot is an operculum (fig. 93, *f*), which closes the mouth of the shell when the embryo retracts itself. Among the internal organs the acoustic capsules appear first, then the eyes. The tentacles next protrude, and the border of the mantle appears. The mouth is established between the vela. On the 36th day the stomach and a looped portion of intestine come into view out of the germ-mass, the remnant of which is chiefly changed in the hepatic and genital glands. A longitudinal muscle for retracting the body into the shell also now appears. During this course of development the nidamental band has become, by endosmose of sea-water, three times as thick as before. The albuminous substance is absorbed by the embryos; they respire by the reaction of their ciliated surface on the imbibed water. As they

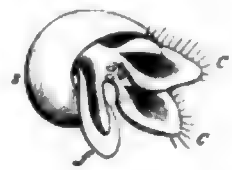


Fig. 93.
Embryo *Æolis*.

[1] See Prep. 2943 B., Hunterian Physiological Series, Lond. Coll. of Surgeons. [2] Ib., Prep. 2947 A. [3] Ib., Preps. 2948 and 2949.

Gastero-poda.

grow they with difficulty find room for their revolutions, and between the 32d and 38th days rupture the delicate membrane of their nest, and struggle out. They are now about one-eighth of a line in length, and swim by ciliary action, the vela being kept stiffly outstretched. They survived in the vessels of daily renewed sea-water two weeks, then died, their embryo shells floating on the surface.

The ova of the *Aplysia* are excluded in a long string, enveloped by a transparent flexible mucus, in the centre of which they are aggregated in several irregular series. When examined at this period, the yolk has apparently divided itself into six, seven, or more numerous globules, or, in other words, as many germinal vesicles, included in the same mass of albumen and in a common chorionic coat have given origin to as many aggregations of vitelline cells. These, therefore, may be regarded as so many independent yolks, in each of which the same progressive fissiparous multiplications have been observed as in the single vitellus of the ovum of the *Planorbis* and of animals in general.

After the multiplication of the globules has gone on to a certain point, two of them, of larger size than the rest, indicate, one the seat of the future branchial organs, the other that of the muscular mass.

The ciliated epithelium, with which the vitellus is now almost entirely covered, occasions the usual rotations of that body. The process of transformation of this monad-like embryo to the gastropodous form resembles closely that which has been described in *Tritonia*. The remains of the vitelline mass not yet metamorphosed into special organs indicate the expanded alimentary sac. The rudimental foot, and the velum with its strongly ciliated border, protrude from a rudimental, thin, pellucid, and flexible shell, which covers all the rest of the surface of the body. The embryo describes elliptical revolutions in the chorionic cavity. As development proceeds and the embryo increases in size, the shell acquires a more distinctly turbinated form, and is slightly bent out of its vertical plane. An operculum is formed upon the protruded surface of the foot. The course of internal development accords with that in *Tritonia*. The ciliated branchial surface begins to be withdrawn more into the interior; and in this state, protected completely by an external shell, the young *Aplysia* is launched into the ocean.

Truly may the subsequent growth, which effects an entirely internal position of the shell, with such a mutation of its form that the primitive nucleus can scarcely be detected upon the almost flattened plate, now destined to protect the equally internal respiratory organs of the mature animal,—justify us in applying to it the term "metamorphosis." This term is still more applicable to the developmental phenomena in the *Tritonia* and *Doris*, since these Gastropods, which are not only naked like the *Aplysia*, but are devoid of any internal rudiment of a shell, are yet provided with a delicate, little, operculated, nautiloid, horny, external shell, in their young state. The same general course of development in which the embryo or larval Mollusk is provided with the ciliated lobes and operculated shell, has been traced by Lovén in *Æolis*, *Bulla*, *Cerithium*; by Lund in *Murex* and *Natica*; by Nordmann in *Tergipes*; by Allman and Vogt in *Actæon*; by Carus in Pteropods; and by Siebold in *Vermetus*. Rudiments of the vela are retained in *Tergipes*, *Æolis*, *Doris*, *Tritonia*, and *Aplysia*; and in *Thetys* they continue in almost their primitive form and proportions, unless the broad head-lobes of the adult be substituted for the embryonal vela, as is the case with the fins of the Pteropods; otherwise the little *Cymbulia*, with its delicate, symmetrical shell (fig. 89), would represent a persistent embryo form of the higher Gastropodous *Encephala*.

Cephalo-poda.

Professor Müller has detected ova and embryos of a Gastropod, which he believes to belong to a species of *Natica*, within the body of the *Synapta digitata*. They were contained in elongated sacs, firmly attached or fused at one end to the head, at the other end to the gut, of the *Synapta*. The upper portion of the sac contains both spermatozoa (like those of *Natica*) and ova; the lower portion of the sac was intus-suscepted with a blind end, and this contained the ova, with developed embryos, according to the velated type. This remarkable discovery indicates some singular parasitic habit in the generative economy of the Mollusk.

The development of the pulmonated Gastropods proceeds without any such metamorphosis as that above described. In the testaceous species its course has been ably traced by Prevost and Dumortier in *Limnea*, by Pfeiffer in *Helix*, by Jacquemin and Quatrefages in *Planorbis*, and by Oscar Schmidt and Gegenbauer in *Helix*, *Clausilia*, and *Limax*.

The whole yolk is transmuted into a germ-mass. This becomes partially divided into a pallial or visceral and a pedial or somatal lobe. The fore part of the pallial portion dilates into a contractile sac, by Gegenbauer deemed the homologue of the "velum" of pectinibranchiate embryos. A similar contractile sac is formed at the end of the pedial lobe; and the contractions of the two sacs alternate, producing a flux and reflux of fluid pabulum before the heart is developed. A peculiar gland is attached to the pallial sac. The first granular rudiments of the shell are deposited in the substance of the mantle. The anterior tentacles and the parts about the mouth are the last to be completed.

CLASS VI.—CEPHALOPODA, Cuvier.

Encephalous Mollusks, with locomotive and prehensile organs radiating from the head; diœcious and ametabolian. Animal divided into a somatal and pallial (fig. 94, *m*, *o*) portion. The former is chiefly muscular (fig. 94, *f*, *h*). It contains the organs of sense, mastication, and deglutition, and supports the organs of prehension and the chief powers of locomotion. It is called the "head" (fig. 97, *a*, *c*). The pallial division (fig. 97, *a*, *bb*), termed "trunk," or abdomen, consists of a more or less muscular sac or mantle, with a transverse anterior aperture, from which an expiratory siphon or "funnel" projects; and it contains the respiratory, generative, and digestive organs. The branchiæ are pinnatifid and concealed. The sexes are distinct. All Cephalopods are oviparous. As far as observation has extended, a part only of the yolk is assimilated into a germ-mass; and development is progressive, without metamorphosis, to the completion of the miniature Cephalopod *in ovo*.[1]

Order I.—TETRABRANCHIATA, Owen.

Branchiæ in two pairs, without branchial hearts; funnel formed by a convolute muscular plate; mantle thin, and feebly muscular; no ink-bag; arms very numerous, hollow, and with retractile tentacula; mandibles with calcareous tips; eyes pedunculate; head retractile, within a shell, which is external, many-chambered, siphunculate, the outer layers porcellaneous, the inner layers and partitions nacreous.

Genus Nautilus, Linn.—Shell discoid, symmetrical, with the apertures, sutures, and siphuncle, simple. The anatomical characters of the order are also those of the sole existing genus. It is the representative of numerous genera and species of chambered Cephalopods that abounded in the Palæozoic and Secondary periods, but which seem to

[1] See Kölliker's masterly *Entwickelungsgeschichte der Cephalopoden*, 4to, 1844.

have been superseded, as carnivorous Mollusks, in the Tertiary and recent periods, by the Pectinibranchiate Gastropods.

The organization of the Pearly Nautilus (*Nautilus Pompilius*), first made known in 1832,[1] throws light upon that of the extinct *Ammonites, Orthoceratites, Lituites, Turrilites*, &c., and possesses, therefore, an extrinsic interest, besides that which arises from the peculiar modifications of Molluscous structure which it presents. The soft parts (fig. 94, *t*, *o*) form an oblong mass, divided by a constriction into two slightly unequal segments; the posterior (*m* to *o*) is smoothly rounded, soft, and membranous, containing the viscera, and adapted to the last chamber of the shell; the anterior (*m* to *t*) is densely muscular, and includes the organs of sense and locomotion. It can be retracted within that chamber, as is shown in fig. 94, which is here selected as

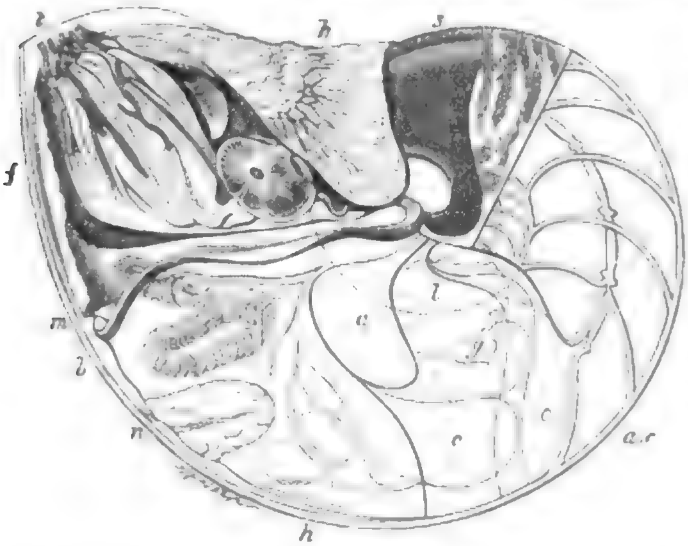


Fig. 94.
Nautilus Pompilius.

showing the relations of the soft parts of the Pearly Nautilus to the shell in a specimen in which those relations had never been disturbed. The subject dissected and described by Professor Owen in 1832 consisted of the soft parts only, and their relations to the shell were determined on anatomical grounds, as they are illustrated in plate 1 of the *Memoir* above cited. The author's deductions were contested by Dr Gray, in the *Philosophical Transactions* for 1833, p. 774; by Professor R. Grant, in the *Lancet*, 1833, pp. 506 and 509; and by M. de Blainville, in the *Nouvelles Annales du Muséum*, tom. iii., p. 7. The second specimen of the Pearly Nautilus, which was brought to Europe in 1838, consisted also of the soft parts only. It was described by Professor Valenciennes,[2] who adopted Professor Owen's conclusions as to their relative position to the shell. The third specimen, brought to England by Captain Sir Edward Belcher, R.N., in 1842, was contained in the shell, but not attached. It had been taken out, and been replaced in the position it originally occupied, according to Sir E. Belcher's convictions. That position agreed with the figure in plate 1 of Professor Owen's *Memoir*. The present figure, from a drawing in the possession of Dr Gray, F.R.S., is from a specimen in the British Museum, naturally attached to and retracted within the shell, a portion of which has been removed to show the soft parts; and the principal viscera are indicated in outline.

The mantle is very thin upon the posterior part of the body. It is continued backwards in the form of a slender tube, which penetrates the calcareous siphon in the septum closing the occupied chamber behind, and is thence continued, as the membranous siphon, through all the other divisions of the shell to the central nucleus. As the mantle advances towards the anterior part of the abdomen it increases in thickness, becomes more muscular, extends freely outwards (*m*), and forms a wide concave fold in the dorsal aspect, which is reflected over the black-stained involuted convexity of the shell *s*. The margin or collar of the mantle is continued downwards and forwards on each side with a sinuous outline, and is perforated below for the passage of the muscular expiratory and excretory tube called the "funnel" *f*. In the female *Nautilus* the nidamental glands form two circular convexities on the ventral surface of the abdomen, behind which the mantle is encircled by a thin layer of brown matter, like the periostracum, which is very narrow above and below, but expands on each side into a broad plate *a*, corresponding in size and form with the surfaces of attachment of the two great muscles for adhesion to the shell.

The somatal division forms a strong and wide sheath, containing the mouth and its more immediate appendages; its inner surface is for the most part smooth, the outer one divided and extended into many parts or processes. The chief of these forms a broad triangular muscular plate or hood *h*, covering the upper part of the head, and presenting a middle and two lateral superficies; the former being traversed by a median longitudinal furrow, indicating the place of confluence of the two large hollow tentaculiferous processes of which it is composed. The back part of the hood is excavated for the lodgment of the involuted convexity of the shell, and the above-described fold of the mantle *s* covering it. Each side of the head supports a group of perforated processes or digitations *t*, the largest of which is next the hood, and the rest decrease in size as they descend in position. Exclusive of the short subocular perforated process, and of the confluent pair forming the hood, the digitations are eighteen in number on each side, and are of a conical form; each contains a long and finely annulated tentacle, with the inner surface supporting narrow, close-set transverse plates.

To the nineteen tentacula which are supported by the confluent and free digitations on each side of the head, two others must be added, which project from very short sheaths, one before, the other behind, the eye; the lateral transverse incisions are deeper in these than in the digital tentacles. The eyes are about the size of hazel-nuts, and are attached each by a short peduncle to the side of the head, behind the digitations, and a little below the margin of the hood. The inferior surface of the oral sheath is excavated for the lodgment of the infundibulum *f*. It appears that, amongst other remarkable peculiarities of the *Nautilus*, is its possession of external ears. Mr Macdonald writes:—"Both Professors Owen and Valenciennes noticed that the hollow subocular process of their specimens of *Nautilus Pompilius* was not tentaculiferous, and I may be permitted to say that this was also true of several specimens of *Nautilus Pompilius*, and one of *N. macromphalus* examined by me. But there is still another matter worthy of remark with reference to this process, namely, that its cavity may be traced downwards, inwards, and a little forwards, to within about the

[1] Owen, *Memoir on the Pearly Nautilus* (*Nautilus Pompilius*, Linn.), &c., 4to, 1832.
[2] Nouvelles recherches sur le Nautile flombé, *Archives du Muséum*, 4to, 1839.

twentieth of an inch of the auditory capsule; indeed it would appear as though provision had been made for the entrance of sonorous waves through a rudimentary external ear." "The interior of the tube is lined with a glandular membrane, thrown into small folds disposed longitudinally."[1]

The mouth is armed with two mandibles, shaped, as in other Cephalopods, like the beak of a parrot reversed, the lower mandible overlapping and curving upwards beyond the upper one. Both mandibles are horny, with their tips encased by dense calcareous matter, and their base implanted in the thick muscular parietes of the mouth.

They are immediately surrounded by a circular fleshy lip with a plicated anterior border, external to which there are four broad flattened processes continued forwards from the inner surface of the oral sheath, two of which are superior, posterior, and external, the other two are inferior, anterior, and more immediately embracing the mouth; the latter are connected together along their inferior margins by a middle lobe, the inner surface of which supports a series of longitudinal lamellæ. On the inner surface of the oral sheath beneath these processes there are two clusters of soft conical papillæ, and on each side of these a group of lamellæ. Each of the four processes, which are called "labial," is pierced by twelve canals, the orifices of which project in the form of short tubular processes from the anterior margin, and each canal contains a tentacle similar to, but somewhat smaller than those of, the digitations. Thus the number of tentacula with which the Pearly Nautilus is provided, amounts to not less than ninety, of which thirty-eight may be termed digital, four ophthalmic, and forty-eight labial.

All Cephalopods have an internal cartilaginous skeleton: that of the *Nautilus* is confined to the inferior surface of the head; no part of it extends above the œsophagus. Viewed sideways, it presents a triangular form; a portion of the annular brain is protected by a groove on the upper surface of the cartilage; two strong processes are continued from its anterior and superior angles into the crura of the infundibulum, giving origin to the chief muscles of that part. Two other thinner processes are continued backwards, and curve inwards and downwards: they give origin to the two great muscles which pass from the internal to the external skeleton, or, in other words, attach the animal to the shell.

The muscular fibres of the "soma" or oral sheath arise from the whole of the anterior or outer part of the internal skeleton. The muscular structure of the funnel presents a much greater development than in the naked Cephalopods; and, from its relation to those masses which, on the one hand, attach the soft parts to the shell at *a*, and, on the other, connect the head to the trunk, we may conclude that the funnel is the principal organ of natation, and that the *Nautilus* is propelled, like the *Octopus*, by a succession of jerks occasioned by the re-action of the respiratory currents upon the surrounding water. The orifice of the funnel is guarded by a valve.

The principal masses of the nervous system are concentrated in the head, and are more or less inclosed by the cephalic cartilage. The superœsophageal portion is a thick transverse rounded chord, connected at each extremity with three ganglionic masses; the middle and superior of these (ophthalmic ganglions) supply the eyes; the anterior and inferior pair are united below the œsophagus; the posterior and inferior pair form a second œsophageal nervous centre. The nerves given off immediately from the superœsophageal mass supply the muscular and other parts of the mouth, and have small buccal ganglions developed upon them. The anterior œsophageal ring gives off principally the nerves to the tentacula, and the two median ones are connected with a ganglion, which supplies the tentacula of the inferior labial processes and the lamellated organs on that part of the oral sheath. The tentacular nerves are continued, like those of the arms in the higher Cephalopods, along the middle of the tentacle, attached by loose cellular tissue to the vessels of the part. The posterior collar gives off numerous nerves of a flattened form, which supply the muscles of the shell. The respiratory nerves form a small ganglion at the base of each pair of gills, from which branches are sent to those organs, to the heart, and to the appendages of the veins. A plexus of more delicate visceral nerves is continued backward along the interspace of the branchial nerves, and the chief branches are connected with a small ganglion situated between the cardiac and pyloric orifices of the stomach.

The calcareous extremity of the upper mandible is sharp-pointed and solid to the extent of five lines. The lower mandible is sheathed with a thinner layer of the hard white substance, which forms a dentated margin. The fossils termed "rhyncholites" are the homologues of these calcareous extremities of the beak in cognate extinct Cephalopods. The muscular subspherical mass, which supports and moves the mandibles, is provided with four retractors, and can be protruded by a strong semi-circular muscle, which is continued from the margin of one of the inferior labial processes over the mandibles and their retractor muscles to the labial process of the opposite side.

The glottidium is supported by a horny, slightly curved, and transversely striated plate. The fleshy substance forms three distinct papillose caruncles anteriorly, or "tongue" proper, into which the retractor muscles are inserted. The tooth-strap supports four longitudinal rows of recurved spines, behind which the surface of the glottidium is again soft and papillose. Two broad duplicatures of mucous membrane project forwards from the sides of the pharynx; they each include a simple layer of salivary follicles, the secretion of which escapes by a single perforation in the middle of the process.

The lining membrane of the pharynx is disposed in numerous longitudinal folds, where it begins to contract into the œsophagus. This tube, having passed through the nervous collar, dilates into a capacious crop (fig. 94, *c*), from the bottom of which a contracted canal, half an inch in length, is continued to an oval gizzard *g*. The intestine commences near the cardiac orifice, and soon communicates with a small, round, laminated pouch, through which the biliary secretion passes to the intestine. This tube forms two abrupt inflections, and terminates in the branchial cavity near the base of the funnel close to the proboscidian end of the oviduct.

The epithelium of the œsophagus and ingluvies is developed into a thick cuticular membrane, with minute ridges in the gizzard. In the specimen dissected by the writer, the crop and gizzard were laden with the fragments of a small crab, the pieces being more comminuted in the gizzard.

The liver *l* is a bulky gland, extending on each side of the crop as low down as the gizzard; it is divided into four lobes, connected posteriorly by a fifth transverse portion: the lobes are subdivided into numerous lobules of an angular form. The secretion of the bile is derived, as in other Mollusks, from arterial blood; it is conveyed from the liver by two main trunks, which unite into one duct, about two lines from the laminated sac. The bile, having entered the sac, is diverted by a peculiar development and disposition of one of the laminæ from flowing towards the gizzard. The follicular structure of this and the other folds of membrane indicate their glandular character; and the entire laminated pouch may be considered as a more developed form of pancreas than the simple cæcum which represents that gland in some of the Gastropods. No other foreign

[1] *Proceedings of the Royal Society*, 1856, p. 381.

Cephalopoda.

secretion enters the alimentary canal, as there is not any ink-gland in the Pearly Nautilus.

The heart and large vessels, with their follicular appendages, are contained in a large cavity opposite the letter *h*, subdivided into several compartments. Some of these contain groups of follicles developed from the veins proceeding to the branchiæ, and they communicate by small apertures with the pallial cavity. Sea-water is thus admissible into the pericardium, and thence into the siphuncle. Any matter excreted from the venous follicles, which seem homologous with the so-called "renal gland" of lower Mollusks, may escape by the above apertures into the pallial cavity. The principal venous trunk, returning the blood from the soma, is separated from the abdominal cavity by a layer of decussating, chiefly transversely disposed, muscular fibres. There are several small intervals left between the muscular fibres and corresponding round apertures in the venous tunics. These communications with the general abdominal cavity are similar to that discovered by Cuvier in the *Aplysia*. M. Valenciennes detected the same structure in the specimen of the *Nautilus* dissected by him. The blood from the diffused abdominal venous sinus is thus received into the chief vein proceeding to the gills.

The branchial circulation may be considered to commence when the blood again begins to move from trunk to branches, four of which trunks are continued from the terminal venous sinus to convey the carbonized blood to the four gills, of which there is a larger and a smaller one on each side. Each pair of gills, situated opposite the letter *b* in fig. 94, is connected by a common peduncle to the inner surface of the mantle; the larger branchia consists of a central stem supporting forty-eight vascular plicated lamellæ on each side; the smaller branchia has thirty-six similar lamellæ on each side.

The four vessels continued from the venous sinus have attached to them, in their course to the gills, the clusters of glandular follicles above mentioned. The veins extend beyond the follicles each to the root of its respective gill, where it receives a small vein. At this part there is a valve which opposes the retrogression of the blood; the vessel, which may now be termed branchial artery, penetrates the root of the gill, and dilates into a wider canal, which is continued through the soft white substance forming the branchial stem. A double series of branches are sent off from the lateral lamellæ, which ramify and subdivide to form the capillary plexus, from which the returning vessels terminate in the branchial vein. These veins quit the roots of the gills, and return to terminate at the four corners of a subquadrate transversely elongated ventricle. From this ventricle two arteries arise, one anterior, the other posterior, of large size, and with a muscular bulb at its commencement, with which is connected an elongated, pyriform, apparently closed sac.

The female organs of the *Nautilus* consist of an ovary, an oviduct, and, as in the Pectinibranchiate Gastropods, of an accessory glandular nidamental apparatus. The ovary is situated on the right side of the gizzard in a peritoneal cavity peculiar to itself. It is an oblong compressed body, one inch and a half in length, and an inch in breadth; convex towards the lateral aspect, and on the opposite side having two surfaces sloping away from a middle longitudinal elevation. At the anterior and dorsal angle there is an orifice about three lines in diameter, with a puckered margin, which conducts into the interior of the ovary. It is filled with numerous oval ovisacs of different sizes, which are attached by one extremity to the ovarian capsule, but are free and perforated at the opposite end. The oviduct terminates at the base of the funnel near the anus. The nidamental gland consists of numerous close-set pectinated laminæ. An interesting account of the dissection of a male *Nautilus Pompilius* has been contributed by Professor Van der Hoeven to the fourth volume of the *London Zoological Transactions*, p. 21. Professor Vrolik has published a good description and figures of a specimen in his collection, from Amboyna, in the tenth volume of the *Mémoires de la Société Linnéanne de Normandie*, 1855.

In contrasting the organization of the *Nautilus* with that of the inferior Mollusca, already treated of, we find the main advance to have been made in the organs of animal life.

A true internal skeleton is established in the *Nautilus*, and thus the lowest Cephalopod offers an approximation to the vertebrate type, which not even the highest of the articulate series had attained. Perfect symmetry now reigns throughout the animal and vital organs. The muscular system forms a larger proportion of the body, with various arrangements and complications unknown in the lower Encephalous Mollusks. The respiratory tube, though still completed by the overlapping, not by the coalescence, of its side-walls, has received an enormous development as contrasted with the siphonated Trachelipods; and, by its powerful muscles, and their firm cartilaginous basis of attachment, would seem to be endowed with a new function, in relation to propelling the Cephalopod with its testaceous dwelling through the sea.

The nervous centres concentrated in the head have received a marked increase of bulk, which, nevertheless, is still manifested more strongly in the inferior masses, and especially in the anterior subœsophageal ring than in the superior or cerebral part. Here, however, we find for the first time in the Molluscous series, especial ganglions subordinated to the greatly enlarged organs of vision.

The organs of reptation, which had progressively advanced (as Lamarck's denomination of the higher Gastropods indicates) towards the head, are exclusively attached to that part in the *Nautilus*, and project from before the eyes and mouth. The mouth, besides its jaws and spiny tongue, is now served by organs of prehension; and it is most interesting to observe that these cephalic, prehensile, as well as exploratory, tentacula, at their first appearance manifest the vegetative character in their multiplied repetition and comparative simplicity, compared with their homologues in the Dibranchiate Cephalopods.

Some of the Gastropods have a pair of jaws working upon each other, but in the horizontal plane, as in insects. In the *Nautilus* they are opposed to each other vertically, as in the vertebrate series, and they present a form which is repeated amongst fishes by the *Scari*, amongst reptiles in the *Chelonia*, and almost universally in the class of Birds. The close resemblance to the latter class which the *Nautilus* offers in the modifications of the alimentary canal is sufficiently striking, but hardly more so than some of the *Bryozoa* present, in which radiated animalcules may be discerned one of the roots of the great Molluscous branch of the Animal Kingdom.

In the very few Conchiferous Gastropods that are able to swim the shell is of diminutive size, of a simple form and structure, and of an extremely light and delicate texture. The strong and muscular occupant of the Pearly Nautilus shell would seem to have that abode adapted for occasional natation by the air-chambers and siphuncle. The first living specimen which was captured and brought to Europe in a state fit for dissection was observed *floating on the sea with the shell upwards*,[1] and was obtained by the boat-hook. The parts of the shell, progressively vacated during the growth of the animal, are successively partitioned off by smooth plates concave towards the outlet. The formation of these proceeds from the circumference to the centre, and there meeting with the siphuncular

[1] Owen, *Memoir*, ut supra, 4to, p. 7.

Cephalopoda.

prolongation of the mantle, which retains its primitive connection with the shell-nucleus, calcification is continued backwards for a short distance around that process, which now forms the membranous siphon, and acquires the partial protection of the calcareous tube. An air-tight chamber is thus formed, traversed by the siphon; by a repetition of the same processes a second chamber is formed, included within two perforated septa; and similar, but wider partitions continue to be added, concurrently with the formation of the new layers which extend and expand the mouth of the shell, until the animal acquires its full growth, which is indicated by the body having receded for a less distance from the penultimate septum before the formation of the last septum is begun.

The periodical formation of these septa in the progress of growth is analogous to that of the projecting external plates in the Wendletrap, and of the rows of spines in the *Murex;* but these external processes consist of the opake calcareous layer of the shell, whilst the internal processes in the *Nautilus* consist of the nacreous layer like the septa in the *Turritella.* Thus the embryo *Nautilus* at first inhabits a simple shell like that of most univalve Mollusca, and manifests, according to the usual law, the most general type at the early stage of its existence; although it soon begins, and apparently before having quitted the ovum, to take on the special form.

In acquiring the camerated structure of the shell, the *Nautilus* gains the power of rising from the bottom, and the requisite condition for swimming; by the exhalation of some light gas into the deserted chambers, it attaches to its otherwise too heavy body a contrivance for ascending in its atmosphere, as we ascend in ours, by the aid of a balloon. But the *Nautilus,* superior to the human aeronaut, combines with the power of elevating and suspending itself in the aqueous medium, that of opposing its currents and propelling itself at will in any direction. It possesses the latter essential adjunct to the utility of the balloon as a locomotive organ, by virtue of the muscular funnel, through which it ejects into the surrounding water, doubtless with considerable force, the respiratory currents.

It appears that the proportion of the air-chambers to the dwelling-chamber of the *Nautilus* and its contents is such as to render it of nearly the same specific gravity as the surrounding water. The siphon, which traverses the air-chambers, communicates with the pericardium, and is most probably filled with fluid from that cavity. It certainly conducts small blood-vessels, which are essential to the maintenance of the vitality of the chambered part of the shell.[1]

In air a large and perfect shell of the *Nautilus Pompilius* weighed six ounces and a-half avoirdupois; it required an additional weight of one ounce seven drams to sink it in water. The soft parts of a female Pearly Nautilus weighed, in air, five ounces; but the specific gravity, including the contents of the crop, was nearly that of sea-water.

The power by which the *Nautilus* alters its specific gravity is probably like that possessed by the fresh-water testaceous Gastropods, depending chiefly upon changes in the extent of the surface which the soft parts expose to the water, according as they may be expanded to the utmost, and spread abroad beyond the aperture of the shell, or be contracted into a dense mass within its cavity. The *Nautilus* would likewise possess the additional advantage of producing a slight vacuum in the posterior parts of the chamber of occupation which is shut out by the horny cincture and muscles of adhesion from the rest of that cavity; and it is possible that the gas in the last air-chamber might expand as the *Nautilus* protrudes from the shell, and be in the same degree condensed as it forcibly drew itself back.

Whatever additional advantage the existing *Nautilus* might derive, by the continuation of a vascular organized membranous siphon through the air-chambers, in relation to the maintenance of vital harmony between the soft and testaceous parts, such likewise must have been enjoyed by the numerous extinct species of the Tetrabranchiate Cephalopods, which, like the *Nautilus,* were lodged in chambered and siphoniferous shells.

Sp. *Nautilus Pompilius* (Pearly Nautilus).—This species ranges from the Persian Gulf and Indian Ocean, to the Chinese Seas and Pacific.

Sp. *Nautilus scrobiculatus* (Umbilicate Nautilus).—Hab. the warmer latitudes of the South Pacific.

Sp. *Nautilus macromphalus* (Widely Umbilicate Nautilus).—Hab. New Caledonia, and neighbouring isles of the South Pacific.

It is not certain to which of the above species the following remark, on their abundance, applies:—"The Pearly Nautilus is so abundant, that its shell serves the Papouans of Port Praslin in 'Novelle Bretagne,' and throughout the Papouan Archipelago, as a scoop to bale out the water from their canoes; the debris of the shell cover the shores of those islands."[2]

If the *Nautilus* extended itself in a straight line during its growth, instead of revolving round an imaginary axis, a straight conical shell would be produced, with the chambered part divided by simple septa concave next the outlet. Such are, in fact, the characters of the fossil shells called *Orthoceratites.*

The margins of the septa of the shell in all the existing species of *Nautilus* are slightly sinuous, which makes the surface next the aperture of the shell convex at one part and concave at another. In an extensive genus of extinct chambered shells called *Ammonites,* the sinuosity of the margins of the septa is much greater, and most of the surface next the outlet is convex: the siphon perforates the septa at their centre in extremely few species, and in the rest is situated at that margin which is next the outer curve or circumference of the shell. Certain chambered shells thus characterized are straight, like the *Orthoceratites,* but generally compressed, with their numerous septa joining the outer shell by foliated dentations: they are termed *Baculites.* In the true *Ammonites* the shell is discoid, and coiled upon itself as in the *Nautilus;* but it is strengthened by arched ribs and dome-shaped elevations on the convex surface, and by the tortuous windings of the foliated margin of the transverse partitions. Separate casts of the interior of the chambers are not unfrequently obtained, which have become detached by the solution of the calcareous walls and septa of the shell, or are held together by the dove-tailed lobes of the margins of the chambers.

The *Turrilite* is essentially an *Ammonite* disposed in spiral coils. The *Hamites* and *Scaphites* are other modifications of the outward form of similarly-constructed chambered shells: in the former the small extremity of the shell is curved, the rest being straight; in the latter both ends are curved towards each other like those of a canoe.

With none of these species has there ever been found a trace of the ink-bag; a part, indeed, of so delicate a texture that some surprise may be excited that any evidence of its existence could be met with in a fossil state. Not only the ink-bag, but the muscular mantle, fins, and cephalic arms, of extinct Cephalopods, with chambered shells, have been discovered in Oolitic strata, which have determined such fossil shells to belong to the second and higher order of Cephalopods.[3]

Order II.—DIBRANCHIATA, Owen.

Branchiæ two, forming a pair, each with a branchial

[1] Owen, *Memoir,* ut supra, 4to, p. 47.

[2] Duperrey, Zoology of the *Voyage de la Coquille,* p. 246.

[3] "On Belemnites with their soft parts," *Philos. Trans.,* 1844, p. 65.

heart; funnel an entire tube; mantle muscular; an ink-bag; eight non-retractile acetabuliferous arms, with two long additional tentacles in most; eyes sessile; beak horny; shell internal (save in the females of one genus).

Compared with the *Nautilus*, the cephalic organs of prehension in all Dibranchiates are much reduced in number, the external ones, continued from the oral sheath, not exceeding eight, as in figs. 97, *c*, and 100, *c*, to which, in most of the genera, is added a pair of internal and much longer tentacula, as in figs. 97 and 100, *d*. The arms are much increased in size and of a more complicated structure, supporting on their internal surface numerous suckers, and sometimes connected together by a powerful muscular web. The eyes are much larger and more complex, are no longer pendunculated, but lodged in orbits (fig. 97, *ee*). The mouth (fig. 96) is armed with two piercing and trenchant horny jaws, *c*, resembling in shape and in their vertical movements those of the *Nautilus*. The gills (fig. 95, *g*) are two in number, each with a ventricle *i* expressly appropriated to the branchial circulation; the systemic circulation having a single muscular ventricle *h*, as in the *Nautilus*. The infundibulum *b* is a complete muscular tube, shaped like an inverted funnel. They possess a gland and membranous receptacle *p* for secreting and expelling an inky fluid. The sexual organs are in distinct individuals, as in the Tetrabranchiate order. All the species of both orders of Cephalopods are aquatic and marine.

The Dibranchiate order may be subdivided into two tribes; the one provided with the eight ordinary arms and the two longer tentacles, hence called *Decapoda* (fig. 97); the other tribe without the tentacles, and called *Octopoda* (fig. 101).

The various forms of the extinct *Belemnitidæ* constituted one family in the Decapod tribe. The little *Spirula*, characterized by a less complex, but internal chambered shell, is the type of a second family. The cuttle-fish (*Sepia*, fig. 97), known by its internal calcareous shell (fig. 98), which feebly represents that of the *Belemnite*, exemplifies a third family of Decapods called *Sepiadæ*. The common calamary (*Loligo*), in which the internal shell is reduced to a horny quill-shaped plate, represents the fourth and most extensive family of the present tribe, which I have called *Teuthidæ;* and in which one genus (*Enoploteuthis*) had the caruncle of its acetabula produced into horny claws. In all the Decapods the mantle supports a pair of fins, and the siphon is generally provided with a valve.

In the tribe *Octopoda* fins are rarely developed from the mantle; but the eight ordinary arms are longer, thicker, and are united together by a broader web, which forms a powerful organ for swimming in a retrograde direction. One family in this tribe (*Testacea*) is represented by the genus *Argonauta* (fig. 102), in which, in the female sex, the first or dorsal pair of arms is dilated at its extremity into a broad thin membrane, like the mantle in the testaceous Mollusks; by means of these membranes the animal, in fact, forms for itself an extremely light, slightly flexible, and elastic, but calcareous, symmetrical shell, which is simple, and not divided into chambers; the vacated portion communicating with the rest, and being used by the inhabitant as the receptacle for the eggs (fig. 103). The siphon is without a valve, but is articulated at its base on each side to the inner surface of the mantle. The second family of the Octopods is termed *Nuda*, the species not being provided with an external shell (fig. 101). The first pair of arms is elongated, and contracts to a point: the funnel or siphon is without an internal valve or external joints. The rudimental shell is represented by two short styles, encysted in the substance of the mantle. The typical genus of this family is termed *Octopus*, in which the arms are provided with a double alternate series of sessile acetabula. In a second genus, *Eledone*, the arms are provided with a single series of acetabula. In the *Sciadephorus* a pair of filaments project between each of the suckers.

The skin of the naked Cephalopod is generally thin and lubricous, and can be more easily detached from the subjacent muscles than in the inferior Mollusks. In some of the smaller Cephalopods it is semitransparent; it is densest in the Calamaries, in which the epidermal system is most developed, as is exemplified in the horny rings or hooks upon the acetabula. In the Octopods the epidermis is reflected over the interior of the acetabula without being condensed into horn. Upon the body the epiderm may generally be detached in the form of a thick white elastic semitransparent layer. The second, or pigmental layer of the skin, analogous to the *rete mucosum*, consists of numerous cells of a flattened oval or circular form, containing coloured particles suspended in a fluid. The colour is rarely the same in all the cells; the most constant kind generally corresponds more or less closely with the tint of the inky secretion. In the *Sepia* there is a second series of vesicles containing a deep yellow or brownish pigment: in the *Loligo vulgaris* there are three kinds of coloured vesicles, yellow, rose-red, and brown; in the *Octopus vulgaris* there are four kinds of vesicles, red, yellow, blue, and black. In the skin of the *Argonauta* all the colours which have been observed in other Cephalopods are present, and contained in their appropriate cells. These cells possess the power of rapid alternate contractions and expansions, by which the pigment can be driven into the deeper parts of the corium, or brought into contact with the semitransparent epiderm. If the skin of an *Octopus* be slightly touched, the colour will be accumulated, gradually or rapidly, like a cloud or a blush upon the irritated surface. The *Argonaut* strongly exemplifies this chameleon-like power of change of colour.

The sole locomotive organs in the ordinary Octopods, and the sole prehensile organs in all the Dibranchiata are the appendages developed from the head, termed "arms," "feet," and "tentacles." They have no true homology with the locomotive members of the Vertebrata, but are analogous to them, inasmuch as they relate to the locomotive and prehensile faculties of the animal.[1]

The eight arms of the *Octopus* commence by a hollow cone of muscular fibres attached by a truncated apex to the anterior part of the cephalic cartilage. The fibres are for the most part oblique, and interlace with one another in a close and compact manner, as the cone advances and expands to form the cavity containing the mandibulate mouth, at the anterior extremity of which they are continued forward, and separate into eight distinct portions which form the arms. The development of the eight external arms bears an inverse proportion to that of the body; they are longest in the short round-bodied *Octopi*, and shortest in the lengthened Calamaries and Cuttle-fishes, in which the two elongated retractile tentacles are superadded by way of compensation. These latter organs are not continued from the muscular cone which corresponds with the cephalic sheath in the *Nautilus*, but arise, like the internal labial processes in that Cephalopod, close together from the cephalic cartilage, internal to the origins of the ventral pair of arms. They proceed at first outwards to a large membranous cavity situated anterior to the eyes, and emerge between the third and fourth arms on either side.

The complex mechanism of the suckers of the arms is under the most complete control of the predatory Cephalopod. Mr Broderip states, that he has attempted, with a hand-net, to catch an *Octopus* that was floating within sight

[1] Geoffroy St Hilaire regarded the cuttle-fish as a vertebrate animal bent double, with the approximated arms and legs extending forwards.

with its long and flexible arms entwined round a fish which it was tearing to pieces with its sharp hawk's bill; the Cephalopod allowed the net to approach within a short distance of it, before it relinquished its prey, when in an instant it relaxed its thousand suckers, exploded its inky ammunition, and rapidly retreated under cover of the cloud which it had occasioned, by rapid and vigorous strokes of its circular web.

The Cephalopods which frequent the more open seas, and which have to contend with more agile and powerful fishes, have still more complicated organs of prehension. In the *Calamary* the base of the piston of the sucker is inclosed in a horny hoop with a dentated margin. In the *Onychoteuthis* the margin is produced into a long, curved, sharp-pointed claw. These formidable weapons are sometimes clustered at the expanded terminations of the tentacles (fig. 100, *f*), and in a few species are arranged in a double alternate series along the whole internal surface of the eight ordinary arms, as they were in the extinct *Belemnite*.

In connection with the uncinated acetabula at the extremities of the long tentacula of the hook-squids, may be observed a cluster of small simple unarmed suckers at the base of the expanded part. When these parts in each tentacle are applied to one another, they become locked together (fig. 100, *e*), and the united strength of both the peduncles *d* is thereby more effectually brought to bear upon any resisting object which may have been grappled by the terminal hooks. This is a very striking mechanical contrivance: human art has remotely imitated it in the fabrication of the obstetrical forceps, in which either blade can be used separately, or by the interlocking of a temporary joint be made to act in combination.

The brain (fig. 95, *a*) is inclosed in a cartilaginous cranium, together with a portion of the œsophagus, from which it is separated by the membrane analogous to the *dura mater*. Between that part of the fibrous membrane which lines the cerebral cavity and the *pia mater* covering the brain, there is an intervening space filled with a gelatinous arachnoid tissue. In the cuttle-fish, the superœsophageal cerebral mass *a* consists principally of a cordiform body, superficially divided into two lateral lobes by a median longitudinal furrow. From the lower and lateral parts of this body proceed the short and broad optic nerves, which constitute the peduncles of the large reniform optic ganglions, and upon each peduncle there is placed a small spherical medullary tubercle. These tubercles exist also in the Calamaries, but appear not to be present in the Octopods.

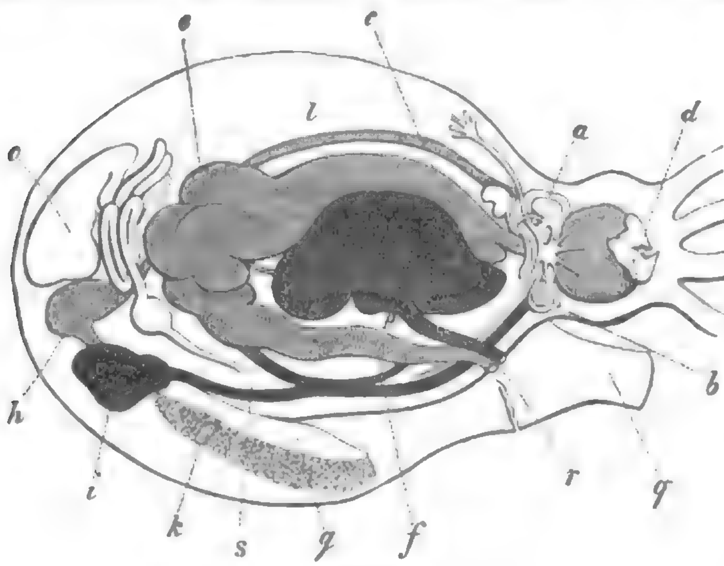


Fig. 95.

Plan of anatomy of Dibranchiate.

From the inferior and anterior parts of the superœsophageal mass, a thick cord descends on each side of the œsophagus, unites with its fellow, and dilates below that tube to form the anterior subœsophageal ganglion, from which the nerves of the feet and tentacles arise. Two broader bands descend from the superœsophageal mass behind the preceding, and form, by a like enlargement and union, the posterior œsophageal body, which blends laterally with the anterior one, and forms with it a large mass with a central perforation. Four short and slender chords, two of which are continued from the anterior apices of the optic lobes, and two from the anterior subœsophageal lobes, converge forwards and unite to form a round flattened ganglion, which is closely applied to the back part of the fleshy mass of the mouth above the pharynx, from which are sent off the nerves to the different parts of the mouth. Two filaments from the pharyngeal ganglion descend to join a pair of ganglions below the mouth, homologous to the labial ganglions of the *Nautilus*. The nerves of the arm proceed from the anterior and inferior subœsophageal ganglion, and correspond in number to the organs which they supply, being eight in the *Octopoda*, and ten in the *Decapoda*. The nerves answering to those of the shell muscles in the *Nautilus* form a single large pair, arising from the posterior angles of the subœsophageal mass, and after a certain course outwards and backwards they expand into large stellate ganglions, from which the nerves of the mantle and of the pallial fins are derived. The branchial and visceral nerves and ganglions correspond pretty closely with those in the *Nautilus*.

With respect to the parts of the brain in the Vertebrata which are represented by the cephalic nervous masses in the Dibranchiate Cephalopods, we may regard the cordiform superior mass, which is principally in communication, and co-exists with the large and complex eyes, as the homologue of the optic lobes. The smaller superœsophageal mass, anterior to the optic lobes in the *Octopus* and some other Cephalopods, may represent an olfactory lobe. The large subœsophageal nervous mass, since it gives origin to the brachial nerves, to the acoustic and respiratory nerves, and to those two large moto-sensory columns which represent, by their structure, position, and distribution, the spinal chord of the Vertebrata, must be regarded as the representative of the medulla oblongata: it is obviously the part of the nervous centre which is most intimately connected with the vitality of the animal, and which is therefore here, as in the higher animals, the deepest seated and best protected part of the nervous system.

The Cephalopods are predatory and carnivorous animals. The curved, pointed, and trenchant mandibles (fig. 96, *c*, *c*), are encased upon a dense muscular cushion, *e*, and are protected by an outer lip *a*, and an inner lip *b*. The glottidium retains the true complex molluscous type (compare with fig. 29); but a greater proportion of it is uncovered by the tooth-strap, and forms soft caruncles suggestive of the possession of the faculty of taste. Their retractor muscle is shown at *i*. A fin is represented as in the duct of the salivary gland. In most of the Dibranchiata a second and larger pair of salivary glands is situated on each side of the œsophagus, at the commencement of the abdominal or hepatic cavity; their ducts unite to terminate below the tongue in the concavity of the lower mandible.

The peritoneal membrane is divided and disposed as in the *Nautilus*, in order to form special receptacles for the

Cephalopoda.

different viscera. The œsophagus is narrower than in the *Nautilus*, and provided with longitudinal plicæ: it dilates

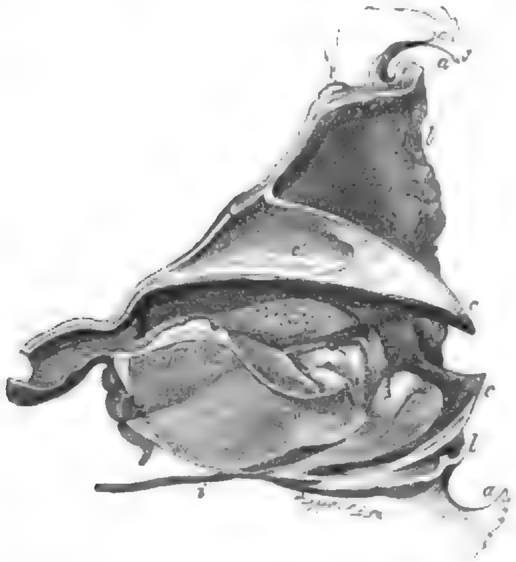


Fig. 96.

soon after having passed through the cranium into a long ingluvies, forming a large cul-de-sac (fig. 95, *c*), at its commencement in both the *Octopus* and *Argonauta*; but in the Decapods it continues narrow and of uniform breadth to the stomach. This cavity (fig. 95, *e*) is an elongated sac, presenting, in the disposition of its muscular fibres, in the proximity of the cardiac and pyloric orifices, and in the thickness of the epithelial lining, the usual characters of the gizzard. The intestine, at a short distance from the pylorus, communicates with a glandular and laminated sac *q*, homologous with that in the *Nautilus*, and presenting a similar globular form in the *Rossia* and *Loligopsis*; but elongated and spirally convoluted in the *Sepia* and *Loligo*. It receives the biliary secretion between two broad lamellæ, as in the *Nautilus*. The intestine is very short in all the Dibranchiata. In the *Octopus* it is bent upon itself (fig. 95, *r*), as in the *Nautilus*; but in the *Sepia* and *Loligo* it is continued forwards in a straight line, as at *f* (fig. 95), from the stomach to the vent. Its internal membrane is longitudinally folded, but is smooth at the short tract beyond the entry of the duct of the ink-bag; its termination is constricted either by the muscular fibres of the branchial septum, or by those which connect together the pillars of the funnel. In the Decapods provided with fins for swimming forwards, the anus can be closed by triangular fleshy valves; and in some species these are modified into the form of antennal filaments.

The liver is of large size in the Dibranchiata (fig. 95), but of more simple form than in the *Nautilus*. In the *Sepia* it is divided into two lateral lobes, which are notched at the upper extremity; in the *Onychoteuthis* it is a simple, elongated, compressed lobe, with undivided extremities; in the *Octopus* it forms a single oval mass, flattened anteriorly; in the *Eledone* it is spherical, corresponding with the ventricose visceral sac. In the two latter genera the ink-bag (fig. 95, *p*) is enclosed within the capsule of the liver, and was naturally mistaken for the gall-bladder by some of the early anatomists of these Mollusca; but in the *Argonaut*, and in all the Decapoda, it manifests its distinct function by its separate position. The liver is surrounded by a smooth capsule, and is not subdivided externally into lobules, as in the *Nautilus* and lower Mollusca. The biliary ducts in the *Octopoda* are simple canals, which unite and terminate by a common orifice, in the pancreatic sac. In the *Decapoda* they receive the ducts of numerous clusters of cæcal appendages beyond the smooth part of the liver.

The ink-bag consists of tough white fibrous texture, the outer surface of which is coated by a thin silvery or nacreous layer; its inner surface presents a fine spongy glandular texture. It presents a trilobate form in the *Sepiola*, and an oblong pyriform shape in the *Sepia* and *Loligo*. It is a very active organ, and its inky secretion can be reproduced with great activity. The tint of the secretion varies in different species, as is exemplified by the Italian pigment called "sepia," and the Chinese one called "Indian ink." It is of a very indestructible nature, as is exemplified by its frequent preservation in a fossil state in both the extinct Calamaries and the Belemnites. It is affirmed by some chemists to contain a peculiar animal principle, which Vizio has termed "melanine."

Many of the Cephalopods possess the power of emitting a luminous secretion. All of them are nocturnal and social animals, and are readily attracted by bright metallic substances.

The chief modifications of the circulating and respiratory systems of the higher order of Cephalopods are expressed in the characters of the order *Dibranchiata*.

The branchiæ (fig. 95, *g*) are concealed, as in the *Nautilus*, by the mantle, which extends in front of the other viscera to form the branchial chamber, the infundibular muscular tube *q* projecting from its outlet. The rectum and the generative organs *o* open into the branchial chamber at the base of the funnel, manifesting the same relation of the breathing organs to the termination of the alimentary canal which characterizes the lower orders of the Mollusca. Each gill consists, as in the *Nautilus*, of a number of triangular vascular laminæ, extending transversely from either side of the fleshy stem, and decreasing in size to the extremity of the gill. Each plate is composed of smaller transverse laminæ, which are themselves similarly subdivided; the entire gill presenting the tripinnate structure, which affords the most extensive surface for the minute subdivision of the blood-vessels. In the *Loligopsis* each gill has twenty-four pairs of plates; in the *Sepia*, thirty-six pairs; in the *Loligo sagittata*, sixty pairs. The stem of the gill is not only attached by its base, but by a thin fibrous membrane through nearly its whole length to the mantle.

The mechanical part of the respiratory act is performed by the muscular actions of the mantle and funnel, the gills not being provided with vibratile cilia, as in many of the inferior Mollusca. The water is admitted into the branchial cavity at the anterior aperture of the mantle, outside the base of the funnel. Two large valvular folds of fibrous membrane, which are concave towards the respiratory cavity, prevent the currents from escaping by this entry. They are therefore propelled by the whole force of the contraction of the muscular mantle through the cavity of the funnel, the base of which is articulated, in most of the Cephalopods, by lateral joints, with the sides of the anterior aperture of the mantle.

In the male Cephalopod, the testis, lodged at the bottom of the visceral sac, consists of a membranous pouch, to one part of the inner surface of which are attached numerous dichotomising blind spermatic tubuli. These swell and burst at the breeding season. The spermatozoa are conveyed along a convoluted sperm-duct, where they are moulded, with added mucus, into a slender cylindrical coherent thread; this next passes into a wider tube, with glandular walls, where the thread divides into packets of spermatozoa, which become inclosed in albuminous sheaths; a glandular sac or cæcal tube (called "prostatic") communicates with the vesicular canal; and this finally opens into the pouch in which filamentary packets of sperm-material, having acquired the requisite mechanism, exhibit

Cephalopoda.

the movements which first attracted the attention of Needham.[1]

These moving filaments in the terminal pouch, or capsules of spermatozoa and sperm-fluid, with a peculiar associated mechanism, of which an internal spiral spring is the most conspicuous part, form one of the most remarkable peculiarities of the Cephalopoda, and have been regarded as parasitic worms, under the names of *Echinorhynchus*, *Scolex dibothrius*, *Needhamia expulsatoria*, &c., by different comparative physiologists. They are now denominated "spermatophora;" and they parallel in the male the albuminous packets of ova in the female. The efficient cause of their movements appears to be a combination of the contractility of the external sheath and sperm-receptacle, with the elasticity of the internal spiral membrane, and the phenomena of endosmosis. The final intention of the super-addition of protecting sheaths for the semen, like those for the ova, appears to relate to the safe conveyance of the spermatozoa to the ova of the female, there being apparently no true intromission in the Cephalopoda. The peculiar mechanism of the sperm-receptacles insures their rupture and the dispersion of their contents after their brief transit through the sea-water.

The female organs consist in the Dibranchiate Cephalopods, as in the *Nautilus*, of ovarium, oviduct, and superadded nidamental glands, but with several modifications in the efferent part of the apparatus. The ovary (fig. 95, *o*) is always single, and the ovisacs, characterized by their elliptical form and reticulate parietes *b*, are attached to one part of its cavity, as in the *Nautilus*. In the cuttle-fish there is a single oviduct, with a glandular laminated outlet; and there are two distinct laminated nidamental glands on each side of its termination. In the *Octopoda* there are two oviducts, which in the *Octopus* and *Eledone* are each provided with a special glandular enlargement about the middle of their course; but there are no detached nidamental glands. In the *Loligo* there are two distinct convoluted oviducts, and two separate nidamental glands. These glands in the cuttle-fish rest upon a soft parenchymatous body, of a bright orange colour. The corresponding part is rose-coloured in the *Sepiola*; it is double in the *Rossia* and the Calamaries. These bodies have no ducts.

Tribe I.—DECAPODA.

Arms eight, tentacles two.

FAMILY I.—SPIRULIDÆ, Woodward.

Shell internal, nacreous, discoidal, whirls separate, many-chambered; the involute spire next the ventral surface of the body; septa concave, next the outlet; siphuncle near the concavity of the shell-curve; mantle with a tricuspid front-border, bilobed behind, and terminated by a sub-circular fleshy disc, with a narrow lamelliform appendage on each side; at the notches on the dorsal and ventral sides, above the disc, are exposed parts of the last whirl of the shell.

Genus SPIRULA, Lam.—Body oblong; arms short, with six rows of minute suckers; tentacles long, cylindrical, funnel-valved, and with elongated basal lateral joints with the mantle. The internal organization of the *Spirula* accords with the Dibranchiate type, and exhibits the modifications characterizing the Decapodous tribe, such, *e.g.*, as the glandular follicles upon the hepatic ducts, the absence of the septum or frænum of the branchial chamber, the appendages to the branchial hearts, the absence of an ingluvial dilatation of the gullet, the division of the liver into two lobes, and the separation of the ink-bag from the liver.

The most perfect known example of the *Spirula* is in the collection of Mr Cuming. It was picked up by Mr Percy Earl on the coast of New Zealand. This specimen is nearly three inches in length from the pallial disc to the tips of the arms; only the clavate ends of the tentacles seem to be wanting. It is figured in the *Annals and Magazine of Natural History*, vol. xv., pl. 15, and in L. Reeves' *Elements of Conchology*, part i., plate A, figs. *a*, *b*, *c*. The names *Spirula lævis* and *Spirula australis* have been proposed for this specimen. The species *Spirula reticulata* (Owen, in the *Zoology of the Samarang, Mollusca*, pp. 14-16, pl. iv., figs. 3 and 9) is founded on a mutilated specimen, taken by Mr George Bennett, F.L.S., on the coast of Timor.

If the *Spirula* taken in the Atlantic Ocean, and figured by Péron in the *Atlas du Voyage aux Terres Australes*, tab. xxx., fig. 4, be there accurately delineated, it may be regarded as a distinct species, and retain the name of *Spirula Péronii*.

The *Spirula* is widely diffused over the warmer parts of the ocean, especially in the southern hemisphere. The delicate shell is strewed in abundance over parts of the coast of New Zealand, and a few specimens have been brought by the Gulf Stream to the south-west coast of England.

FAMILY II.—BELEMNITIDÆ, Owen, Gray.

Shell internal; the chambered and siphunculated part, called "phragmocone," is straight, conical, and is lodged in a sheath or guard, produced more or less anteriorly into a calcareo-albuminous plate, and behind into a solid "mucro," varying in length and shape. This is the part commonly known as the "belemnite." The septa of the phragmocone are concave next the outlet or base, and the siphuncle is at the ventral side. All the genera and species of the family are extinct. The acetabula of the arms were provided with horny hooks.[2] They range from the lias to the gault.

FAMILY III.—SEPIADÆ, Woodward.
(Cuttles or Cuttle-fishes.)

Trunk or pallial part (fig. 97, *a*, *b*) sack-shaped, bordered on each side with a narrow longitudinal musculo-dermal fin *bb*; shell (fig. 98) internal, gelatino-calcareous, friable, consisting of a flattened closely-laminated phragmocone *bc*, lodged in an open expanded guard *aa*, prolonged behind into a "mucro."

Genus SEPIA, Linn. (as restricted by Cuvier).—The septa of the phragmocone are very numerous and close-set; they are united by finely-undulated vertical lamellæ (fig. 98, A). The whole shell is light and porous. It is still used as "pounce," and for polishing the ivory plates of miniature-painters. It is sometimes given medicinally as an antacid, the hardening salt being pure carbonate of lime. Arms (fig. 97, *c*, *c*) with four rows of suckers; funnel valved, and articulated to two lateral tubercles on the mantle.

Sp. *Sepia officinalis*, Linn. (fig. 97).—*a*, constriction between "soma" and "pallium;" *b*, pallial fins; *c*, cephalic or somatal arms; *d*, clavate tentacles; *e*, eyes. The left ventral arm in the male has many of the suckers on its basal half very small or oblate; and the arm is there expanded, with the inter-acebular membrane pitted and reticulate. The spermatophora are attached *in coitu* to the lip of the female. (Steenstrup.[3])

The eggs of the Cuttle-fish are of comparatively large

Cephalopoda.

[1] *An account of some microscopical discoveries in the Calamary, and its wonderful milt-vessels*, 8vo, 1745.

[2] Description of certain Belemnites, preserved with a great proportion of their soft parts, &c., in the *Philosophical Transactions*, 1844. Some of the species here described have been formed into a sub-genus, called *Belemnoteuthis*; but they possess the "phragmocone" and "guard," which are the essential characters of the extinct family.

[3] *Annals and Magazine of Natural History*, August 1857.

size, of an oval form, attenuated at the extremities, and each

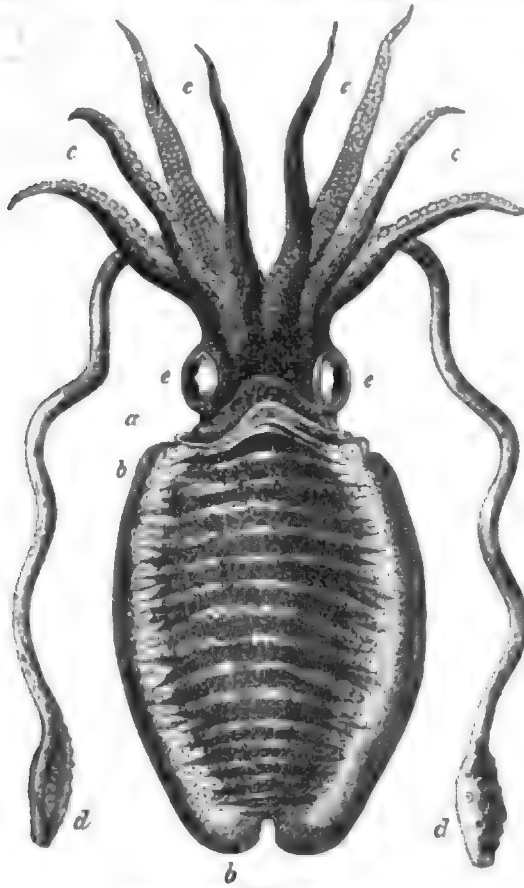
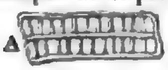


Fig. 97.
Sepia officinalis (one-fourth natural size).

enveloped in its proper horny covering, which is prolonged

A


into a pedicle at one extremity, and attached thereby to some foreign body. Many of these egg-capsules are generally found clustered together. They are called "sea-grapes" by the fishermen.

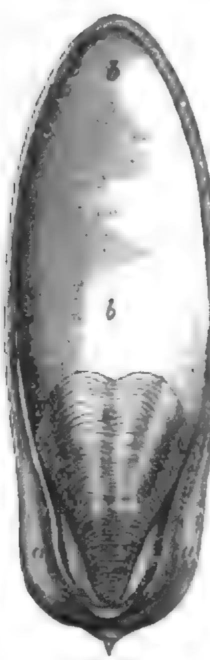


Fig. 98.
Shell of *Sepia*.

FAMILY IV.—TEUTHIDÆ, Ow.
(*Calamariæ, Squids.*)

Shell internal, reduced to an albuminous or horny plate, consisting of a stem or shaft, and two lateral expansions or wings. It is called the "gladius" or pen (fig. 99).

Sub-Family 1.—ŒGOPSIDÆ.[1]

Eyes exposed; fins terminal and united.

Genus OMMASTREPHES, D'Orb. (*Flying-Squids*). — Gladius with three diverging ribs, and a hollow conical appendage; body long and cylindroid; fins terminal, large and rhombic; arms with two rows of suckers; tentacles with four terminal rows of suckers; eyes not covered by the integument. Muscular chord on the funnel.

Sp. *Ommastrephes sagittatus* (*Loligo sagittata*, Lam.)—In the sagittated Calamary the male has a shorter body and longer and stronger arms, the second and third pairs of which have relatively larger acetabula than in the female. The spermatophora are attached *in coitu*, within the mantle, to its wall or to part of the viscera of the female. The species of this genus are gregarious, and frequent the open ocean. With the best organs of vision, they manifest the highest powers of locomotion in the Molluscous province, leaping out of the water so high as sometimes to fall on the decks of ships; whence they are called "flying squids." They form the chief food of the cetaceous dolphins and cachalots, and of the albatross and larger petrels. They are used as bait in the Newfoundland fisheries.

Fig. 99.
Gladius of *Loligo*.

Genus ONYCHOTEUTHIS (*Hook-Squids*).—Gladius lanceolate, with a hollow conical stem-base; arms (fig. 100, *c*, *c*) with two rows of suckers; tentacles *d* long, with the clavate ends provided with a double series of hooks *f*, and usually with a group of suckers at the base, which, uniting with that of the opposite tentacle, as at *e*, fig. 100, enables both to act in conjunction; terminal fins unite to form a rhomb.

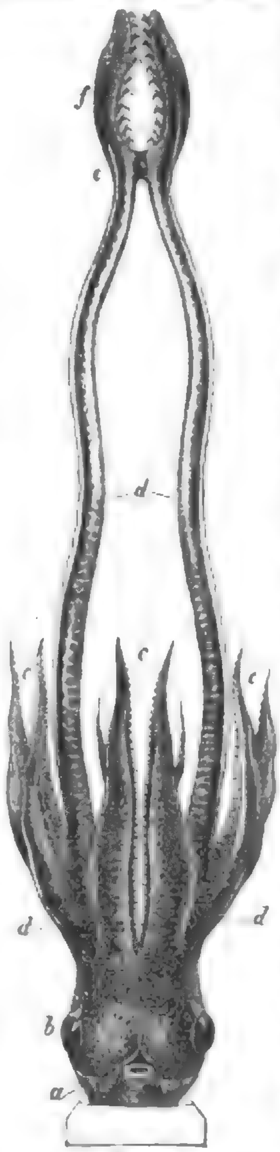


Fig. 100.
Head and arms of *Onychoteuthis*.

Genus ENOPLOTEUTHIS, D'Orb.—Gladius and terminal fins as above; arms provided with a double series of hook-bearing pedunculate acetabula; tentacles long, with terminal hooks. The hook-squids are solitary, frequenting the open sea, often near the banks of sargasso-weed.

A specimen of the second genus (*Enoploteuthis unguiculata*) was taken during Cook's first voyage, in the South Pacific, which must have been six feet long from the tips of the arms to the end of the mantle. The huge rhomboid pair of fins are still preserved, dried, in the Hunterian Museum of the London College of Surgeons, together with spirit-preparations of sections of the uncinated arms, the heart, and the mouth. Fig. 96 is taken from the last specimen, but is reduced to one-half the natural size.

The natives of the Polynesian Islands, who dive for shell-fish, have a well-founded dread of these formidable Cephalopods.

Genus LOLIGOPSIS, Lam. —Arms with numerous small acetabula; the third pair usu-

[1] Gr., signifying "eyes which turn."

ally the longest, the first the shortest; tentacles very long and slender, rarely preserved in captured specimens; body conical, tapering to the extremity, at or near which is a pair of rounded fins; no infundibular valve; mantle subtransparent, widely open anteriorly.

Sp. *Loligopsis Zygæna*.—This species has the tentacles acetabulate throughout their length. The *Loligopsis Veranyi* is remarkable for the great length of the tentacles; the suckers are limited to the clavate ends. The *Loligopsis vermicularis* has the slender head longer than the longest arm.

Genus LEACHIA, Stp.—The *Leachia Reinhardtii* is distinguished by its strong armature of cartilaginous bands on the mantle; one, denticulate, along the middle of the back; arms in length, 3, 2, 4, 1, or each with two series of suckers.

Sp. *Leachia hyperborea*, Stp.—Fins narrow, extending along half the length of the body, and forming together a lanceolate figure; arms, as to length, 3, 2, 1, 4, with very large acetabula; tentacles twice as long as the arms.

Sub-family 2.—MYOPSIDÆ.

Eyes covered (wholly or almost) by skin.

Genus CRANCHIA, Leach.—Body large, ventricose; fins small, terminal; mantle supported in front by a branchial septum; head very small; arms short, with two rows of suckers; tentacles with four rows of suckers on the clavate ends; funnel with a valve; gladius long and narrow.

The *Cranchia scabra*, Leach, a species about two inches in length, was taken off the west coast of Africa, during Tuckey's Congo expedition: the genus founded thereon was named in honour of Mr Cranch, naturalist to the expedition.

Genus LOLIGO, D'Orb. (part of the genus *Loligo* of Lamarck), (*Calamaries* or *Common Squids*).—Body elongate, especially in the male, tapering behind, with a pair of rhomboidal, terminal, more or less extended, fins; gladius narrow, pen-shaped, with the shaft produced in front—it is multiplied by age, several being found packed closely, one behind the other, in old specimens; arms with two rows of pedunculate suckers; tentacular club with four rows of suckers, the fourth left arm in the male, with the suckers of the terminal part, gradually disappearing, whilst their peduncles increase, and assume the form of long papillæ, especially along the outer margin, giving the extremity of the arm a pectinate appearance; spermatophora attached, *in coitu*, to the fringed lip of the female.

In *Loligo vulgaris* the suckers of the peduncular club are very large on the two central rows, and very small in the lateral rows; the horny ring of the central suckers is finely toothed along half its circumference.

In *Loligo Forbesii* the central rows of the peduncular suckers are scarcely larger than the lateral ones, and not more than one-third larger than the largest suckers of the third arm; the horny ring of the peduncular suckers is toothed all round. A specimen of the species has been taken which was 2 feet long, including the tentacles.

These squids are good swimmers; they also crawl, head downwards, on their cephalic disc. The ova are inclosed in long gelatinous cylindrical sheaths, and offer a close analogy to the spermatophora in the male. Bohadsch estimated a cluster of these capsules to contain nearly 40,000 eggs.

Genus SEPIOTEUTHIS, Bl. (*Long-finned Squids*).—Gladius lanceolate, narrowed anteriorly, convex dorsad; lateral pallial fins as long as the mantle.

In *Sepioteuthis sepioidea* the fourth left arm in the male has the outer row of suckers of the terminal part metamorphosed into compressed leaf-like papillæ, united by a membranous bridge with the roots of the peduncles in the opposite row, which are transformed into blunt elevations. The fourth right arm has the terminal suckers scarcely discernible, and probably assisting the left during the generative act.

The spermatophora are attached, *in coitu*, to the fringed lip of the female (Steenstrup). The species are distributed in the Mediterranean, Indian, South Atlantic, and Australian Seas.

Genus LOLIOLUS, Stp.—Internal shell horny, broad, with the shaft sharp-keeled; no muscular chords to the funnel, and suckers without the elevated band round the horny ring, thus resembling *Sepiola* and *Rossia*.

In *Loliolus typus* the left fourth arm in the male is without a trace of sucker; the acetabular bed being converted into a compressed obtusely-dentate edge, produced by the confluent bases of the peduncles of the inner series of suckers.

Genus SEPIOLA, Leach.—Abdomen short, purse-like; fins dorsal, rounded, contracted at the base; no muscular bands to the funnel; no elevated band round the horny ring of the suckers; mantle continuous with the back of the head.

In the *Sepiola Rondeletii* the left dorsal arm in the male is expanded by the confluence of the elongated stalks of the suckers, especially of the inner row, and by a production of integument at the base of the inner side of the arm. (Stp.)

Genus ROSSIA, Ow. (so named in honour of Sir James Clark Ross, R.N., the arctic and antarctic navigator).—Body short, ventricose, with subdorsal rounded fins, no muscular bands to funnel; posterior border of the mantle free; the dorsal pair of arms in the male obliquely twisted inwards, with about eleven of the outer row of suckers elevated on long peduncles, the roots of which are compressed, leaf-shaped, and surrounded by dermal folds or processes.

"In one of my males I found two soft envelopes of spermatophora between the cutaneous folds of the arm." (Stp.)

Sp. *Rossia palpebrosa*, Ow.—This is the largest known species of the genus. It is characterized by numerous small suckers on the tentacles. A fold of integument is reflected, like a large lower eyelid in front of the eyeball. The species was obtained by Captain Sir James Ross at Elwin Bay, Prince Regent's Inlet. The utility of the peculiar defence of the eyes, in a species living in seas sometimes charged with spiculæ of ice, is obvious.

Sp. *Rossia Mölleri*, Stp.—This is distinguished by very large suckers on the tentacles, in both males and females; the middle row exceeding in size the largest brachial suckers. Hab.—Greenland.

The *Rossia dispar*, Rupp. (*Heteroteuthis*, Gray), has very large suckers on the third pair of arms.

The *Rossia Owenii*, Ball, agrees with the male, and *Rosiia Jacobii*, Ball, with the female, of the *Rossia macrosoma*, of D'Orbigny, and of Forbes and Hanley.

Genus HISTIOTEUTHIS, D'Orb.—Trunk short, bursiform, with a pair of terminal subdorsal rounded fins; palpebral orifice large; first, second, and third pair of arms united by a web to within one-fourth their length from their tips.

Sp. *Histioteuthis bonelliana*, D'Orb.—This species was discovered by M. Verany in the Gulf of Genoa. The remarkable form of Cephalopod of which it is the type is beautifully figured in plates 19, 20, and 21 of the *Mollusques Mediterranéens* of that excellent Malacologist.

Section OCTOPODA, Leach.

Arms with sessile suckers, no tentacles; trunk united to the head by a broad nuchal band; branchial chamber divided by a longitudinal partition; two oviducts, without nidamental glands.

FAMILY I.—PINNATA, Owen.

A pair of advanced subdorsal fins from the mantle.

Genus SCIADEPHORUS (*Cirroteuthis*, Eschricht).—Pallial fins rounded; arms united by a web nearly to their tips; suckers in a single row, alternating with cirri. In the male a portion of the suckers seems, as it were, stripped off the lower third of the right arm.

Sp. *Sciadephorus Mülleri* (*Cirroteuthis Mülleri*, Eschricht).—Hab. coast of Greenland.

Cephalopoda.

FAMILY II.—NUDA, Owen.

No pallial fins. Shell represented by two short styles in the substance.

Genus ELEDONE, Leach.—Arms with a single series of suckers. In the male the third right arm is shorter and somewhat thicker than the left one, with fewer acetabula (sixty-four instead of ninety-three in *Eledone moschata*). A strong cutaneous border commences in the middle, on the margin of the membrane, stretched between the third and fourth arms, and thence runs along the arm to its apex, where the terminal plate is furnished with several longitudinal folds. All the other arms have membranous laminæ instead of suckers at their extremity. (Stp.)

The Mediterranean species, *Eledone moschata*, is so called on account of the musky odour it emits.

Genus OCTOPUS, Cuv. (Poulps).—Arms with a double alternate series of suckers united at their base by a web. The species of *Eledone* and *Octopus* were the "polypi" of Aristotle. They swim by vigorous contractions of the interbrachial muscular web, darting with the rounded end of the trunk forwards. They creep on shore with the same part upwards, and with their eight arms, like the legs of a spider, sprawling over the surface, in a rotating shuffling manner. The ink which they discharge is of a dark chestnut-brown colour. In the male the third right arm is much shorter, but is as thick or thicker than the left, with fewer acetabula, and bearing externally at its apex a longish plate provided with a greater or less number of transverse ridges with intervening pits. A muscular fold of skin connects this plate with the web at the base of the arm, the fold running down the dorsal margin of the arm; which margin is so rolled towards the inner side of the arm as to form a more or less closed channel, probably to conduct the spermatophora to the apical plate. The female oviposits on sea-weeds or in empty shells.

"*Octopi* of enormous size are occasionally met with among the islands of the Meïa-co-shimah group. I measured one, which two men were bearing on their shoulders across a pole, and found each brachium rather more than 2 feet long, giving the creature the power of exploring an area of about 12 feet without moving, taking the mouth for a central point, and the extremities of the arms, to describe the circumference." (Adams.)

Genus TREMOCTOPUS.—Dorsal pairs of arms (in the female) webbed to or near to their ends; suckers in two rows; conspicuous aquiferous pores on the back of the head.

In the male of *Tremoctopus carenæ* (fig. 101) the arms are not webbed; but the third right arm *df* is enlarged with a double row of numerous (forty in each row) suckers, and a terminal disc *f*; a cavity in this arm contains a long convoluted spermatophore. It is deciduous *in coitu*, and adheres to the female, usually to the inner side of the mantle, where it was mistaken for a parasitic worm (*Hectocotylus*, Cuvier[2]) when first discovered. This hectocotylised arm is further distinguished from the rest by being white or colourless.[3]

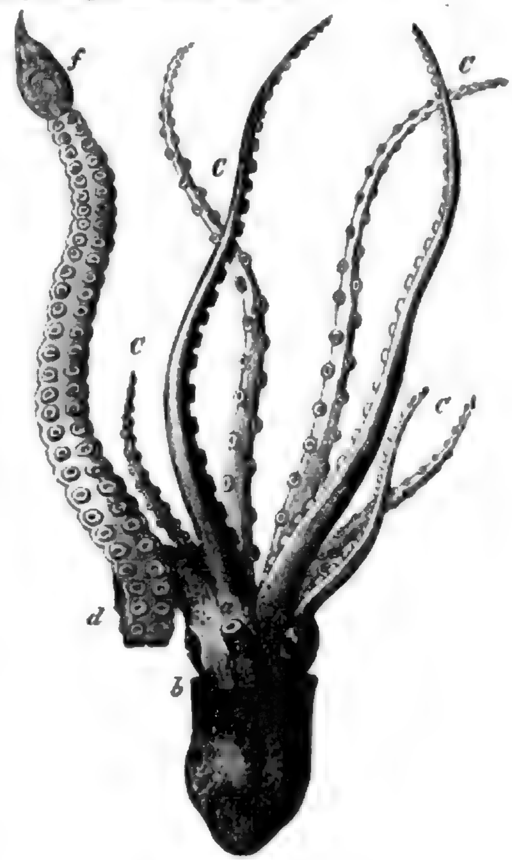


Fig. 101.
Male Tremoctopus.

FAMILY III.—TESTACEA, Owen.

Dorsal arms of the female (fig. 102, 1), with much expanded terminal membranes, serving to secrete and sustain a symmetrical involuted nidamental shell. The third left arm in the male is "hectocotylised" and deciduous *in coitu*.[4]

Genus ARGONAUTA, Linn.—The characters of the family are those of its sole representative genus.

Sp. *Argonauta argo*, Linn.—On this species, which inhabits the Mediterranean, and is found in tolerable abundance at Messina and Sicily, Madame Power made her observations and experiments, which finally determined the

1 *Catalogue of Mollusca in British Museum*, Part I., *Cephalopoda Antepedia*, pp. 5 and 14.

2 Mémoire sur un ver parasite d'un nouveau genre (*Hectocotylus*), *Annales des Sciences*, vol. xviii., 1829.

3 Aristotle, describing this species of "Polypus," wrote, "differt mas e femina eo, quod habet corpus oblongius, et genitale, quod e piscatoribus vocatur, in brachio, album." (*Hist. Anim.*, lib. v., c. 10, 1, ed. Schneider, p. 196.)

4 The following is Prof. Steenstrup's summary of the sexual characters presented by the males of the *Cephalopoda*:—

OCTOPODA—

	Argonauta	Third left arm a *Hectocotylus*, deciduous, colourless, developed in a sac. (*Feminæ polyandræ.*)	
	Tremoctopus	Third right arm a *Hectocotylus*, deciduous, colourless, developed in a sac. (*Feminæ polyandræ.*)	
	Octopus, *Eledone*	Third right arm hectocotilised, permanently attached, coloured, developed in a free state. (*Feminæ Monandræ?*)	

DECAPODA—

Myopsidæ	*Rossia*	First left arm hectocotylised	with the right one only in the middle.
	Sepiola		alone, in its whole length.
	Sepia	Fourth left arm hectocotylised	at the base.
	Sepioteuthis		at the apex.
	Loligo		at the apex.
	Loliolus		in its whole length.
Œgopsidæ	*Ommastrephes*, *Onychoteuthis*, *Loligopsis*	no hectocotylised arm yet observed.	

Cephalopoda.

long-mooted question whether that Cephalopod was the fabricator or merely the parasitic occupant of the shell.

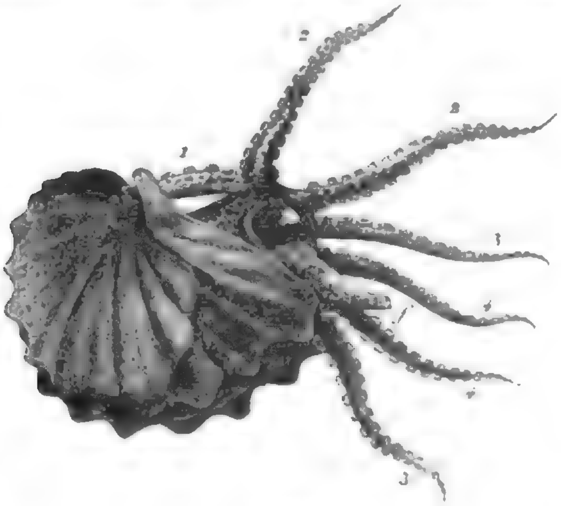


Fig. 102.
Argonauta gondola.

The question arose out of the anomalous relations of the shell to its occupant; the shell not being attached by any muscle to the Cephalopod, and this having been observed to quit the shell and survive in captivity for some time without attempting to resume it. Madame Power first observed and published[1] the function of the brachial membranes in maintaining the shell in proper relation to the body, as shown in fig. 102, 1, where the membrane is partly retracted from the shell, which it can wholly cover. She likewise demonstrated, experimentally, the function of those membranes in the formation and reparation of the shell. She removed portions of the shell from healthy argonauts imprisoned in her aquaria, and preserved them long enough to witness the mode and degree of reproduction of the mutilated parts of the shell. She cut off one of the membranous arms, and preserved the mutilated argonaut long enough to show that the growth of the side of the shell next the amputated arm did not proceed; whilst that which remained covered by the membrane of the entire dorsal arm had received a notable increase. Specimens of the shells, showing that inequality of the two sides of the shell as the result of the experiment of removing one membranous arm, were transmitted by Madame Power to the author of the present article, by whom the experiment was suggested to that lady.[2]

The argonaut shell is, however, peculiar to the female sex. It has the special function of an incubating and protective nest. It is not the homologue of the camerated shell of other testaceous Cephalopods, nor of the internal rudimental shell in naked Cephalopods. It is to be regarded as answering to the cocoon which is secreted for a similar office by the leach and in many Articulata, and to the nidamental float in *Janthina*.

Fig. 103 shows the place of attachment of the eggs, which are appended by filamentary stalks to the involuted spire of the shell. They are usually compacted in that part of the shell, and concealed by the body of the parent argonaut. This figure, and fig. 102, are of the species described by Mr Adams[3] as the *Argonauta gondola*, of which he writes:—

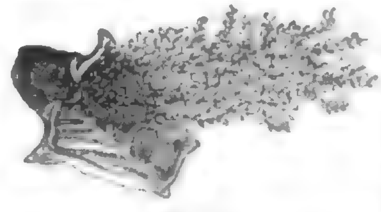


Fig. 103.
Nidamental shell and eggs (*Argonauta gondola*).

"There is a considerable difference in the general aspect and disposition of the spots, &c., between the animals of *Argonautæ gondola* and *argo*. In *A. gondola* the sac-like mantle is more ovoid and elongated; the head is narrower; the funnel broader, shorter, and furnished, at the upper and anterior extremity, with two conical elongations; the eyes are considerably larger and slightly more prominent; the tentacular arms are much shorter in comparison and of greater width, more particularly at their basal portions; the suckers are much larger, more prominent, and placed closer together. This species varies also considerably in colour from *A. argo*. The extremities of the brachia are marbled with deep-red brown, and, in the other parts, are covered with large, irregular, oval, reddish blotches, each margined with a dark colour; the circumference of the suckers is marked with brown spots; the upper surface of the funnel is covered with pale pink, rather scattered and irregular, quadrate blotches, margined with dark-red brown; the mantle, on the dorsal surface, is densely sprinkled with round and square spots of a chestnut-brown and crimson of different sizes; the velamenta are minutely dotted with crimson and red-brown, and have a more bluish tinge than those of *A. argo;* the under surface is mottled and minutely dotted with dark chocolate on the arms, and on the body is marked with small, irregular, dark red-brown spots.

"In the specimen of *A. gondola* from which the accompanying drawing was made, the ovary was distended with ova, but in a much less advanced stage of development than those deposited in the shelly nidus. Some of these latter were sufficiently matured to enable me to trace, under the microscope, the early indications of the being of the argonaut; and although the progress is not followed very far, it is sufficient to ascertain the similarity with the changes observed by Poli in the same genus, with whose writings I afterwards compared my remarks; the only difference of any importance appears to be that Poli regarded as the shell what I have called the yolk-bag. At first, the ova are semi-opaque, pale yellow, and apparently speckled minutely, which is owing to the granular yolk; afterwards they become clouded with light brown blotches, and three dark spots make their appearance, one for each eye and one for the viscera; these spots, in the next stage, approach each other, and a faint outline of the future argonaut is visible, a club-shaped embryo, rounded in front and tapering behind. The front part is then lobed; a black mark for the horny mandibles is perceived, and the eyes are large and prominent; the yolk-bag, or vitellus, is next seen very distinctly, and the processes extending from the head are more elongated." (*Loc. cit.*, p. 7.)

The most complete series of observations on Cephalopodous development are those recorded by Kölliker, of the cuttle-fish (*Sepia officinalis*).[1] The primary germ-cell

[1] *Giornale di Gabinetto di Messina*, December 1834; and Ragguaglio delle Osservazioni ed Esperienze fatte sullo *Argonauto Argo* (L.) da Madama Jannette Power, in *Giornale di Scienze, Lettere ed Arti*, Messina, Maggio, 1836. See also *Proceedings of the Zoological Society of London* for February 1839.

[2] *Reports of the British Association*, 1844, Transactions of the Sections, p. 74. The fabled office of the brachial membranes, as "sails" to waft the argonaut along the surface of the ocean, and that of the attenuated arms, as "oars" extending over the sides of the boat, have afforded a favourite topic for poetic imagery and philosophic analogy during many ages; and the little hypothetical navigator of nature's ship has been the object of the disquisitions of the naturalist from Aristotle to Cuvier, and of the song of the poet from Callimachus to Byron.

[3] *Zoology of the Samarang*, Mollusca, p. 3.

Cephalopoda.

divides and subdivides, but assimilates only a small proportion of the vitellus to form the germ-mass; the rest of the yolk being taken in for food after development of the embryo, as in the oviparous shark and bird. What is called a "germinal area" is thus formed upon the yolk. The basis of the trunk or mantle seems to be the first to appear; but almost simultaneously follow parts which are afterwards recognised as the "funnel-lobes," "gills," and "eyes."[1] Next appear parts of the head called "anterior" and "posterior" cephalic lobes; then the arms, beginning by the ventral pair, and all these parts, save the gill-rudiments, manifest ciliary action. The lobes or crura of the funnel elongate, the eyes become reniform, the mouth is established as a median semilunar depression with a raised border. The mantle first liberates a border at its ventral side (some Cephalopods, *e.g.*, *Sepiola octopus*, retain this stage); afterwards the free border extends all round, and by its growth begins to cover the gills. The crura of the funnel approximate, the cephalic lobes coalesce, the bases of the dorsal pair of arms extend, approximate, and complete the encompassing of the mouth. There is nothing in the developmental relations of the cephalic arms that countenances the idea of their homology with the repent ventral disc of Gastropods. The crura of the funnel first coalesce at their dorsal margin, and in *Nautilus* the development of the tube is arrested at this stage; but the ventral overlapping borders of the funnel-lobes next coalesce, completing the tube. The alimentary canal, with the liver and ink-bag, are successively developed. The molluscous bend of the intestine is formed as the mantle-cavity rises from the germinal area; the anus having been previously established between the gill-rudiments and the ventral ends of the funnel-lobes. The vitelline sac is drawn in between the mouth and vent, and becomes divided into an internal and external yolk; the latter becoming progressively "internal" until finally absorbed. At a certain stage of pallial growth alternate contractions and expansions of the mantle indicate the respiratory movements. The ink-bag is conspicuous by the colour of its contents, which suffice to blacken a considerable quantity of water. At the period of exclusion five layers of the shell of the young cuttle-fish have been formed; but, except the nucleus, which is calcified, they are flexible and transparent; the internal shell of the *Teuthidæ* is arrested at this stage. The pallial fins are relatively broader than in the mature animal, and the cephalic arms are furnished with both suckers and a basal web. Thus the little cuttle is enabled to swim either backwards or forwards, and its eyes have acquired the requisite development to direct it to its appropriate food, or warn it of an approaching enemy, from which it has also the means of concealing itself by its already developed ink-bag.

In the class at the summit of the Molluscous series, as in the *Arachnida* of the Articulate series, there is no metamorphosis. The Cephalopodic character is manifested before the parts of the embryo are completed; even the Dibranchiate peculiarity of the infundibular cartilages is recognisable, when as yet, only the visceral sac, funnel, gills, and eyes have been outlined on the germ-mass. No phase or form of Molluscous existence below the Cephalopod is transitorily manifested. Before the ciliary action is visible on the germ-mass, the parts that afterwards exhibit it bear the Cephalopodous stamp. The retained conditions which are transitional in the embryo *Sepia* are peculiar, as has been pointed out, to certain other Cephalopods. Were growth superinduced at any arrested stage of Cephalopodous development, no known inferior form of Mollusk would result; and no arrested stage of Vertebrate development would produce anything like a cuttle-fish.

The notices of the habitats of the species selected to illustrate the several divisions of the Molluscous province, will have served to convey a general idea of their distribution in space. It remains only to sum up briefly the relations of the Mollusca to time.

In the oldest known fossiliferous deposits—Cambrian or Lower Silurian—this province of life is represented by species of BRACHIOPODA (*Orthisina*, *Pseudocrania*), of LAMELLIBRANCHIATA (*Lyrodesma*, *Modiolopsis*), of GASTEROPODA, both Nucleobranchiate (*Maclurea*, *Belerophon*) and Scutibranchiate (*Rhaphistoma*, *Holopæa*), and of Tetrabranchiate CEPHALOPODA (*Gonioceras*, *Lituites*, *Endoceras*). Thus the leading modifications or classes of the MOLLUSCA appear simultaneously at the earliest beginnings of life to which our present knowledge reaches. Some additional but allied species of the same families appear in the Upper Silurian beds. In the Devonian system of rocks the BRACHIOPODA are principally represented by *Spirifera*, and *Producta* here makes its first appearance; the LAMELLIBRANCHIATA are exemplified by *Megalodon* and *Pterinæa*; the CEPHALOPODA by *Clymenia* and *Bactrites*. The *Goniatites*, which make their first appearance in the Devonian, flourish most in the Carboniferous series. New BRACHIOPODA—*e.g.*, *Camarophoria*—first appear in the Permian, at which period the Lamellibranchiate *Myalina* was most abundant. A Permian Bivalve has been referred to the genus *Lima*; the Brachiopodous *Lingula* and *Crania* have continued to be represented from the Cambrian epoch to the present day; but most of the Molluscous genera of the Palæozoic rocks are extinct.

True Ammonites first appear in the Trias, and the Tetrabranchiate Cephalopods were most abundant and various at the Oolitic periods, when the Dibranchiates, under the form of Belemnites, first appeared on the stage of life. In the same secondary strata the GASTEROPODA are chiefly represented by asiphonate genera. The siphonated *Aporrhais* and *Pyrula* first appear in the Cretaceous strata. Fresh-water *Pulmonifera* occur in the Purbeck beds; but terrestrial species have not been found in strata older than the Tertiary. The Lamellibranchiate genera are reckoned by Woodward to be seven times more numerous in the newer Tertiary than in the Palæozoic strata. In the latter the genera belong to the families with an open mantle. "The siphonated Bivalves do not appear till the middle of the secondary age, and are only now at their maximum." (*Manual*, p. 418.) Fossil shells have afforded the readiest mode of testing and characterizing the chief divisions of the Tertiary system. To those strata in which a small per-centage is only referable to recent species the term "Eocene" is given, as if the dawn of actual life had then appeared. Strata of the "Miocene" age are those that have not more than 50 per cent. of recent species. When they constitute from 50 to 70 or 80 per cent. they characterize the "Pliocene" Tertiary beds.

The natural families of the MOLLUSCA which seem now to be verging towards extinction are the *Rhynchonellidæ*, the *Trigoniadæ*, and the *Nautilidæ*. The following seven families have altogether passed away:—*Productidæ*, *Orthidæ*, *Spiriferidæ*, *Hippuritidæ*, *Orthoceratidæ*, *Ammonitidæ*, and *Belemnitidæ*.

In this retrospect of Molluscous organization, so far as it can be carried through the dark vistas of geological time, we discern "an ascent and progress in the main." Lamellibranchiate have superseded Palliobranchiate Bivalves; Siphonate have succeeded Asiphonate Univalves; and the Dibranchiate now vastly outnumber the Tetrabranchiate Cephalopods. (R. O.)

[1] *Entwickelungsgeschichte der Cephalopoden*, 4to, 1844.

[2] Ibid., taf. ii., fig. xvi.

MOLOCH, or MOLECH, or MILCHÔM, the national god of the Ammonites, who dedicated their children to him, by making them "pass through the fire." There are various opinions concerning this method of consecration. Some think that the children leaped over a fire sacred to Moloch; others are of opinion that they passed between two fires; and others conceive that they were really burned in the fire by way of sacrifice to this god. That the latter opinion is the only tenable one may be shown from such passages as Ps. cvi. 38; Jer. vii. 31; Ezek. xvi. 20, xxiii. 37. It cannot be precisely ascertained at what period the Israelites became acquainted with this idolatry, but it is highly probable that it was before the time of Solomon, the date usually assigned for its introduction.

Moses in several places forbids the Israelites to dedicate their children to this god, as the Ammonites did, and threatens death and utter extirpation to such persons as should commit this abominable idolatry. (Lev. xx. 1–5.) There is great probability that the Hebrews were much addicted to the worship of this deity; since Amos (v. 26), and after him Stephen (Acts vii. 43), reproaches them with having carried along with them into the wilderness the tabernacle of their god Moloch.

Solomon built a temple to Moloch upon Mount Olivet (1 Kings xi. 7); and Manasseh, long afterwards, imitated his impiety by making his son pass through the fire in honour of Moloch. It was chiefly in the valley of Tophet and Hinnom, to the east of Jerusalem, that the Israelites paid their idolatrous worship to this false god of the Ammonites. After the restoration all traces of this idolatry disappear.

The accounts of this idol and his worship found in the Old Testament are very scanty. Münter has collected the testimonies of the classical writers on this point with great completeness, in his *Religion der Karthager*. Many of these notices, however, only describe late developments of the primitive rites; the description, *e.g.*, of the image of Moloch as a brazen statue, which was heated red hot, and in the outstretched arms of which the child was laid, so that it fell down into the flaming furnace beneath. This account, which is first found in Diodorus Siculus as referring to the Carthaginian Κρόνος, was subsequently adopted by Jarchi and others, but is not admitted by Movers, to apply to the Moloch of the Old Testament.

The names of Moloch ("king") and Baal ("lord") are almost synonymous. Their connection is seen by comparing Jer. xxxii. 35 with xix. 5; where both names are used as if they were interchangeable, and where human sacrifices are ascribed to both deities. Baal is the chief name by which the principal god of the Phœnicians is known in the Old Testament; but only the two above-cited passages ascribe to him the sacrifice of human victims. The Greek, and Latin authors, however, give abundant testimony to the human sacrifices which the Phœnicians and their colonies offered to their principal god, in whom these classical writers have almost always recognised their own Κρόνος and Saturn. Thus we are brought to the difficulty of reconciling Moloch, as Saturn, with Baal, as the sun and Jupiter. In reality, however, this difficulty is in part created by our association of classical with Semitic mythology. When regarded apart from such foreign affinities, Moloch and Baal may appear as the personifications of the two powers which give and destroy life, which early religions regarded as not incompatible phases of the same one God of nature.

MOLTON, SOUTH, an old market-town and municipal borough of England, county of Devon, on the right bank of the Mole, 26 miles N.N.W. of Exeter. It has an ample market-place and several well-built and cleanly-kept streets. The principal building is the parish church, a Gothic edifice of the fifteenth century, containing a richly-carved stone pulpit. It has also a guildhall and a borough jail. Manufactures of coarse woollen fabrics and lace are carried on here. The borough is governed by a mayor, 3 aldermen, and 12 councillors. Market on Saturday. Pop. (1851) 4482. In the neighbourhood are some rich copper mines, where gold is occasionally found. About 3 miles to the N.E. is a small village called North Molton.

MOLUCCAS, or SPICE ISLANDS, a numerous group of islands in the Asiatic Archipelago, situated between Celebes on the W. and New Guinea on the E., and stretching from N. Lat. 2. to S. Lat. 9. They are believed to amount to several hundreds, though many of them are small and uninhabited. The group is formed of three smaller clusters, viz., the Gilolos or Moluccas proper, the Ceram group, and the Timor Laut group. The first of these, extending from 2. S. to 3. N. Lat., comprehends the islands of Gilolo, Morty, Mandioly, Batchian, Ooby, Mysole, Ternate, and Tidore, besides others of smaller size. The cluster of Ceram, which lies in the centre of the group, between 3. and 5. S. Lat., contains, among others, the islands of Ceram, Booroo, Amboyna, and Banda. The third group lies farther to the S., situated between Australia and the W. of New Guinea, and includes the Timor Laut, the Key, and Aroo islands. The surface of the whole group is decidedly mountainous, and attains in some of the islands heights varying from 7000 to 8000 feet above sea-level. In its geological structure the group is principally volcanic, and contains several active craters, as well as a number of hot springs, which are found chiefly in the island of Amboyna. The outline of the mountains, moreover, is bold and rugged, and the coasts are both steep and irregular. Violent earthquakes are of frequent occurrence. The mountains are extensively wooded, even to their summits; while in the lower regions there is a rich soil. There are numerous excellent harbours, but sand-banks are frequently thrown up on the coast by the earthquakes, which render the navigation intricate. Owing to their tropical situation, the climate of the Moluccas is at all seasons warm; but the smallness of their size, and the prevalence of the monsoons, prevent the heat from rising to an excessive degree. From October or November till April or May, when the N.W. monsoon prevails, the hot and rainy season continues; but during the other months, when the S.E. monsoon blows, the temperature is considerably lower. The moisture of the air, however, is at all times great, and even during the dry season occasional showers fall. The nature of the climate and soil prevent the cultivation of corn in the Moluccas; and the principal food of the natives is obtained from the sago palm; besides which, bread-fruit, cocoa-nuts, and many other products of tropical countries, grow in great abundance. Spices, however, as the name of the islands indicates, are the articles of produce most important to Europeans. Of these, cloves and nutmegs are the principal, and are exported in large quantities. Sandal and other kinds of wood useful for furniture are also obtained here. Small quantities of gold, coral, madrepore, and mother-of-pearl are found on the islands; and some commerce is carried on with China in edible birds' nests, sea-slugs, and sharks' fins. The Dutch monopolies, however, which have trammelled the trade here for so many years, are now almost completely abolished, and the good effects are rapidly becoming more apparent in an extended commerce. The inhabitants of the Moluccas are of two races, —the Papuans and the Malays. The former, believed to be the same as the inhabitants of Australia, have in many of the smaller islands been exterminated by the Malays, and in the larger ones have only retained possession of the interior and mountainous parts. The Moluccas were first visited by the Portuguese in 1510; but shortly after, their right of possession was disputed by the Spaniards under Magelhaens, at the head of a small fleet sent out by Charles

V. This dispute at length terminated in favour of the latter. It was not till 1596 that the Dutch made any permanent settlements on these islands. The Dutch East India Company, founded in 1603, had obtained in 1618 the supremacy over many of the princes of the Moluccas, who were allowed to retain their authority subject to the company. This company was dissolved in 1795, and the Moluccas became immediate dependencies of Holland. During the French war of 1796, however, they were taken by the British, who held possession of them till 1800, when they were returned to Holland. The islands were again occupied by the British in 1810, but were finally restored to the Dutch in 1814, by the treaty of Paris.

MOLYN, Peter, surnamed *Il Tempesta* and *Pietro Mulier* or *De Mulieribus*, a distinguished painter, was the son of an artist of the same name, and was born at Haerlem in 1637. At an early age he was initiated in his art by his father, and is said to have been so fond of drawing, that he used to play truant from school, and to skulk by the sea-shore, sketching the ships in the distance, and the cattle that were grazing near him. His first models were the hunting pieces of Snyders; and his imitations, if continued, might in course of time have rivalled their originals. In his thirtieth year he was converted to Popery by a Carmelite monk, and shortly afterwards proceeded to Rome. There Molyn practised his art with great success. The Duke of Bracciano became his patron, and his fame rapidly increased. He was especially remarkable for the wild imaginative power with which he represented devoted ships tossing amid the confused turmoil of the elements. So striking, indeed, was his success in storm scenes, that he came to be generally known among the Italians by the name of "Tempesta." He also excelled in landscape-painting. His pictures of that description are marked by an imposing variety of scenery, consisting of woods, lakes, rocks, and romantic edifices, overhung by troubled skies, and relieved by lively and expressive figures. While Molyn was thus raising himself in the rank of his profession, he was also degrading himself in the scale of morality, and was fast becoming insensible to every virtuous emotion. At length, it is said, growing tired of his wife, an Italian lady, he left Rome on some pretence, and, after visiting Venice and Milan, settled in Genoa. From this city he was not long in despatching an accomplice to Rome with a letter to his wife charging her to come to him with the messenger. The lady, full of suspicion, at first refused, but on a second summons complied. She was murdered on the way by her companion; and her husband at the same time married a woman of Genoa, of whom he had become enamoured. Such suspicious circumstances led Molyn to be tried for murder, convicted, and condemned to perpetual imprisonment. The gloom of his dungeon, and the terrors of his guilty conscience, seem to have stimulated the peculiar powers of his imagination, for the tempests which he continued to paint were darker and more terrific than before. After Molyn had lain in prison for five years, according to some, or for sixteen years, according to others, he contrived to escape. Taking up his abode at Milan, he plied his pencil with greater success than ever, and increased both in affluence and in profligacy. He lived most sumptuously, and kept a private menagerie to afford him facility for the study of animal-painting. At the same time he became so notorious a libertine that he received the additional surname of "Mulier." Towards the close of his life the decaying faculties of Molyn failed to sustain him in his former style of living, and he lapsed into comparative poverty. He died of a fever in 1701. Many of his pictures may be seen among the collections in Milan and in its neighbourhood. (See Lanzi's *History of Painting*, and Stanley's *Dutch and Flemish Painters*.)

MOLYNEUX, William, a learned mathematician, was descended from a family of fortune, and was born at Dublin in April 1656. He entered the university of his native city in 1671, and after graduating as B.A., he repaired to London in 1675 to study law at the Middle Temple. The greater part of his time, however, was devoted to philosophy and mathematics. On his return to Ireland in 1678, his independent fortune enabled him to marry, and to devote all his time to the cultivation and advancement of his favourite studies. It was at his suggestion that the Dublin Philosophical Society was instituted in 1683. He became its first secretary; and by the zeal and talent with which he discharged this office, he speedily attracted the notice of some of the most influential men in the country. The consequence was, that in 1685 he was appointed by the Irish government to inspect the fortresses in Flanders; and in the following year he was elected a member of the Royal Society of London. During the commotions that prevailed in Ireland in 1689 and 1690, Molyneux was in England engaged in completing his principal work, the treatise on Optics. In 1692 it was published in 4to at London, under the title of *Dioptrica Nova*, and with an appendix containing the theorem, newly discovered by Dr Halley, for finding the foci of optic glasses. Molyneux sat in the Irish Parliament in 1692 for the city, and in 1695 for the university of Dublin. He was a bosom friend of Locke, and while suffering under his last illness, he undertook a journey to England to visit that philosopher. His death took place in October 1698. Molyneux also wrote a *Translation of the Six Metaphysical Meditations of Descartes*, together with the objections against them by Thomas Hobbes, Lond., 1680, and twenty-seven papers on miscellaneous subjects in the *Philosophical Transactions*.

MOMBAS, a seaport-town of Africa, on a small island, 3 miles in length by 2 in breadth, in a bay on the coast of Zanzibar, in Lat. 4. 4. S., Long. 39. 38. E. The bay in which the island is situated is about 5 miles in length by 3 in breadth, and forms the harbour of Mombas, said to be one of the best in the world. The coasts of the island consist of steep cliffs of madrepore, and render the town almost impregnable; while it is still further defended by an old Portuguese fort, situated on an elevation to the S. of the town. The town, which is in a wretched and ruinous condition, consists of two parts,—one occupied by Arabs, the other by Sowhylese, a Moorish race, who inhabit a great part of this coast. Although Mombas is very suitable both as a commercial and military station, it seems to be less used in the former capacity than Uzi, a town which absorbs most of the trade of the neighbourhood. Mombas was first visited by the Portuguese under Vasco de Gama in 1498, and the town was then large and flourishing. In 1505 Francisco de Almeida, the Portuguese viceroy of India, in revenge for some insults offered by the inhabitants, took and burned the town. It was, however, afterwards rebuilt, when the Portuguese in 1529 returned and repeated their work of destruction. From that date to 1720 it was held by the Portuguese. In the latter year Mombas fell into the hands of the Imam of Muscat, but he was soon dispossessed by a rebellion of the inhabitants. From 1824 to 1826 the town came under British protection; but it is now governed by an Arab sheikh. Pop. 3000 or 4000.

MOMPOX, a river-port town of New Granada, capital of a province of the same name, in the department of Magdalena. It is situated on the left bank of the Magdalena River, about 20 miles above its confluence with the Cauca. Lat. 9. 15. N., Long. 74. 30. W. The town is regularly laid out, with broad streets crossing each other at right angles. Some of the houses near the centre of the town are well built; but the greater part of them are little more than mere sheds. Mompox has a handsome custom-house, and a quay sufficiently elevated above the

stream to be secure from the great floods, which in the month of December raise the waters of the river 10 or 12 feet above their usual level. This town is of considerable importance, being the great commercial emporium for the Magdalena valley. The climate is very warm and moist; and the neighbourhood is infested with alligators and mosquitos. Pop. (1851) 11,600.

MOMUS, in fabulous history, was the god of raillery, or the jester of the celestial assembly, who ridiculed both gods and men. He is the personification of mockery and censure. Being chosen by Vulcan, Neptune, and Minerva, to give his judgment concerning their works, he blamed them all: Neptune for not making his bull with horns before his eyes, in order that he might give a surer blow; Minerva for building a house which could not be removed in case of bad neighbours; and Vulcan for making a man without a window in his breast, that his secret thoughts might be seen. Venus he considered alone blameless. For the freedom of his reflections upon the gods, Momus was expelled from heaven. He is generally represented as raising a mask from his face, and holding a small figure in his hand.

MONACHISM (from Latin *monachus*, a monk; Greek μοναχὸς, solitary) is a general name descriptive of a mode of religious life which has prevailed in the church from almost the earliest ages, and which, during many periods of its history, has formed the most characteristic and powerful expression of its activity. It sprang into settled existence during the third century, and was the natural product of many influences then moving the church. Previously to this period, indeed, a system of solitary and ascetic devotion is found prevailing among the Jews both in Palestine and in Alexandria. The Essenes, on the western shores of the Dead Sea, and the Therapeutæ, on the borders of Lake Mœris, seem to have formed regular communities of ascetics, whose existence long preceded the rise of Christian Monachism, and to whose example the origin of the latter may in some degree be attributed. The main causes out of which Monachism arose, however, are undoubtedly to be found within the church itself,—in those hardships and persecutions which oppressed it, especially during that age, and the spirit which these persecutions naturally quickened and fostered. During the severities which followed the edict of Decius in the year 250, many Christians were driven from their homes in search of shelter from the relentless vengeance which pursued them. The comparative security of those remote wilds in which they sought refuge, the peacefulness and freedom from idolatrous intrusion in which they found themselves, combined with a growing spirit of mystical devotion which had sprung up, as in many other cases, from the very extremity of the social distractions in the midst of which they had lived, seem to have been the direct sources of the monastic idea. Such an isolation as that in which many now found themselves came to be regarded by them, under the force of such circumstances as those in which they were placed, as the only possible realization of the Christian life. In such a position alone did it appear practicable to carry out that spirit of self-denial and abstinence from worldly enjoyments which represented the ideal of their holy calling.

Egypt was the fruitful soil in which such thoughts germinated and sprung to maturity. The honour of their original has been shared by two names—Basil and Anthony; the former of whom may be regarded as the first in point of time who exemplified in his own practice that Christian asceticism which developed into Monachism; but the latter of whom was really the first who drew such attention to the monastic life as to spread abroad its fame and attract many to its adoption.

Anthony was born on the borders of Upper Egypt, in the village of Coma, in the province of Heracleopolis, about the year 251. A spirit of simple and earnest, but somewha unintelligent piety, animated him from his youth. Losing both his parents about his twentieth year, the care of a young sister and of considerable property devolved upon him. Setting aside the ordinary Christian obligations arising out of this position, he conceived himself called upon, like the rich young man in the Gospels, to dispose of his property, and submit to a life of voluntary poverty, in which he might, without impediment, give himself to his spiritual duties. In obedience to this impulse, he assigned his landed estates to the inhabitants of his native village, under condition that he should receive no trouble as to any charges to which they were liable; and having made provision for the education of his sister with a society of pious virgins, he settled down near his paternal mansion, and commenced a life of rigid asceticism. He supported himself by the labour of his hands, and distributed whatever exceeded the supply of his own bare wants for the benefit of the poor. This solitary life, however, was not without its temptations. Those natural feelings which he strove to mortify continued to assert themselves in such a manner as to disturb the serenity of his spiritual contemplations, and grosser feelings even obtruded themselves under the guise of alluring imaginations, which rose before him with a more painful distinctness the more he laboured to subdue them. Afterwards he learned the more Christian way of resisting such temptations by cheerful activity and trust in the presence of the Lord; but at first he thought to overcome them by a still stricter seclusion and more severe regimen. He retired to a farther distance from his native village, and took up his abode in a recess of rock, such as the Egyptians used for purposes of entombment. Here he fasted and afflicted himself till he was overtaken by illness, and carried back in a fainting and semi-deranged condition to the village. A morbid spirit of devotion, however, burned in him too ardently to be quenched. He afterwards sought a still more distant retirement, where he remained for twenty years, maturing a saintly renown which spread abroad his name, and brought many to seek his advice and to settle under his encouragement to the same mode of life. The deserts of Egypt began to swarm with devotees, who courted his presence and example, and naturally acknowledged him as their leader. The love of seclusion prevailed over his love of power; and the numbers who intruded upon his solitude drove him to a still more inaccessible retreat among the mountains. But even here he did not escape molestation. Followers gathered around him in spite of all his efforts to maintain his privacy; and the first rudiments of a monastery grew up in this remote wild. Anthony did not indeed aim at any complete organization of his followers; this task remained for another; but he taught them to labour for their support, and directed to some extent their religious duties.

The life of Anthony was prolonged to upwards of a hundred years, and his saintly fame, as may be easily conceived, grew with his years, till a peculiar sacredness and a miraculous virtue were supposed to attach to his person. On two occasions on which he made his appearance in Alexandria the religious enthusiasm which he excited was intense and universal; and especially on the latter occasion, in the year 352, when he was more than a hundred years old, it reached such a height that even pagans are said to have pressed forward to touch his garment, in the hope of being healed of their diseases. He distinguished himself at such times of public activity as the warm friend of Athanasius in his contest with Arianism; and it is to this circumstance that we probably owe the record of his life from the pen of the great Trinitarian—a record to which the historian is indebted for such facts as we have now related.

The system thus begun by Anthony speedily spread into

Syria and Palestine, favoured by the congenial circumstances of climate and the prevalence of a similar ascetic spirit to that which existed in Egypt. Hilarion, a disciple of Anthony, was chiefly instrumental in the promotion of Monachism in Palestine; while the great Basil of Cæsarea, the fellow-student and friend of Gregory Nazianzen, warmly embraced its spirit, and more than any other contributed to its progress throughout Syria and to the shores of the Black Sea. It is interesting to contemplate in such men as Basil and Gregory, particularly in the latter, the struggles of the monastic with the higher and more comprehensive Christian spirit, and the manner in which this spirit at length succumbed to the perverted tendency of their age, always gathering fresh strength from the increase of social confusion and disorder. Gregory, indeed, never virtually assumed, like Basil, the monastic vows; but the triumph of the ascetical bent was in the end scarcely less complete in him than in his friend. It is deserving of notice that the single monastic order which has subsisted in the Greek church derives its name from St Basil.

While the institution of Monachism thus extended itself, from the example of Anthony, not only in Egypt, but throughout the East, its more complete organization is associated with the name of Pachomius, another Egyptian ascetic, who, independently of Anthony, had entered on a similar career. To him is attributed the foundation of the cloister life, or the collection of the monks in several classes, according to a regular system, and in one large connected building. This was properly the first establishment of the *monastery* or *cœnobium*. The whole community of monks thus formed was placed under a president or *abbot* (from the Hebrew or Syriac word for father), from whom descended an organized gradation of offices and ranks, fitted to preserve the integrity of the society and to secure its order. In the natural course of things, this organized form of Monachism soon came to usurp an exclusive character as the only valid expression of the ascetic spirit. The earlier Anachorets—who lived in single cells, with only a casual combination, and without submitting to any definite rule—were gradually absorbed into the more regular establishments, although in the East they long continued to survive, and to assert their independence in all shapes of ungoverned fanaticism. One class of these independent ascetics, who are known to us under the name of Sarabaites, seem to have been peculiarly obnoxious to the regular monks in the vigour with which they maintained their separate position, and refused to own any government or superior. Cassian, a monk of Palestine, who travelled into Egypt towards the close of the fourth century, with the view of inquiring into the various orders of ascetics there, attributes to the Sarabaites all sorts of excesses and disorders; but his picture is to be received with suspicion, as that of a partizan who resented their independence as insubordination, and blackened their characters because they opposed his system.

The most various results, as may be imagined, sprang from an institution like eastern Monachism. In some cases there was formed a comparatively pure spirit of devotion, such as that which, upon the whole, with all his earlier excesses, animated its great founder Anthony. Nor can it be disputed, that social consequences of a useful and beneficent kind followed the establishment of monasteries throughout the deserts of Egypt and along the bleak shores of the Pontus. A ready and generous hospitality distinguished the cloisters. The traveller received with an ungrudging spirit maintenance and lodgings. The Cœnobites of Egypt, especially, were productive corn-growers, and sent ships laden with food and articles of clothing to be distributed among the poor of Alexandria. The wildest and most ridiculous excesses at the same time grew out of the system. Bands of roving devotees, historically known under different names, as *Euchites* (εὐχῖται), from their notion about constant inward prayer, as *Choreutes* (χορευταί) from their mystic dances, and as Enthusiasts (ἐνθουσιασταί) from their pretended spiritual communications, infested whole districts of country, and spread themselves from the Nile to the Black Sea. These fanatics abandoned all useful employment, and even any regular practices of devotion, and professed to give themselves up to spiritual contemplation; not unfrequently degenerating, by that necessary reaction inherent in all extremes, into gross licentiousness. Individual fanaticism, moreover, took the most grotesque and incredible shapes; as in the case of the famous Simeon Stylites, who is reported to have passed thirty years on the top of a pillar 60 feet from the ground. "Habit and exercise," writes Gibbon in his characteristic manner, "instructed him to maintain his dangerous position without fear or giddiness, and successively to assume the different postures of devotion. He sometimes prayed in an erect attitude, with his outstretched arms in the figure of a cross; but his most familiar practice was that of bending his meagre skeleton from the forehead to the feet; and a curious spectator, after numbering twelve hundred and forty-four repetitions, at length desisted from the endless account. The progress of an ulcer in the thigh might shorten, but it could not disturb, this celestial life; and the patient hermit expired without descending from his column." (Milman's *Gibbon*, vol. vi., pp. 251–2.)

Athanasius has obtained the reputation of extending Monachism into the West. During his compulsory sojourn in Rome in 341 he is said to have carried certain Egyptian monks in his train, whose austerities and devotion, though at first disgusting to the polished Romans, gradually attracted interest, and at length admiration. His Life of Anthony, moreover, which was speedily translated into Latin, gave a great impulse to the monastic spirit. It could not fail, indeed, that this spirit, so soon as it became dominant in the East, should spread to Rome, and, in such a centre of mingling superstitions, receive a ready support. All the most illustrious of the western teachers contributed by their countenance to this result. Ambrose of Milan, Martin of Tours, and even Augustine, were drawn within its influence, and lent it their encouragement. The restless activity of Jerome during his residence in Rome was exerted in its behalf, and under his influence rich and noble ladies were led to retire from the world and consecrate themselves, amid the solitudes of Palestine, to a life of devotion.[1] The labours of Martin of Tours, and of Cassian at Marseilles, were especially successful in transferring Monachism westwards, until, in the course of the fifth century, thousands of devotees spread themselves through the south and middle of France into Britain and Ireland, carrying with them, it cannot be doubted, many influences of civilization, and forming in their settlement rallying points of Christian enlightenment and education, under the repeated incursions and devastations of barbarian tribes.

It may be readily conceived that such a fanatical spirit, in its growth and extension, had a constant tendency to degenerate from its primitive strictness, and to end in mere indolence and license. A yet more thorough system of organization was accordingly necessary to strengthen its widely-branching relations, and to consolidate it in its diffusion. And such a system was not long wanting. There arose among the monks of Italy one who saw the dangers to which Monachism was exposed, and who resolved to encounter them by a more systematic and efficient control Benedict of Nursia was prepared for this great task by a self-discipline of the strictest character. Secluding himself

[1] The case of Paula and her daughter Eustochium, alluded to by Gibbon, vol. vi., p. 236, is well known.

from all companionship, he spent three years of solitary devotion, unrelieved by a single visit, and his retreat unknown to any save a brother monk, who provided him with what he could spare of his own daily allowance of food, by dropping it by a rope to the foot of a steep rock near the grotto in which Benedict lived. Some shepherds at length discovered his retreat, and spread abroad the fame of the holy hermit. His influence was thus at once secured; he was invited to the rule of a neighbouring convent, and accepted it, although under protestation that the severity of the government which he would feel bound to establish would prove intolerable to those who gave him the invitation. It turned out as he supposed: the refractory monks even sought his life; and, leaving them in disgust, he retired once more to his solitude. This event only contributed the more to his fame; wealthy citizens of Rome reverentially sought him out, and entrusted their sons to him for education. He was gradually enabled to found and regulate, according to his own plan, twelve cloisters in the neighbourhood of his original seclusion; and subsequently, on retiring from the scene of his labours to a mountain at some distance, he laid the foundation of a monastic institution, which, under the name of the Abbey of Monte Casino, was destined to play an illustrious part in the annals of the Papacy.

Rigorous as were the personal austerities of St Benedict, he was convinced by experience that an undue severity of fasting and mortification was incompatible with a western climate and western habits. His rule, accordingly, in the ultimate form in which it obtained ascendancy throughout all the monasteries of the West, was characterized rather by its simplicity and order than by any particular severity. He aimed at subordination and discipline by a regular system of alternate labour and devotion, so that no period of the day remained unoccupied. Two hours after midnight the monks were aroused to vigils, and the time between this and daybreak was consumed in learning the psalms by heart, or some other similar study. At daybreak matins were performed, somewhat in the same manner as vigils, by chanting psalms and reading lessons from Scripture. The duty of private and mental prayer was also enjoined under certain restrictions. These early services were followed throughout the day by manual labour and reading. During summer the day was so divided that seven hours were given to the former occupation and at least two to the latter; during winter more time was given to study, but no alteration appears to have been made in the hours of labour. The Sabbath was entirely given to reading and prayer. A system of rigid temperance was of course enjoined, but of such a reasonable character that even the moderate use of wine was not forbidden.

The rule thus established by Benedict extended itself, as we have said, throughout the West, and for many years was instrumental in preserving the integrity and simplicity of devotion in its cloisters. With the gradual increase of riches, however, the Benedictine monasteries lost their primitive character, and became the seats of indolence and vice rather than of cheerful industry and piety.

Many attempts were made to revive the first vigour of the rule, and still more successfully to apply it in new forms, each of which in their turn achieved a great reputation, and powerfully helped the cause of the Papacy in the different countries into which they spread. In this manner arose the Order of *St Cluni*, and the *Cistertian* and *Carthusian* Orders—all branches, as it has been said, from the stem of St Benedict. (Waddington's *Church History*, vol. ii., p. 377.) One and all of these orders, it is remarkable, sprung from the teeming soil of France, in the south and east; and they follow one another, in their full prosperity, at the interval of about a century, beginning with the commencement of the tenth. As a monk of Cluni it was that Hildebrand nursed those ambitious schemes which he afterwards carried out as Gregory VII. The immortal name of St Bernard is associated with the Cistertian Order, of which the Abbey of Clairvaux was a dependent; and the simple purity of the Carthusians, maintained for many years in the midst of surrounding license, acquired for them a great reputation and a strong settlement in almost every land of Europe, from the south of Italy to the northern shores of Scotland.

In the meantime other forms of monastic order had sprung up, the most notable and distinguished of which, dating from an early period, was the Order of St Augustine, which was destined to play so prominent a part in the advance of the Reformation. This order, at least in its origin—which, although claiming the sanction of the great teacher of the West, cannot be carried back so far—was chiefly composed of those who were looking forward to, or ordained to, the clerical profession—who were ecclesiastics, in short; while in the convents generally, according to their original constitution, there were but a few eligible or devoted to the ecclesiastical life. In the course of time, however, and from the increase of wealth, the number of those exclusively given to spiritual or ecclesiastical offices multiplied in all the convents,—a change which was greatly fostered by the institution of what were called *Lay Brethren*, upon whom the routine of manual labour and the discharge of all servile duties devolved.

There are still two further developments of the monastic system that claim notice, although our space will scarcely enable us to do more than mention them. These are the rise and establishment of the *Military* and the *Mendicant* or *Preaching* orders.

The former sprung up out of the close union subsisting between the ecclesiastical and the military professions in the middle ages, and especially out of the crusading spirit of the twelfth century, and the necessities of defence which it created. They are well known under the historical names of *The Knights of the Hospital*, *The Knights Templar*, and *The Teutonic Order*. They one and all took their rise in Palestine, and are associated with some of the most brilliant, and at the same time tragic, passages in the history of the church. They gradually disappeared about the time of the Reformation—the Knights Templar, especially, having been, two centuries previously, subjected to a fierce persecution, instigated and chiefly carried out by Philip IV. of France, who cherished towards them the most deadly and unrelenting hatred.

While the Military orders arose out of the external necessities of the church, and the warlike spirit kindled by the advance of Mohammedanism; the Mendicant orders originated in the internal dangers of the church from the encroaching spirit of reform and of free opinion. St Dominic (1191) acquired his fame as a preacher against the heresy of the Albigenses; and, recognising the effects following such eloquence in his own case, he framed the bold idea of establishing an order of Mendicant preachers, whose vow should especially bind them to the interests of the Holy See, and the extirpation of heresy. Innocent III. at first looked coldly on the project, but its obvious policy soon commended it to papal recognition; and St Dominic found himself at the head of one of the most devoted and illustrious societies which ever sought its own aggrandizement in the gratification of papal ambition and of orthodox vengeance. For it was under the shadow of the Dominican Order—although not, as it has been sometimes maintained, under the sanction of St Dominic himself—that the Inquisition inaugurated its bloody career. St Francis of Assisi was a contemporary of St Dominic, and pursued, independently of him, a similar course of fanatical activity. Enthusiastic almost to insanity, with a temperament capable of sustaining the most intense and prolonged raptures of

devotion, and covetous of the most abject and degrading austerities, he burned to realize, in a definite social form, the pictures of evangelical purity and of self-renunciation which his imagination had conjured up. The story of his interview with Innocent III., when he first appeared before him with his plan, is well known. Hurried away from the holy presence as a mean madman—a convenient dream aroused the Pontiff to his mistake, and led him to lend all his countenance to a scheme which at first he repelled. While preaching was the characteristic feature of the Dominican rule, poverty was intended to be the chief distinction of that of St Francis; but the two orders gradually merged their distinctive peculiarities, and the members of each gave themselves equally to mendicancy and preaching. The history of these orders, as well as that of Jesuitism,—which may be said to be a development of the monastic spirit, but in such a distinct shape as to require separate notice,—is inseparably bound up with that of the Papacy. Their labours and rivalries form one of the most stirring chapters of human interest, of ecclesiastical ambition, and, we should add, so far at least as the Dominicans are concerned, of philosophical and theological activity.

Since the Reformation Monachism cannot be said to have manifested any inherent vitality or power. With the advance of modern civilization, its highest meaning and only conservative use are gone; and, so far as it still maintains itself in Europe, it must be held to be an opponent at once of genuine religious life and the advance of an elevated rational cultivation.

(For the more particular history of Monachism, the general reader may be referred to the Church Histories of Neander, Waddington, and Milman; and for a special account of its earlier phases, to Burgham's *Antiquities*, and the learned reader to Helyot's *Histoire des Ordres Monastiques*, Paris, 1714 and 1792.) (J. T—H.)

MONACO, a small principality of North Italy, bounded on the S. by the Mediterranean, and on all other sides by the Sardinian States, under whose protection it is. It has a length of about 10 miles from N. to S., a breadth of 6, and an area of 52 square miles. The soil is fertile, and its climate mild, as it is sheltered towards the north by the lofty range of the Alps. Oranges, lemons, citrons, and other fruits are produced in abundance, and large herds of cattle are fed on the excellent pastures. Since the tenth century Monaco has been in the hands of the Grimaldi family, to whom it still nominally belongs; but it is now governed by the King of Sardinia, and garrisoned by his soldiers. The town of Monaco is situated on a lofty promontory 9 miles E.N.E. of Nice. It was called in ancient times *Arx Herculis Monocci*, from which its modern name is derived. The town is walled and fortified, but is completely commanded by the higher elevations towards the north. It has a good harbour, which is secure and well sheltered. Pop. about 1500. Mentone is a larger town than the capital, and contains about 4000 inhabitants. The entire population of the principality is about 7000.

MONAGHAN, an inland county of Ireland, in the province of Ulster, bounded N. by Tyrone, E. by Armagh and Louth, S. by Louth and Cavan, and W. by Cavan and Fermanagh. It comprises an area of 500 square miles, or 319,757 acres, of which 285,885 are arable, 21,585 uncultivated, 5816 in plantations, 304 in towns, and 6167 are under water; of the 21,000 acres of uncultivated land 14,500 are situated at elevations exceeding 800 feet, the remainder consisting chiefly of small detached bogs and marshy lands on the margins of lakes. About 7000 acres are capable of improvement by cultivation, 8000 acres might be improved by draining, and 6000 acres may be considered as incapable of improvement.

The general appearance of the surface is hilly, yet not rising into heights of considerable elevation. The principal mountain range is that of Slievebeagh, a rugged and barren tract, extending south-westward along the Tyrone boundary into Fermanagh, and nowhere exceeding 1050 feet in altitude. North of Castleblayney, on the confines of Armagh, the Mullyash Mountain rises to the height of 1030 feet. There are no rivers of any consequence. The Finn, which rises near the centre of the county, scarcely merits the title of river until after its entrance into Fermanagh; and the Blackwater, forming part of the north-eastern boundary towards Tyrone, is the receptacle of many of the smaller rivulets which take their rise in Monaghan. Although deficient, however, in rivers of magnitude, it is amply furnished with streams of running water, well suited to the purposes of agriculture and of manufacturing industry. The number of lakes in this county is 184, thirty of which are considerable sheets of water, but the great majority are of very small extent. The most remarkable are Lough Egish, on Crieve Mountain, which supplies water for a long succession of mills and bleaching-greens; Lakes Damby, Camm, and Oona. Others are celebrated for the beauty which they impart to the scenery; more particularly the chain of lakes between Coolehill and Ballybay, which ornament the demesnes of Dawson Grove and Bellamont Forest, and the beautiful Lough Muckno, which contains several islets, and forms part of the demesne of Castleblayney.

The soil is of various kinds. In the central and more level part of the county it consists of a rich limestone. The southern districts are partly of the same quality, and partly a deep clay, capable of a high degree of cultivation under judicious management. The north consists mostly of a stiff retentive clay, marshy in winter, and hardening quickly by the heat of summer, yet interspersed in many parts with tracts of valuable calcareous soil. Whilst the limestone formation predominates in the level districts, the more elevated portions exhibit traces of sandstone and basalt. Coal has been found between Moynalty and Carrickmacross, in more than one portion of a small basin which rests on a patch of the carboniferous limestone insulated within the slate district; but in beds so poor and scanty as not in any case to exceed 14 inches in thickness, which, in addition to the very difficult working caused by the strata dipping at a large angle, renders this coal district valueless in an economical point of view. Slates of good quality are quarried in Crieve Mountain. A lead mine was also worked there, but has long since been relinquished. Ochre, potters' clay, brick-clay, manganese, antimony, and fullers' earth are also found. There is a chalybeate spring at Drumtubberbuy, on Cairnmore, the water of which casts up a thick scum of ochre. A well near Clones is much celebrated for its efficacy in cases of jaundice, whence it has acquired its name of Granabuymore, or "the great yellow cure." This county has a large proportion of bog, which, together with its great number of lakes, and its exposure to the N.W. winds, renders the climate damp, though not unwholesome.

The state of agriculture has much improved during the present century. Descriptions given shortly after the year 1800 speak of the old country plough of clumsy construction, the slide-car without wheels, the conveyance of manure and field produce on horses' or asses' backs, and of spade-husbandry, as being generally prevalent. At present many of the improvements introduced by scientific agriculturists are to be seen in practice here, as far as they have been found consistent with the peculiar nature of the soil and climate. Ploughs on the most improved plan, Scotch carts, and implements of various kinds to supersede the improvident exertion of manual labour, are universal; yet in some parts, where the nature of the ground forbids the use of the plough, considerable tracts of land are still cultivated by the spade. The old, stunted, and ill-conditioned breeds of black cattle, sheep, and hogs, have given way to

the most esteemed British or foreign stocks, the character of which has not unfrequently been made more suitable to the agricultural localities by judicious crossings with the native breeds. The extent of land under each description of crop in 1850, 1855, and 1857 was,—

	1850. Acres.	1855. Acres.	1857. Acres.
Wheat	5,861	3,466	5,046
Oats	80,946	83,562	75,402
Barley, bere, rye, beans, and peas	7,467	3,711	4,095
Potatoes	22,105	25,399	28,915
Turnips	7,190	7,061	6,963
Other green crops	2,543	2,129	2,162
Flax	10,157	11,858	11,537
Meadow and clover	11,399	15,377	17,659
Total	147,668	152,563	151,779

Oats and potatoes are the principal crops, together with flax, for the growth of which the soil is peculiarly favourable. Clover is much encouraged, and few farmers are without a patch of it, however small. It is cut for green food, and found extremely economical. The tops of furze or gorse are also used, when pounded, as food for horses. The manure is formed of composts, of which lime and burned turf-mould are generally component parts; marl, though abundant, is little used; and the coal strata of the county afford a large deposit of gypsum, which, from its moderate solubility in water supplies lime for the growth of clover, &c., better than any other compound. The fences in some parts are of white thorn, interspersed with sallows; in others a slight mound of earth serves rather to determine the boundary than to prevent trespassing. The county, which is now very bare of trees, was once almost a continuous forest, excepting the higher lands, which appear to be of a nature ungenial to the growth of trees. The numerous demesnes of the nobility and gentry, however, are richly embellished by plantations of modern growth. Ash and sycamore are much encouraged, the wood of the latter being in great repute for some parts of mill-machinery. Osieries are frequently to be found in the marshy bottoms at the foot of hills, and prove highly profitable.

The estates in land are of every value, from L.20,000 per annum to L.20, being partly held under grants of the escheated lands in Ulster in the time of James I., and partly arising out of the forfeitures in the time of Cromwell. The total number of farms or holdings exceeding one acre in extent, which in 1847 amounted to 23,255, has diminished to 19,000. Of this number about 3000 are between 1 and 5 acres in extent, 9000 between 5 and 15 acres, and 5000 between 15 and 30 acres; the remaining 2000 exceed 30 acres.

The mansions of the landed proprietors are numerous and elegant; the houses of the wealthier farmers, and more particularly of those who combine manufactures with agriculture, exhibit every indication of comfort; but the dwellings of the cotters and labourers are miserable in the extreme. Flesh-meat seldom forms a part of their diet; and those living in districts remote from towns are seldom able to procure any food but potatoes and butter-milk. Fuel is cheap and abundant in consequence of the quantity of bog.

The principal manufacture is that of linen, which has long been carried on with great spirit. The woollen manufacture is chiefly employed in supplying the domestic consumption. The sand or gritstone of Cairnmore has given rise to a manufacture of millstones there, which are in considerable demand. Coarse earthenware is manufactured at Glasslough; and a small ironwork at Smithborough, near Clones, supplies many of the agricultural implements used in the county.

The Ulster Canal, which intersects the county, passing the towns of Monaghan and Clones, affords water communication with Lough Erne and Lough Neagh; and the Dundalk and Enniskillen and other railways will shortly furnish the means of transit to the ports of Londonderry, Belfast, Drogheda, and Sligo.

The education of the county is chiefly in the hands of the national schools. In 1851 there was a total of 242 schools in Monaghan, with an aggregate of 9372 scholars. Of the schools in that year, 114 were national, 58 private, and 45 connected with religious bodies. The number of persons, five years old and upwards, who could neither read nor write, in 1841 and 1851, was ascertained by the census commissioners to be—

	Males.	Females.	Total.	Rate per cent.
1841	37,431	53,006	90,437	51
1851	22,270	31,859	54,129	42

The use of the Irish language in this county, as elsewhere, is on the decline.

Monaghan has few remains of antiquity. The most remarkable are two round towers,—one near the county of Fermanagh, in the burial-ground adjoining an ancient church at Clones; the other at Inniskeen, on the borders of Louth. The former, which is a very rude specimen of these singular monuments of antiquity, consisted of five storeys, the traces of which are still visible in the walls, its door being about 4 feet above the level of the ground. Near it is a large stone coffin, above ground, with a cover of the same material shaped like the roof of a house. The tower at Inniskeen, which is in a very inferior state of preservation, is unique, as having its door upon a level with the surrounding country, although this is supposed by some to be the effect of a modern alteration. Near Clones are two large raths, one in good preservation, exhibiting distinct traces of its fosses and ramparts; the other smaller and much decayed. Danish forts are numerous; but the county is singularly deficient in those ancient ecclesiastical and military remains which abound in the neighbouring counties of Meath, Louth, Armagh, and Fermanagh. The only monastic structure of which any vestiges remain is that of Clones, which was a foundation of regular canons. It was destroyed by Hugh de Lacy shortly after the arrival of the English; but was rebuilt soon afterwards, and protected by the erection of a castle in its neighbourhood. An abbey of Conventual Franciscans was founded at Monaghan by one of the M'Mahons, but was afterwards totally destroyed, and a castle erected on its site, which also was in a ruinous state in the reign of James I. The ruins of the castle of Mannan are to be seen at Donaghmoyne near Carrickmacross.

The population of the county has been ascertained at the following periods:—In 1821 it amounted to 174,697; in 1831 to 195,536; in 1841 to 200,442; and in 1851 to 141,813. In 1841 Monaghan was one of the most densely peopled counties in Ireland, having no less than 401 inhabitants to each square mile; in 1851, however, this number had diminished to 287,—a decrease in ten years of 114 persons for each square mile, being the greatest decline of population exhibited by any Irish county during that period.

This county was represented in the Irish Parliament by four members,—two for the county at large, and two for the borough of Monaghan. The latter were struck off at the Union, and no alteration has since been made.

The district now forming the county of Monaghan is supposed to have been occupied by a tribe of the Scoti in the time of Ptolemy. Subsequently it formed part of the territory of Uriel and Orgial, and was long known as "MacMahon's Country," after a sept who for some time maintained their authority here. In the reign of Elizabeth it was reduced into shire-ground, and divided into the five baronies which still exist,—viz., Cremorne, Dartrey, Farney, Monaghan, and Trough. The whole of the county, which contains twenty-one parishes, is comprised within the diocese of Clogher.

MONAGHAN, the capital of the above county, is situated near its centre, a short distance north of the Blackwater, a place of considerable thoroughfare and business in the linen trade and the sale of agricultural produce. Its ancient name was *Muinechan* (The Town of Monks), given to it from the religious establishment formerly existing there. The principal buildings are a market-house, erected by Lord Rossmore in 1792, a court-house, and a parish church. In the immediate vicinity of the town is a Roman Catholic chapel, a Presbyterian meeting-house in the New Market, the county infirmary, the diocesan school-house, the barrack for cavalry at the northern entrance of the town, an extensive county prison, and the union workhouse. Its population in 1851 amounted to 3484. The other towns in the county whose population exceeds 2000 are as follows:—Carrickmacross, 2534; Clones, 2333; and Castleblayney, 2084. (H. S—R.)

MONARCHY. Literally translated, this imposing word signifies *single power*, implying government placed in the hands of one individual, that individual being the sole ruler of his people. Originally, the difficulty of obeying the wills of many different persons possessing authority, and not agreed as to the method of administration, led, in all probability, to the establishment of a monarchy. The corruption of the proto-republic thus gave birth to kings. A French philosopher has said, that when commonwealths become rotten they degenerate into monarchies; and a French emperor has given it as his opinion, that old monarchies can never be successfully converted into young republics. A third Frenchman has asserted that there exists no example of a people voluntarily destroying their own republic, and surrendering themselves and their laws to the irresponsible rule of a despotic monarch. The latter may, by force or cajolery, have imposed himself upon a nation; and, it may be added, that when the nation has been unfit for liberty, a salutary despotism may be for the country's good.

There is but one real basis for the stability of a monarchy, —love. The hatred of subjects denaturalizes the kingly system. According to Montesquieu, the true principle of monarchy is honour,—of a republic, virtue; which is very like many other of the distinctions drawn by Montesquieu, having in them very little difference indeed. It has been objected against what may be called the *legality* of monarchy, that if it had been of Divine origin, it would have rendered those subjected to it happy. Here again is a fallacy; for the monarchy of heaven itself was assailed by the angels who could not be happy under that Divine system.

The wellbeing of a people is perhaps never so perfectly secured as under a constitutional monarchy, which is, in fact, a republic with safeguards against revolution; or rather a commonwealth under which the people do not learn the "sacred right of insurrection," but accomplish all necessary revolutions quietly, surely, and according to law. When the accomplished Halifax was treating of despotic monarchs and turbulent republics in his *Character of a Trimmer*, he said:—"*We* take from the one the too great power of doing hurt, and yet leave enough to govern and protect us. We take from the other the confusion, the parity, the animosities, and the license, and yet reserve a due care of such a liberty as may consist with men's allegiance; but it being hard, if not impossible, to be exactly even, our government has much the stronger bias towards monarchy, which, by the general consent and practice of mankind, seems to have the advantage in dispute against a commonwealth." This advantage was acknowledged so long ago as the era of the Macedonian monarchy. The system was of course despotic; yet, if we may believe Quintus Curtius, the Macedonians had an innate affection for their kings:—"Ingenitam illi genti erga reges suos venerationem." But this is always advanced by interested rulers or writers in favour of despotism. The Poles followed another system, which they considered the best,—namely, the elective system. It was a miserable failure; and yet the people, by which must be understood the nobles only, were wont to boast of it in these terms,—"In other kingdoms the monarch holds the people, but *we* hold the monarch." The elective system is still followed in the case of that ecclesiastical monarch, the Pope, the electors of whom are supposed to be influenced by the Holy Ghost, in answer to the prayer, "Veni Creator Spiritus." According to Bishop Jewel, the prayer was once replied to by the appearance of an owl in the conclave; and, according to Beranger, the reply to the invocation was, "Non," dit le Saint Esprit, "je ne descends pas!" The state papers recently published having reference to the candidature of Wolsey for the papal throne, best show the system by which this elective monarchy was perpetuated. The third form is constitutional monarchy, according to which the sovereign is the first magistrate of a free people, with regard to whom there are laws in common, and rights and duties peculiar to each. And this constitutional monarchy may be in its origin elective, as that of England, when the nation, through Parliament, disinherited one family, elected a second, and then declared that the sceptre should be hereditary in such family, under certain stipulations. It may, however, be considered as a general rule, that *all* monarchies are the consequences of election on the part of the people. Except where a conquerer has chosen to rest on his right of the sword, there has seldom existed even an usurper who has snatched the crown without going through some ceremony by which he seemed to acknowledge, or the people were made to imagine, that the result was the effect of a cause traced to the love, veneration, free-will, and unshackled choice of the nation.

To a constitutional monarch laws are not manacles, but garlands. They adorn rather than oppress him. "There is a wantonness," says the noble statesman whom we have already quoted, "in great power, which men are generally too apt to be corrupted with, and for that reason a wise prince, to prevent the temptation arising from common frailty, would choose to govern by rules, for his own sake as well as for his people's, since it only secures him from errors, and does not lessen the real authority that a good magistrate would care to be possessed of. For, if the will of a prince is contrary either to reason itself or to the universal opinion of his subjects, the law, by a kind restraint, rescues him from a disease that would undo him. If his will, on the other side, is reasonable or well-directed, that will immediately becomes a law, and he is arbitrary by an easy and natural consequence, without taking pains or overturning the world for it." For a monarch under such restraint there is no doubt a far greater degree of happiness than was ever enjoyed by despots, who feared their own guards next to dreading their own people, and *that*, too, when the acknowledged system of government was comprised in the talismanic words, "Quod principi placuit, lex esto!" It was in those days when monarchy was supposed to mean, and to be, simply the will, more or less idle, of the monarch, that men were slaves whose very breath could scarcely be drawn in freedom, even when the tyrant slept. The old lines by M. Bret illustrates this sentiment exactly; and, "done into English," they run thus:—

"Upon his golden couch a tyrant dread,
In seeming tranquil sleep, reclined his head:
'Is slumber made,' said one, 'for wretch so rare?
Does Justice nod, and Heaven its victim spare?'
'Hush!' said a fakir, 'lest the noise you make,
E'en by a whisper, should the monster wake.
'Tis God who thus allows him to be blest,
That Innocence may have a moment's rest.'"

In classifying the great monarchies which have held the world in awe, St Augustine names but two,—the Baby-

lonian and the Roman. The more usual method is to reckon the four great monarchies,—the Assyrian, the Persian, the Grecian, and the Roman. Legend, however, notices a monarchy older than the oldest of these,—namely, the Chaldean. This dynasty, which, like that of Bacchus, is wanting in records, is said to have commenced 460 years after the creation, and under ten kings to have lasted half a million of years! The name of the first king of this wonderful dynasty was Alorus,—in other words, "Shepherd of his People,"—a significant title to commence with, it must be allowed. We are accompanied by the wonderful even when we have the traditionary. Thus of Nimrod (or Belus, the Orion of the skies), the first king named by Moses, we are told in a pretty story, doubtless suggestive of the Divine origin of his kingship, that as he was one day abroad hunting, he saw in the heavens the figure of a starry crown. Taking the appearance to have special reference to himself, he engaged a craftsman to copy the sparkling pattern; and when this was fashioned into a sparkling diamond crown, Nimrod wore the same as a symbol of the authority and the favour conferred on him by Heaven.

The *Assyrian* empire properly commences with Ninus, the son of Belus, who reigned in Assyria, built Nineveh, and captured Babylon. This took place about 2060 years B.C. About 1200 years elapsed before Jonah told of the disastrous end, in the streets, of Nineveh; and Sardanapalus gave way to the conquering Arbaces 820 years before that of the Redemption. The empire continued to exist, however, with narrower limits, till 621 B.C., when the second Sardanapalus perished like the first, and Assyria was divided among the conquerors.

The *Persian* monarchy, which may be said to have annexed, or to have been included in, that of Assyria, dates from Zoroaster, 2115 B.C. Its early annals present only inextricable confusion; but we find Cyrus, King of Persia, master of all Asia in the sixth century B.C.; and the Persian empire stood, under alternations of glory and disaster, till the conquering Alexander subjected the country, and laid the foundation of the Greek empire, 331 B.C.

The *Greek* or *Macedonian* empire had, in Alexander, for its chief the twenty-first king of Macedonia. Such part of that wide empire as, after the death of Alexander, was comprised in Macedonia, fell before the Roman Æmilius Paulus, who pronounced Macedon a Roman province, and (167 B.C) took its last king, Perseus, and his sons to Rome, where they walked in chains before the chariot of the conqueror.

The *Roman* monarchy, if it is to be dated from the building of the city by Romulus, commenced 752 B.C. Seven kings had reigned when, on the deposition of Tarquinius Superbus, the first consuls Brutus and Collatinus were appointed 509 B.C. The republic existed till the foundation of the imperial monarchy in the person of Julius Cæsar, 48 B.C. In the year of our Lord 363 the Roman empire was split into two divisions on the death of Jovian. The Western empire expired on the deposition of Romulus Augustulus, by Odoacer, King of the Heruli, A.D. 476. The Eastern empire, with Byzantium for its capital, existed nearly a thousand years later, its fall dating with the extinction of the imperial families of the Comneni and the Palæologi, A.D. 1453.

It would be impossible to name here all the other monarchies under which government has been administered; for of some, like that of Achaia, the names of the kings have been forgotten, and of others, like the Davids of Georgia, their acts are scarcely worth recording. In a tabular and alphabetical form, however, we give below some brief account of the existence of the principal monarchical systems which have won or exacted the obedience of mankind.

Alba.—Founded by Ascanius, 1152 B.C.; annexed to Rome by Tullus Hostilius, 665 B.C.

Algiers.—Founded as an independent monarchy in 1505 by Harush Barbarossa, a Sicilian renegade. Houssan, the thirty-second and last of the "Deys," was dethroned and expelled by the French in 1830.

Arcadia.—Founded by Pelasgus, 1521 B.C. The last king, Aristocrates II., was stoned to death, and Arcadia made a republic, 681 B.C.

Argos.—Founded by Inachus, 1856 B.C. It existed as a monarchy upwards of seven centuries, but it subsequently became a republic.

Armenia.—The kings of Armenia were absolute over their own subjects, but the country itself was successively subject to the three great monarchies; and the Roman power became paramount in Armenia after the dethronement of Tiridates, A.D. 62.

Assyria.—(See above).

Athens.—Cecrops founded a monarchy here 1556 B.C. After a period of nearly 500 years, occupied by seventeen kings, royalty was abolished, on the singular ground that it would be impossible to find such another king as Codrus, the last of the line.

Austria.—(See below, *Germany*).

Babylon.—(See above, *Assyria*).

Bavaria.—This monarchy was established in 1805, when the elector, Maximilian Joseph, was declared king.

Belgium was formed into a kingdom in 1831.

Bithynia.—The first independent king was Dydalsus, 383 B.C. The last sovereign, Nicomedes, bequeathed the kingdom to the Roman republic, 75 B.C.

Bœotia.—This monarchy, founded by Cadmus, 1493 B.C., was abolished by the Thebans, 1215 B.C.

Bohemia was originally governed by dukes. The regal title was conferred by the Emperor of Germany on Vratislaus in 1061. The crown was ultimately secured to the Austrian family by the treaty of 1648.

Bosphorus (Cimmerian).—A line of kings ruled here for about five centuries and a half. The last was Mithridates II., at whose deposition the Emperor Claudius made of the kingdom a province of the empire.

Brazil.—Erected into an empire, A.D. 1825.

Britain had its kings at the period of the Roman invasion. The first Christian king was Lucius, A.D. 179. Constantine added Britain to the Roman empire, A.D. 306. In the year 446 the Saxons were invited over by King Vortigern. The Saxon heptarchy was converted into a monarchy by Egbert, King of the West Saxons, A.D. 827. During the heptarchy, however, the most powerful king was called *Rex Gentis Anglorum.* From the establishment of the Norman line, A.D. 1066, the following are the dates and names of the successive dynasties that have possessed the English throne:—House of Lancaster, 1399; York, 1461; Tudor, 1485; Stuart, 1603; Brunswick, 1714.

Burmese Empire.—Founded by Alompra, from whom the reigning monarch is descended, in the middle of the last century.

Caliphate (The).—The first caliph was Abu Bekir ("Father of the Girl"), A.D. 632. After a succession of fifty-seven caliphs, the capture of Bagdad by Holagou Khan, A.D. 1258, put an end to the line in the person of Al Mostasim Billah. The Egyptian caliphate, which was the consequence of a schism, A.D. 908, flourished vigorously till the overthrow of the Eastern caliphate. When Selim I. annexed Egypt to Turkey in 1517, and received from the last of the Abbassides the key of the temple at Mecca, the Turkish sultan became the representative of the caliphs, and the "Father of the Faithful."

China has been governed by twenty-two dynasties since the establishment of the first dynasty, 2207 B.C. The last monarch of the Chinese race, Whay-tsong, of the House of Ming, hung himself, 1628. Since his death the Mogul race of Tsing has reigned in China.

Corinth.—The monarchy was founded by Sisyphus 1376 B.C. The glory of Corinth dates from the establishment of the republic 582 B.C. It fell under the dominion of Rome 146 B.C.

Denmark.—In the Danish annals there is a list of fifty-six kings previous to the period when Margaret united the three crowns of Sweden, Denmark, and Norway. The present king is the twenty-first sovereign of Denmark since the last-named era.

Egypt.—Vulcan, or "Elementary Fire," is fabulously said to have been the first king of this ancient monarchy. There is nothing that is said of the ancient royal records that can be relied on till the period of the foundation of the dynasty of the Pharaohs in the person of Mizraim, 2188 B.C. This dynasty disappeared before the conquering Cambyses 525 B.C. The Persian dynasty held Egypt till its conquest by Alexander, at whose death commenced the line of Ptolemies, beginning 304 B.C. with Ptolemy Soter, and terminating 27 B.C. with Cleopatra, the thirteenth sovereign of that line. Since that period it has never been, in the strict sense of the word, an independent monarchy.

England.—See *Britain.*

Epirus.—The annals of this monarchy are obscure. Neoptolemus, son of Achilles, is said to have been the first king, 1170 B.C. It was annexed to Macedon, 220 B.C., about fifty years after the death of its last king, the great Pyrrhus.

Etruria.—The monarchical system observed in this ancient kingdom deserves a word of notice in this place. The country anciently comprised twelve different nations, each of which had its respective monarch, under the title of Lucumon.

France.—This monarchy popularly dates from Pharamond, the Frank invader of Gaul, A.D. 418; his second successor, Merovæus, or Merovig, gave name to the line Merovingian. The Carlovingians began with Pepin, the father of Charlemagne, A.D. 751; the House of Capet with Hugh Capet, A.D. 987; House of Valois, Philip VI., 1328; Bourbon, Henri IV., 1589; the empire, Napoleon I., 1804; Bourbons restored, 1814; House of Orleans, 1830 to 1848; second empire, 1852.

Germany.—The "Holy Roman Empire" in the west was restored by the Pope, A.D. 800, in the person of Charlemagne. His line has been thus followed:—By the Saxon line, A.D. 911; the Franconian line, 1024; the Suabian line, 1138 to 1212. The imperial throne was occupied by sovereigns of various houses, but chiefly of Austria, from the latter date till the year 1438, when Albert II., a descendant of Rudolph of Hapsburg, commenced the *uninterrupted* line of Austria. In 1804 the elective German empire was abolished; but its last emperor, Francis II., became Francis I., hereditary emperor of Austria.

Greece.—The modern kingdom of Greece was founded in 1832 in the person of the Bavarian Otho, the reigning monarch.

Hanover was erected into a kingdom in 1814, George III. of England being its first king. The succession being in the male line only, Ernest, Duke of Cumberland, succeeded to the throne on the death of William IV., King of England and Hanover, in 1837.

Hayti has been a hybrid sort of monarchy from the time Dessalines was crowned emperor in 1804.

Holland.—This commonwealth became a kingdom in 1806, under Louis Bonaparte. After the fall of the French empire, William Frederick, Prince of Orange, assumed the style of King of the Netherlands, 1815.

Hungary, having become free of the German empire in 997, Stephen, Duke of Hungary, was named by the Pope "Apostolic King" of that country. After a line of thirty-two monarchs, it became permanently annexed to Austria (1527) by the marriage of Anne of Hungary with Ferdinand of Austria.

Ilium.—This kingdom was founded by Dardanus 1480 B.C.; and at the overthrow of Priam, its sixth king, had lasted about three centuries.

India.—The Ghiznian dynasty, the first of which we have authentic records, was founded by the invader Mahmoud Ghizni about the year 1000 of our era. After a succession of thirteen kings, Mahmoud Ghour established the short-lived dynasty of two kings, named after him, in 1186. The Patan or Delhi line, commenced in 1210 with the Kuttub-ul-Deen. The Mogul race of Timour commenced in 1525 in the person of the famous Zehir-ud-Deen Mahomed Baber, or the "Tiger." This once glorious race sank into insignificance in the middle of the last century, since which time the Mogul monarchs ceased to have any political importance until the temporary restoration of a Mogul chief, consequent on the outbreak of 1857.

Ireland.—The monarchical annals of Ireland contain lists of hundreds of kings, from the flood downwards. The first sole monarch, however, was Brian Boru, by election of the people, A.D. 1027. Nearly a century and a half later Henry II. of England became "Lord of Ireland."

Italy.—After the deposition of Romulus Augustus, A.D. 493, Odoacer, chief of the Heruli, assumed the title of "King of Italy;" the line existed about three quarters of a century, disappearing before the Lombard kings. In modern times the first and only crowned "King of Italy" was Napoleon I., A.D. 1805.

Japan has had an hereditary succession of ecclesiastical emperors from the year 660 B.C.

Jerusalem.—When the Crusaders captured the city, A.D. 1099, they established a kingdom which lasted eighty-eight years,—that is, till the recapture by Saladin, A.D. 1187. The first Christian king was the renowned Godfrey de Bouillon; its ninth and last was Guy de Lusignan. The monarchy was elective.

Jews.—The kingdoms of the Jews commence, it is almost superfluous to say, with Saul, chosen by lot; but it was not until the death of Solomon that the kingdoms divided into Judah and Israel, about 975 B.C. That of Israel lasted till Samaria was captured, and the ten tribes were carried into captivity by the Assyrians, 721 B.C. The kingdom of Judah existed till the year 587 B.C., when the temple and city were burned by the invading Nebuchadnezzar, who razed the walls of Jerusalem to the ground.

Lombardy.—The kingdom of the Lombards, a people from North Germany, existed from the year 570, when the Lombard soldiers at Milan proclaimed their chief Alboin king, till the year 772, when Charlemagne took possession of the country, and deposed the last king, Desiderius.

Lydia.—This kingdom boasted of a long line of monarchs, namely, from Argon, a descendant of Hercules, 1223 B.C., to Crœsus, after whose deposition the "kingdom of the richest king among kings" was annexed to Persia by Cyrus, 548 B.C.

Macedon.—Named above.

Media, although at different times annexed to Assyria and Persia, claims mention as an independent monarchy from the period of its revolt against Arbaces, 820 B.C., till its conquest by Cyrus, 537 B.C.

Mexico, when discovered in 1518, had long been under the rule of a line of monarchs. After it threw off the yoke of Spain, Iturbide was made emperor in 1822, but was deposed, and was shot for attempting to restore the empire in 1824.

Morocco.—A line of kings in Fez was commenced as early as the end of the eleventh century; the line did not expire till the opening of the thirteenth. About two centuries later the foundations of the empire of Morocco were laid by Hascen, of the race of Sheerefs, at a time when there were still chiefs in Fez styling themselves kings. The empire, as comprising Morocco, Fez, Susiana, Tophilet, &c., was not, however, consolidated and established till the

 seventeenth century, under Muley Abdel Melech, whose descendant is now on the throne.

Naples, or the *Two Sicilies*.—Goth, Lombard, Saracen, Norman, Gaul, and Spaniard, alternately occupied this locality. The treaty of Utrecht (1713) made Victor Amadeus, Duke of Savoy, King of the Two Sicilies, a title known as early as 1442. Subsequently the Savoyed king exchanged his crown for Sardinia, with a kingly title. The Two Sicilies belonged to the German empire till 1734, when Spain conquered them, and established there a line of Bourbon princes, of whom the present monarch is a descendant.

Netherlands.—See *Holland*, and *Belgium*.

Parthia.—The monarchy here lasted from the period of Arsaces, 250 B.C., to that of Artabanus V., A.D. 229, when it was annexed to the new kingdom of Persia.

Pergamus.—This kingdom was founded by Philetærus, 283 B.C. The last king, Attalus Philomater, bequeathed his kingdom to Rome, 133 B.C.

Persia was reconstructed by Ardisheer Babegan (Artaxerxes I.) Between the death of Alexander and this last period, Persia had seen the Syro-Macedonian dynasty of Seleucus and that of the Parthian Ash, or Arsaces. Artaxerxes I. was the founder of the Sassanian dynasty, which, amid triumphs and defeats, existed upwards of four centuries. Persia was subsequently possessed by the Caliphs and by the Tartars; afterwards by Timour Leng, at the beginning of the fifteenth century. A century later the disorganized monarchy was seized by Hussoon Uzun, chief of the tribe of "White Sheep," whose son Shah Ismael (1502) was the first of the nine shahs of the Suffavean dynasty. The Afghan line commenced with Mahmoud, A.D. 1722, and ended with the eighth and last monarch, Shah Rokh, 1750. After a few years of anarchy, the Zund dynasty succeeded in the person of Kureem Khan Zund. His last descendant, Lootf Ali Khan, was slain in 1794 by Aga Mahomed Khan, the founder of the Kujur dynasty, of which the reigning shah, Nasr-ul-Din, is the fourth sovereign.

Poland, at first governed by dukes, was raised to a sovereignty by papal authority under Boleslaus I., A.D. 999. The *Piast* kings of Poland were *native* sovereigns, and not a regular dynasty. The Jagellon line commenced at the close of the fourteenth century, and continued till the middle of the sixteenth. The monarchy existed in its elective form till 1795, when Stanislaus Poniatowski was deposed by Russia.

Pontus.—This kingdom was an offshoot from that of Persia. Darius Hystaspes, named "Artabazus," was the first sovereign of Pontus, 487 B.C. After the death of Mithridates VII., A.D. 40, the kingdom became a province of the Romans. Subsequently a new and Christian monarchy was established within a portion of the limits of the old kingdom of Pharnaces, Tigranes, and Mithridates. When the Crusaders, or "Latins," established their temporary empire at Constantinople, a dynasty of five successive sovereigns carried on the old succession from 1204 to 1261, under the name of the Greek empire of Nicæa. In the last-named year Michael Palæologus recovered Constantinople from Baldwin II.

Popes of Rome, as elected monarchs with temporal power, claim a word of notice in this record. Stephen II., the ninety-ninth pope, who was elected in 752, was the first who united the sovereign temporal and ecclesiastical dignities, in which he has been followed by 169 orthodox successors, one only of whom was an Englishman (Nicholas Breakspeare of St Albans), Adrian IV., 1154–1159.

Portugal.—The monarchy here dates from A.D. 1139, when Alphonso, Count of Portugal, was proclaimed king by the army, after defeating the Moors at Ourique. With the exception of the period 1580–1640, when Portugal was a province of Spain, and that of the French occupation in the present century, the independent monarchical system has been uninterrupted in Portugal.

Prussia, after being governed since 1134 by margraves, electors, or dukes, was raised to a kingdom in 1701. It has had six kings, of whom the present, Frederick William IV., began to reign in 1840.

Rome.—See above.

Russia.—From the period of Ruric, 862, to the commencement of the sixteenth century, the Russians were governed by sovereign dukes, called of Kiev, Vladimir, or Moscow. In 1533 Ivan Vasilievitch assumed the title of "Czar," and that title Peter the Great exchanged in 1708 for that of Emperor.

Sardinia or *Piedmont*.—See also *Naples*. The first king of Sardinia was Victor Amadeus, 1713. The present monarch, Victor Emanuel II., is the eighth of the line, four sovereigns of which have abdicated.

Scotland.—The Scottish annals name kings of Scotland as far back as the period of Alexander the Great; but it will suffice to state here, that Kenneth MacAlpine, by uniting Scots and Picts, became the first sole monarch of Scotland, A.D. 843. From that period till the accession of James VI. to the throne of England, A.D. 1567, the government was administered, more or less independently, by above forty kings.

Spain.—Few nations have seen so many different monarchical systems as Spain. At length the various crowns of the kingdoms of Oviedo, Navarre, Cordova, Castille, Leon, Barcelona, Aragon, and (Moorish) Granada, were united on the head of Ferdinand V. in 1512, since which period fourteen sovereigns have successively occupied the throne.

Sparta (Lacedæmon).—This celebrated republic under kings, some of whom were puppets and many were "absolute," enjoyed a long but a chequered career. The rule of kings begins with Lelex, 1516 B.C., and nearly thirteen hundred years elapsed before royalty was totally abolished.

Sweden.—Between the year 1001, when Olif Schoet Konung was elected first king of Sweden, to the year 1393, when the tyranny of Albert of Mecklenburg was followed by revolt, and that by anarchy, Sweden reckons twenty-one monarchs. In 1397 the three northern kingdoms were governed by one sovereign, but this union was repealed in 1523, when the patriotic Gustavus Vasa ascended the throne. The reigning monarch, Oscar, is the son of Charles John Bernadotte, originally a private soldier in the army of Louis XVI. of France.

Syria.—See *Assyria* and *Persia*.

Thrace.—The government here was originally monarchical, but divided among independent princes. It was annexed to the Macedonian empire about 335 B.C.

Turkey.—This monarchy established itself in Europe by the capture of Constantinople under Mahomed II. in 1453. That sultan was the ninth of a line founded in Asia by Othman, A.D. 1299. Abdul Medjid is the twenty-fifth sultan since the fall of the great Christian capital in the east of Europe.

Vandals and *Goths*.—The Italian monarchy of the latter has been already noticed. About the end of the fourth century they founded a kingdom in Spain, which expired in the eighth century with Roderick, their last king. In the year 428 Genseric crossed from Spain, and established the dynasty of Vandal kings in Africa. The line consisted of six monarchs, with the last of whom fell modern Carthage, Arianism, and the royal Vandal line, before the conquering sword of orthodox Belisarius, A.D. 534.

Wirtemberg, formerly a ducal electorate, became a kingdom at the close of 1805, of which the reigning king, William I., is the second sovereign, having succeeded his father Frederick in 1816.

By the above list the reader may learn in what period the strongest empires have fallen into decay, and may safely

predict that the mightiest which have followed them will, like them, pass away, and all earthly distinctions shrink to nothing. When *all* crowns lie shivered, as one day they must, then will be applicable to the entire roll of once living monarchs the noble lines which Beaumont penned on the royal tombs in Westminster:—

"Mortality, behold and fear!
What a charge of flesh is here!
Think how many royal bones
Sleep within these heaps of stones!
Here *they* lie, had realms and lands,
Who now want strength to move their hands;
Where, from their pulpits, seal'd with dust,
They preach, 'In greatness is no trust.'
Here's an acre, sown indeed
With the richest, royalest seed
That the earth did e'er suck in
Since the first man died for sin.
Here the bones of birth have cried,
Though gods they were, as men they died.
Here are wands, ignoble things,
Dropt from the ruin'd state of kings.
Here's a world of pomp and state
Buried in dust, once dead by fate."

(J. D—B—N.)

MONASTEER, a seaport-town of Tunis, on the Mediterranean, 85 miles S.E. of the town of Tunis; Lat. 35. 45. N., Long. 10. 49. E. It has a citadel, a harbour, manufactures of woollen stuffs, and a considerable trade. Pop. 12,000.

MONASTIR, or BITOLIA, a town of European Turkey, capital of a department of the same name, in the province of Macedonia, is situated on the Vestrizza, at the edge of a large plain, 90 miles W.N.W. of Salonika. Most of the commercial intercourse between Albania and the Ægean is carried on through it; and it is the centre of all military operations in Albania, Macedonia, Thessaly, and Bosnia. Pop. 15,000.

MONCEY, BON-ADRIEN JEANNOT, Duc de Conégliano, was the son of an advocate, and was born in 1754 at Moncey, the village near Besançon of which he afterwards assumed the name. In 1774 his relations, yielding to his master-passion for a soldier's life, allowed him to enrol in the gendarmery of Luneville. After passing into the volunteers of Nassau-Siegen, and then into the "Chasseurs Cantabres," he became captain in 1791; and in 1794 we find him, as general-in-chief, defeating the Spaniards at Villa Nova. Chancing to be in Paris at the revolution of the 18th *brumaire*, he zealously supported Napoleon, and thus opened a path to future preferment. He was appointed by the First Consul inspector-general of the gendarmery, and in 1804 was rewarded with a marshal's baton, the title of Duc de Conégliano, and the rank of grand officer of the Legion of Honour. In 1808 he commanded in the Spanish province of Catalonia, but was recalled by Bonaparte to the command of the gendarmery. In 1813 he received the additional appointment of commander-in-chief of the Parisian National Guard, and was entrusted with the protection of the city during the Russian campaign of Napoleon. No one was more active during the defence of the capital in 1814 than Marshal Moncey. He organized the National Guard of Paris, and was among the last to lay down his arms after the capitulation of the city. At the beginning of the Hundred Days his submission was tendered to the Bourbons, but was withdrawn as soon as Napoleon landed from Elba. He was nominated president of the commission for the trial of Marshal Ney in 1815; yet, rather than accept this nomination, he chose to be deprived of all his titles and to lie for three months in the prison of Ham. In 1816 he was restored to his dignities, and was received into the favour of the king. On the outbreak of the Spanish war in 1823 Moncey was far advanced in age; he accepted, however, the command of a division, and served in Catalonia with all the fire and vigour of his prime. He died in April 1842.

MONCOLIERI, a town of Sardinia, North Italy, is pleasantly situated on the slope of a hill, near the right bank of the Po, 5 miles S. of Turin. The town is entered by two gates. It possesses an ancient palace, two handsome churches, several convents, an elegant college, several schools, a town-hall, a theatre, and an hospital. Manufactures of earthenware, tiles, cabinet-work, and silk, are carried on; and the town has a considerable trade in cattle, for which there is a fair in October. Pop. 9129.

MONCREIFF, SIR HENRY WELLWOOD, Baronet, D.D., an eminent Scottish divine, was the son of the Rev. Sir William Moncreiff and Catherine Wellwood, and was born on the 7th February 1750, at Blackford, a parish in Perthshire, of which his father was minister. After completing his elementary education at the parochial school of Blackford, he repaired to the university of Glasgow in 1763, with the view of pursuing his studies for the Scottish church. In the midst of a brilliant collegiate career he had the misfortune to lose his father. The patrons of the charge thus left vacant at once resolved to reserve the living for young Sir Harry, who had already given such promise of future eminence. He removed to Edinburgh in 1768 to prosecute his theological studies; and on the 15th August 1771 was ordained minister of his native parish. The superior talents of the young preacher early attracted the attention of the Scottish metropolis; and in October 1775 he was appointed minister of St Cuthbert's parish in the city of Edinburgh. Here he commenced the arduous duties of his office with great zeal, and continued to labour with remarkable energy, at once for the spiritual advancement of his parish and for the general good of the Scottish church. He was possessed of talents which might have won for him a bright reputation in any of the higher walks of public distinction, but he preferred the more exalted, if less ambitious career of fulfilling the pious duties of the Christian pastor, and of freeing his church from what he conceived to be serious barriers to her spiritual progress. "Had he not preferred his church to every other object," says Lord Cockburn, "there is no public honour to which he might not have fought his way." (*Life of Lord Jeffrey*, vol. i., p. 188). When Sir Harry entered upon public life the moderate party was dominant in the Scottish church, and political independence was seldom to be met with. Worldly interest and his own secular rank might have inclined him to the majority, but he at once took a decided position with the liberal and evangelical party. He soon became their leader and oracle; and among the people his "mere name," says Cockburn, "was a tower of strength." He was unanimously chosen moderator of the General Assembly of his church in 1785, and during his subsequent career had the same honour repeatedly conferred upon him. He possessed great power and energy as a debater, and was distinguished for soundness of judgment and unflinching integrity. The writer just quoted, who knew Sir Harry well, remarks in his *Memorials of his Time*, p. 234,—"In comparison with him every other churchman who has appeared since I knew the world must withdraw. Nothing that I could say would express one-half of my affectionate and reverential admiration of this great man." He shone more on the platform than in the pulpit; and public speaking, rather than literary labour, seemed to be his peculiar sphere. As a writer he was comparatively feeble. His *Life of Dr John Erskine* is in no way remarkable; and his three volumes of sermons do not possess very high merits. They were published in 1829 and 1831, with a brief memoir by his son, Lord Moncreiff. His opinions were uniformly liberal and charitable, and he was characterized by very great benevolence. He took a deep interest in whatever was calculated to relieve suffering or encourage merit.

Among his personal friends he numbered the most distinguished names in Scotland during his time. He died in August 1827, leaving his title to his son James Wellwood Moncreiff, who had been chosen Dean of Faculty during the previous year. Sir James was born in 1776, and was educated at Edinburgh, Glasgow, and Oxford. He devoted himself entirely to the law, but inherited much of his father's zeal for the evangelical cause of the Presbyterian Church and for the politics of the Scottish Whigs. He was a man of an energetic mind, and was distinguished for great zeal and purity. So exceedingly conscientious was he, that Lord Jeffrey, who had the greatest regard for him, used to call him "the whole duty of man." He was raised to the bench under the title of Lord Moncreiff in 1829. He died on the 30th of March 1851.

MONDONÊDO, a town of Spain, Galicia, 30 miles N.N.E. of Lugo. The streets are paved and clean, and the houses generally commodious. The cathedral, commenced in 1221, has an image of wonderful remedial power, said to have been conveyed from London at the Reformation. The town and neighbourhood was sacked by Mathieu in 1809. Pop. 6305.

MONDOVI, a town of Sardinia, capital of a cognominal department in the province of Coni, and see of a bishop, stands on a hill near the Ellero, 53 miles W. of Genoa. The town proper, or Piazza, is situated on the summit; and the three suburbs of Carazzone, Brea, and Piano, on the sides and at the foot of the hill. The upper town is walled, and contains a large *piazza* of a hexagonal shape, a cathedral, four other churches, an episcopal palace, several convents, and a royal college. The manufactures consist of woollen and cotton stuffs, silk, leather, iron, earthenware, &c.; and the trade is considerable. Mondovi was the scene of a victory gained by Napoleon in 1796 over the Sardinian troops under Colli; and three years later was taken and pillaged by General Moreau. Pop. (1851) 17,370.

MONEY.

MONEY[1] (Gr. *Μονητα, νόμισμα*; Lat. *moneta, pecunia, nummûs*; Fr., *monnaie*,) the name given to the commodities or articles which the people of different countries universally accept, either voluntarily or by compulsion, as equivalents for their services, and for whatever else they may have to dispose of.

PART I.—METALLIC MONEY.

SECT. 1.—*Circumstances which led to the use of Money. Principal properties which all Commodities used as such ought to possess. Metallic Money not a Sign or a Measure of Value, but a real Equivalent.*

Circumstances which led to the use of money.

Were the division of labour unknown, and did individuals or families directly supply themselves with the articles required for their subsistence and accommodation, there would be no exchanges, and, consequently, no money. But, after this division has been established, the employment of money becomes necessary, or, at least, highly advantageous. A small part only of a man's wants is then directly supplied by his own exertions. The greater part is indirectly supplied by his exchanging services, or articles belonging to him, for such services or articles rendered by or belonging to others as he has occasion for, and they are willing to furnish. Every man thus lives by exchanging, or becomes in some measure a merchant, and the society itself grows to be what is properly a commercial society.

"But when the division of labour first began to take place, this power of exchanging must frequently have been very much clogged and embarrassed in its operations. One man, we shall suppose, has more of a certain commodity than he himself has occasion for, while another has less. The former, consequently, would be glad to dispose of, and the latter to purchase, a part of this superfluity. But, if this latter should chance to have nothing that the former stands in need of, no exchange can be made between them. The butcher has more meat in his shop than he himself can consume, and the brewer and the baker would each be willing to purchase a part of it; but they have nothing to offer in exchange except the different productions of their respective trades, and the butcher is already provided with all the bread and beer which he has immediate occasion for. No exchange can, in this case, be made between them. He cannot be their merchant, nor they his customers; and they are all of them thus mutually less serviceable to one another. To avoid the inconveniency of such situations, every prudent man, in every period of society, after the first establishment of the division of labour, must naturally have endeavoured to manage his affairs in such a manner as to have at all times by him, besides the peculiar produce of his own industry, a certain quantity of some one commodity or other, such as he imagined few people would be likely to refuse in exchange for the produce of their industry."[2]

This commodity, or *Marchandise banale*, as it is termed by the French, whatever it may be, is *money*.

Commodities used as money.

Different commodities have been used as money in different countries and states of society. Those nations which chiefly subsist by the chase, such as the ancient Russians, and the greater part of the Indians who occupy the unsettled portions of America, use the skins of wild animals as money.[3] In pastoral societies cattle are sometimes used for that purpose. Homer tells us that the armour of Diomed cost only *nine* oxen, whilst that of

[1] Etymologists differ respecting the derivation of the word money. Some contend that it comes from *monere* (*quia nota inscripta de valore admonet*), because the stamp impressed on coined money indicates its weight and fineness—(Bouteroue, "Recherches sur les Monnoyes de France, p. 1); and others that it originates in the circumstance of silver being first coined at Rome in the temple of *Juno Moneta*.—Suidas, *in voce* Μονητα.

[2] *Wealth of Nations*, M'Culloch's ed., in one vol., p. 10.

[3] Storch, *Traité d'Economie Politique*, tom. iii. p. 16; Ulloa, *Mémoires Philosophiques sur l'Amerique*, tom. ii. p. 100. Skins, hides, or pieces of leather marked with a stamp (*corium forma publica percussum*) are said to have been used as money by the Carthaginians and Spartans, (Seneca, *De Beneficiis*, lib. v. c. 14. Eckhel, *Doctrina Numoram Veteram*, i. *Proleg.*, p. xx., etc). This statement, which is not a little obscure, has been very differently interpreted; some critics contending that it merely refers to such entire skins or hides as were bartered for other things, while others contend that it is meant to designate small bits of leather, marked with a stamp, and (like our bank-notes) substituted for and representing real money. It seems, perhaps, most probable that both interpretations may be true, that is, that entire skins and bits of leather, marked with stamps, may have been used sometimes in the one way and sometimes in the other. The stamp on the skin or hide might represent its weight, and that on the bit of leather its nominal value, or the money to be given for it to the holder.

Glaucus cost a *hundred*.[1] The etymology of the Latin word (*pecunia*) signifying money, and of all its derivatives, would seem to prove that cattle (*pecus*) had been the primitive money of the Romans.[2] And that they had been used as such by the ancient Germans is obvious; for their laws uniformly fix the amount of the penalties to be paid for offences in cattle.[3] In remoter ages corn was very generally used in agricultural countries, as money; and even now, nothing is more common than to stipulate for corn rents and wages. Other articles have been used in other countries. Salt is said to be the common money of Abyssinia.[4] *Cowries*, a species of shells gathered on the shores of the Maldive Islands, are used in smaller payments throughout Hindostan, and form the only money of extensive districts in Africa.[5] Dried fish serves as money in Iceland and Newfoundland;[6] and Adam Smith mentions that, at the period of the publication of the "Wealth of Nations" (1776), it was customary in a village in Scotland for workmen to carry nails, as money, to the baker's shop and the alehouse.[7]

Defects of these commodities.

But these articles universally want some of the principal properties which money ought to possess. Products must frequently be brought to market which are worth only part of an ox and part of a skin; but as an ox could not be divided, and as the division of a skin would most probably deprive it of part of its value, they could not be exchanged for such money. Divisibility is not, however, the only indispensable quality in a commodity used as a medium of exchange. It is farther necessary that it should admit of being kept for an indefinite period without deteriorating; that it should, by possessing great value in small bulk, be easily carried about; and that one piece of money of a certain weight and fineness, should be precisely equivalent to every other piece of money of the same weight and fineness. But none of the commodities specified above, as having been used as money, possesses these properties. Though cattle had been sufficiently divisible, they could neither be preserved, nor transported from place to place, without a great deal of trouble and expense; while, owing to the difference in their qualities, one ox of a superior might be worth two or three oxen of an inferior variety. It is plain, therefore, that they could not serve as money except in a very rude state of society, when the arts were almost unknown, and the rearing of cattle formed the principal employment. Corn is sufficiently divisible; but its bulk is far too great in proportion to its value to admit of its easy transportation, and it also is of very different and not easily appreciated qualities. Salt, shells, and fish, are all open to insuperable objections. Equal quantities of all of them differ very greatly in their values; some of them cannot be divided, and others cannot be preserved or transported without much loss.

These commodities were also deficient in a still more important particular. Their value was not sufficiently invariable to permit of their being advantageously used as money. They were not durable or lasting, nor was it possible to adjust their supply so as to avoid sudden fluctuations of price. The occasional abundance and scarcity of pasture has a powerful influence over the price of cattle, which is still more seriously affected by the occurrence of epidemical diseases, and other contingencies. The fluctuations in the price of corn, arising from variations of the seasons, are too frequent and obvious to require to be pointed out. And in the islands where cowries are picked up, a strong gale from a particular point of the compass has frequently, in a few hours, sunk their value considerably. It was not, therefore, to be expected that such commodities should be either generally or permanently used as money in civilised societies. Parties would very frequently be unwilling to buy, or barter produce for articles which might, in a few weeks, or even days, lose a third or a half of their value.

Gold and silver the fittest materials for money.

The desire of uniting the different qualities of invariability of value, divisibility, durability, facility of transportation, and perfect sameness, doubtless formed the irresistible reasons which have induced all civilised communities to employ gold and silver as money. Though far from invariable, the value of these metals changes only by slow degrees; they are readily divisible into any number of parts, which may be reunited, by means of fusion, without loss; they do not deteriorate by being kept; their firm and compact texture makes them difficult to wear; their cost of production, especially of gold, is so considerable, that they possess great value in small bulk, and can, of course, be transported with comparative facility: and their identity is perfect, the pure gold and silver supplied by Russia and Australia having precisely the same qualities with that furnished by California and Peru. No wonder, therefore, when almost every property necessary to constitute money is possessed in so eminent a degree by the precious metals, that they have been used as such from a very remote æra. Their employment in this function is not ascribable to accident, to the genius of any individual, or to any peculiar combination of circumstances. It grew naturally out of the wants and necessities of society, on the one hand, and the means of supplying them possessed by these metals, on the other. They became universal money, as Turgot has observed, "not in consequence of any arbitrary agreement among men, or of the intervention of any law, but by the nature and force of things."

Introduction of gold and silver as money.

A considerable period must necessarily have elapsed, after the introduction of the precious metals into commerce, before they were used generally as money. But, by degrees, the various qualities which so peculiarly fit them for this purpose would become obvious; and, in

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[1] *Iliad*, lib. 6, lin. 235. Garnier contends, in a note to his translation of the *Wealth of Nations* (v. p. 18, ed. 1822), that by oxen, in the statement now referred to, Homer did not mean the animals so called, but coins impressed with the figure of an ox. But though the oldest Attic and some other ancient coins are marked with an ox, it does not follow that cattle were not used as money previously to their being issued. Indeed, the fair presumption is, that that circumstance was the cause of their figures being impressed on the coins.

[2] Morellet, *Prospectus d'un Nouveau Dictionnaire de Commerce*, p. 115.

[3] Storch, *in loco citato*.

[4] *Wealth of Nations*, p. 10.

[5] Dans les pays où le cuivre a trop de valeur pour pouvoir représènter celle des plus menues denrées, on est encore oblige lui substituer quelque autre matière plus commune. C'est cette circonstance qui a fait adopter aux Indiens l'usage des *cauris* en guise des petite monnoie. Cet usage pourroit paroître etrange dans les pays aussi riches et d'une civilisation aussi ancienne que le Bengale et l'Indoustan: maise le cuivre y est si rare, et les vivres y sont a si bon marche, qu'une pièce de la valeur de 1 cop. et ¼ [about a halfpenny English] peut y acheter une quantite des denrees suffisante pour la subsistence journalière d'un homme du peuple. On est donc oblige de deviser la plus petite monnoie de cuivre en plusieurs fractions; et comme une monnoie d'aussi peu de valeur couteroit plus à fabriquer qu'elle ne pourroit valoir, on la remplace par un coquillage dont la nature fait présque tous les fraix. Quelque mince que soit la valeur d'un *cauris*, elle suffit dans ces contrees fertiles pour acheter une pièce des bananes ou quelque autre fruit commun."—Le Goux de Flaix, *Essai sur l'Indoustan*, tom. i. pp. 143-226, quoted by Storch, *Economie Politique*, tom. iii. p. 133.

[6] Smith, *ubi supra;* and Horrebow, *Description de l'Islande*, tom. ii. p. 90.

[7] *Wealth of Nations, loc. cit.*

consulting their own advantage, individuals would endeavour to exchange some portion of their produce for commodities which could be easily concealed or carried about, which did not deteriorate by being kept, and of which they could give a portion that would be equivalent to, and readily accepted for, any article they might afterwards wish to obtain. When first brought to market, gold and silver, like copper, iron, or any other metal, were in an unfashioned state, in bars or ingots. Sheep, oxen, corn, cloth, &c., were then bartered for gold or silver, exactly as they were bartered for iron, copper, tin, or anything else. The parties having agreed upon the *quality* and *quantity* of the metal to be given for the goods, the latter was ascertained by weight. Nor is this a mere conjectural statement, advanced in a later age to explain appearances, and resting on probability only. Aristotle[1] and Pliny[2] tell us, that such was, in fact, the method by which the precious metals were originally exchanged in Greece and Italy; and the sacred writings present us with a remarkable example of the prevalence of the same primitive practice in the East. We are there told that Abraham weighed four hundred shekels of silver, and gave them in payment of a piece of ground he had purchased from the sons of Heth.[3] It is also mentioned that this silver was "current money with the merchant," an expression which evidently refers to its quality only; for, had it been coined, or marked with a stamp, indicating its weight and fineness, it would have been unnecessary to weigh it. These ancient practices still subsist in various countries. In many parts of China, gold and silver do not circulate as coin under the authority of a public stamp. When exchanged, they are cut into pieces, supposed to be nearly proportioned to the value of the article they are to be given for; and the pieces are then weighed to ascertain their precise value. This practice is also prevalent in other countries.[4]

Before the art of metallurgy was well understood, the baser metals were frequently used as money. Iron was the primitive money of the Lacedemonians, and copper of the Romans. But these metals deteriorate by being kept; and, besides this defect, the rapid improvement of the arts, and the consequent reduction of their price, speedily rendered their bulk in proportion to their value much too great to permit of their continuing to serve as money. Copper, however, is still advantageously used in the form of tokens, convertible into silver in very small payments. In Great Britain, copper pence and half-pence are rated far above their real value. But as their issue is exclusively in the hands of government, and as they are legal tender to the extent of one shilling only in any one payment, this over-valuation has not, for reasons which will be afterwards explained, had any bad effect.[5]

The trouble and inconvenience attending the weighing of the metal in every exchange of gold or silver for commodities, must have been early experienced. But the greatest obstacle to the use of unfashioned metals as money, would undoubtedly be found in the difficulty of determining their quality, or the degree of their purity, with sufficient facility and accuracy. The operation of *assaying* is one of great nicety and delicacy; and, notwithstanding all the assistance derived from modern art, it is still no easy matter to ascertain the precise degree of purity of a piece of metal. In early ages, such an operation must have been performed in a clumsy and bungling manner. It is most probable, indeed, that when the precious metals were first used as money, their quality would be appreciated roughly by their weight and colour. A very short experience would, however, be sufficient to show the inexactness of conclusions derived from such loose and unsatisfactory criteria; and the devising of some method by which the fineness of the metal offered in exchanges might be easily and correctly made known, would very soon be felt as indispensable to the general use of gold and silver as money. Such a method was not long in presenting itself. It was early discovered that the purity of the metal would be indicated, and the trouble and expense of weighing it avoided, by marking each piece with a *public stamp*, declaring its weight and fineness. Such seem to have been the various steps which led the ancients, at a very remote æra, to the introduction of coined money.[6] It was an invention of the greatest utility, and has powerfully contributed to facilitate commerce, and to accelerate the progress of civilisation and the arts.[7] Coinage.

Advantages of coined money.

"Without some article of known exchangeable value, such as coin, readily received as an equivalent for other things, the interchange of commodities must have been very limited, and consequently the divisions of labour very imperfectly established. Now, money obviates these evils, and by a twofold operation, augments production. In the first place, it saves all that time and labour which, while the intercourse between man and man is carried on by barter, must frequently intervene before a person can be supplied with the quantity of the commodity which he wants. In the second place, and in consequence of its saving the time and labour which must otherwise be spent in effecting exchanges, it multiplies the transactions of mercantile industry, and thus allows the divisions of employment to be more thoroughly established. By the first operation, it disengages a very considerable portion of labour from an unproductive occupation, and enables it to receive a more useful direction. By the second operation, it increases in a very high degree the productive powers of the labour already usefully employed. It assists every man in availing himself of the skill and dexterity which he may have acquired in any particular calling, and promotes cultivation in a manner suitable to the climate and soil of different districts, and of different countries. And by both these operations, coined money increases to an extent, not easy to be calculated, the wealth of civilised communities."[8]

But however great the advantages attending the use of coins, their introduction did not, in any degree, affect the principle of exchanges. Equivalents are still given

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[1] *Polit.* lib. i. cap. 9. [2] *Hist. Nat.* lib. 33, cap. 3. [3] *Genesis*, chap. xxiii. verse 16.

[4] Goguet, *De l'Origine des Loix*, &c., tom. i. p. 269.

[5] See Memorandum on the Silver Coinage of 1817, by the Master of the Mint, p. 378 of the Appendix to the Lords' Report on the Resumption of Cash Payments by the Bank.

[6] Goguet, *De l'Origine des Loix*, &c., tom. i. p. 268, 4to. edit. See also Park's *Travels*, vol. i. p. 464, 8vo. edit.

[7] The Roman jurists have given a brief, but clear and comprehensive, account of the circumstances which led to the use of coined money.—*Origo emendi vendendique a permutationibus cœpit. Olim enim non ita erat nummus; neque aliud merx, aliud pretium vocabatur; sed unusquisque, secundum necessitatem temporum ac rerum, utilibus inutilia permutabat, quando plerumque evenit ut quod alteri superest alteri desit. Sed quia non semper, nec facile concurrebat, ut, cum tu haberes quod ego desiderarem, invicem haberem quod tu accipere velles, electa materia est, cujus publica ac perpetua æstimatio difficultatibus permutationum æqualitate quantitatis subveniret; eaque materia formâ publicâ percussa, usum dominiumque, non tam ex substantiâ præbet quam ex quantitate; nec ultra merx utrumque, sed alterum pretium vocatur.*—(Digest, lib. xviii., tit. i., *De Contr. Empt. Leg.* i.)

[8] Torrens *On the Production of Wealth*, p. 305.

Money.

for equivalents. The exchange of a quarter of corn for an ounce of pure unfashioned gold bullion, is undeniably as much a barter as if the corn were exchanged for an ox, or a barrel of beer. But supposing the metal to be formed into a coin, that is, impressed with a stamp indicating its weight and fineness, that circumstance would evidently make no change in the terms of the barter. The coinage saves the trouble of weighing and assaying the bullion, but it does nothing more. A coin is merely a piece of metal of a known weight and purity, and the commodities exchanged for it are always held to be of equal value. And yet these obvious considerations have been very generally overlooked. Coins, instead of being viewed in the same light as bullion or other commodities, have been regarded as something quite mysterious. They are said to be both *signs* and *measures* of value. But a sovereign is not a sign, it is the thing signified. A promissory-note payable on demand, or at some stated period, may not improperly be considered as the sign of the specie to be paid for it; but that specie is itself a commodity possessed of real exchangeable worth. It is equally incorrect to call money a measure of value, at least in the peculiar sense in which that phrase is commonly understood. Gold and silver do not measure the value of commodities, more than the latter measure the value of gold and silver. Everything possessed of value may either measure, or be measured by, everything else possessed of value. When one commodity is exchanged for another, each measures the value of the other. If the quartern loaf sold for a shilling, it would be quite as correct to say, that a quartern loaf measured the value of a shilling, as that a shilling measured the value of a quartern loaf.

Coins not signs of value: in what sense measures of value.

Standards of value.

The quality of serving as a measure of value is, therefore, inherent in every commodity. But the slow degrees by which the precious metals change their value, renders them peculiarly well fitted for forming a standard by which to compare the values of other and more variable articles. To this standard reference is almost always made in estimating the value of products in civilised countries. We do not say that one man is worth a thousand acres of land, and that another is worth a thousand sheep, but we ascertain for how much gold or silver the land and the sheep would respectively exchange, and then say that their proprietors are worth so much money. But in this there is nothing mysterious. We merely compare the value of one commodity with the value of another. And as coin or money is the most convenient standard of comparison, the value of other commodities is usually estimated or rated in it.

Non-existence of an abstract or ideal standard.

It is obvious, from this statement, that the exchange of one commodity, or set of commodities, for another, may sometimes be adjusted by referring to money, without any money being actually in the possession of either of the parties to the exchange. If a horse, for example, commonly sold for £10, an ox for £5, and a sheep for £1, the animals might be exchanged in this proportion without the intervention of money. The frequent recurrence of transactions of this kind seems to have given rise to the notion of an abstract or ideal standard of value. Thus, instead of saying that a horse is worth £10, an ox £5, &c., it has been contended that it might as well be said that they are respectively worth $10x$, $5x$, and $1x$; and, since the comparative values of commodities may be as clearly expressed in this way as in sums of money, that the latter may be discarded as a standard, and a set of arbitrary terms adopted in its stead. But those who argue thus completely mistake the nature and functions of a standard. Its object is not merely to mark the known relations between different commodities, but also to enable those which are unknown to be readily discovered. And although a series of arbitrary terms may serve well enough for the first of these purposes, it is quite impossible that it can ever serve for the second. This, however, is the principal object of a standard; and it is sufficiently plain that nothing can be used as such unless it possess the same properties as the things with which it is to be compared. To measure length, a standard must have length; to measure value, it must have value. The value of commodities is ascertained by separately comparing them with money, and we express their relation to each other by stating the result of our inquiries; that is, by mentioning the number of dollars, of pounds, or of fractions of a pound, they are respectively worth. And, when any new commodity is offered for sale, or when any change is made in the cost of an old one, we ascertain its relation to the rest, by comparing it with a dollar or a pound. It would be impossible, however, to do this, were the terms dollar or pound purely arbitrary, and referable to no really valuable article. We might as well try to estimate distances by an imaginary inch or an imaginary foot, as to estimate prices or values by an imaginary shilling or an imaginary sovereign. When we say that an ox is worth £5 and a sheep £1, we not only mean that each is worth a certain amount of gold or silver, but also, that when an ox and a sheep are compared together—that is, when the one serves as a standard by which to estimate the value of the other—one ox is worth five sheep. But suppose that we wish to ascertain what is the relative value of some other commodity—a hat, for example—to oxen or sheep. Of what use would it be to be told that one ox was worth five sheep, or that when the value of an ox was represented by the term "$5x$," the value of a sheep was represented by the term "$1x$"? It is not the relation between oxen and sheep, but the relation between these animals and hats, that we are desirous of learning. And, though this relation may be learned by comparing the cost of oxen and sheep with the cost of hats, or by ascertaining for how much of some other really valuable commodity an ox, a sheep, and a hat will respectively exchange, it is obvious it will never be learned by comparing them with x or z, or other arbitrary term or symbol. It would not, in truth, be more absurd to attempt to ascertain it by comparing them with the hieroglyphics on an Egyptian sarcophagus. Nothing that will not exchange for something else can ever be a standard or measure of value. Commodities are always compared with commodities, and not with abstract terms. Men go to market with real values, or their equivalents, in their pockets. And it is to something possessed of real worth—to the gold contained in a sovereign, and not to the word sovereign—that they always have referred, and must continue to refer, in estimating value.[1]

This principle has been neatly and perspicuously stated by Locke:—"Men, in their bargains," says he, "contract not for denominations or sounds, but for the

[1] The following passage of Montesquieu has often been referred to in proof of the existence of an ideal standard:—"Les noirs de la côte d'Afrique ont un signe des valeurs sans monnoie; c'est un signe purement idéal fondé sur le degré d'estime qu'ils mettent dans leur esprit à chaque marchandise, à proportion du besoin qu'ils en ont; une certaine denrée, ou marchandise, vaut trois macutes; une autre, six macutes; une autre, dix macutes; c'est comme s'ils disoient simplement trois, six, dix. Le prix se forme par la comparaison qu'ils font de toutes les marchandises entre elles: pour lors, il n'y a point de monnoie particulière, mais chaque portion de marchandise est monnoie de l'autre."—*Esprit des Loix*, liv. xxii. cap. 8.

But, instead of giving any support to the notion of an abstract standard, this passage might be confidently referred to in proof of its

Money.

intrinsic value; which is the quantity of silver (or gold) by public authority, warranted to be in pieces of such denominations. And it is by having a greater quantity of silver (or gold) that men thrive and grow richer, and not by having a greater number of denominations; which, when they come to have need of their money, will prove but empty sounds, if they do not carry with them the real quantity of silver (or gold) that is required."[1]

In common mercantile language, the giving of money for a commodity is termed *buying*, and the giving of a commodity for money, *selling*. *Price*, unless when the contrary is particularly mentioned, always means the value of a commodity rated in money.

Having thus endeavoured to explain the circumstances which led to the introduction of money, and to show what it really is, and what it is not, we proceed to investigate the laws by which its value is regulated. It is chiefly from the prevalence of erroneous opinions on this subject, that the theory of money has been so much misunderstood.

Sect. II.—*Circumstances which Regulate the Exchangeable Value of Money.*

Value of money:

This branch of our subject naturally divides itself into two parts: 1st, An inquiry into the principles which regulate the exchangeable value of money when the power to supply it is free or unfettered; and, 2d, An inquiry how far these principles are affected by the operation of monopoly.

When the power to supply it is unrestricted.

I. There does not seem to be much room for difference of opinion respecting the circumstances which regulate the value of the precious metals, and their distribution throughout the various countries of the globe. Bullion is a commodity, on the production of which competition operates without restraint. It is not subjected to any species of monopoly, and its value in exchange must, therefore, depend on the cost of its production, that is, on the quantity of labour required to produce it and bring it to market.

If the same quantity of labour always produced the same quantity of bullion, its value would be invariable, and it would constitute a standard by which the variations in the exchangeable value of other commodities might be correctly ascertained. But this is not the case with bullion or anything else. Its value fluctuates like that of other articles, not only according to the greater or less productiveness of the mines from which it is extracted, but also according to the varying skill of the miners, the improvement of machinery, and other circumstances.

In his treatise on *Political Economy*, Say has a chapter entitled "*De la valeur que la qualité d'être monnoie ajoute à une marchandise.*" But a little reflection will convince us that this is a mistake, and that the circumstance of the precious metals being used as money adds nothing to their value. Say reasons on the hypothesis, which is equally at variance with principle and fact, that an increase of demand is always productive of an increase of value. The latter, however, depends upon the cost of production; and it is obvious that the cost of a thing may be diminished while the demand for it is increased, and conversely. This is so plain a proposition, as hardly to require to be substantiated by argument. And the instance of cotton goods, the price of which, notwithstanding the vast increase of demand, has been constantly on the decline during nearly a century past, is enough to convince the most sceptical of the extreme erroneousness of Say's conclusion. But, with regard to the precious metals, it is clear that under ordinary circumstances, or when mining is prosecuted under nearly the same conditions as other businesses, the capital employed in their production must yield the common and ordinary rate of profit; for, if it yielded more than that rate, there would be an influx of capital to the mining business; and, if it yielded less, it would be withdrawn, and vested in some more lucrative employment. And hence, though the demand for gold and silver should, from the adoption of some other commodity as an instrument of exchange, gradually become less, the value of the precious metals would not on that account be reduced. A smaller supply would, indeed, be annually brought to market, and a portion of the capital formerly engaged in the mining, refining, and preparing of metals, would be disengaged. But as the whole stock thus employed yielded only the average rate of profit, the portion which is not withdrawn must continue to do so; or, which is the same thing, gold and silver must continue to sell for the same price. It is true that where mines are, as they almost always

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non-existence. Had Montesquieu said that the blacks determined the values or prices of commodities, by comparing them with the arbitrary term *macute*, the statement, though erroneous, would have been at least in point. B t he says no such thing. On the contrary, he states distinctly that the relative values of commodities (marchandises) are ascertained by comparing them *with each other* (entre elles), and that it is merely the result of the comparison that is expressed in arbitrary terms.

So much for the weight to be attached to this statement, supposing it to be well founded. The truth is, however, that the term *macute* is not really arbitrary, and employed only to mark an ascertained proportion, but that it has a reference to, and is in fact, the name of an intrinsically valuable commodity. "On a bien dit," says l'Abbé Morellet, "que ce mot macute étoit une expression abstraite et générale de la valeur, et cela est vrai au sens où nous l'expliquerons plus bas; mais on n'a pas remarqué que cette abstraction a été consequente et posterieure à l'emploi du mot macute pour signifier une marchandise, une denrée réelle à laquelle on avoit longtems comparé toutes les autres.

"Macute en plusieurs lieux de la côte d'Afrique, est encore le nom d'une certaine étoffe: '*Chez les negres de la côte d'Angola,*' dit le voyageur Angelo, '*les macutes sont des pièces de nattes d'une aune de long;*' Jobson dit aussi que les macutes sont *une espèce d'étoffe.*

"Les étoffes ont toujours été l'objet d'un besoin tres-pressant chez des peuples aussi barbares, depourvus de toute espèce d'industrie.—Les nattes en particulier leur sont de la plus grande nécessité. Elles sont divisées en morceaux peu considerables et d'une petite valeur; elles sont très-uniformes dans leurs parties, et les premières qu'on a faites auront pu être semblables les unes aux autres, et d'une bonte égale, sous la même dénomination; toutes ces qualités les ont rendu propres à devenir la mésure commune des valeurs."—*Prospectus d'un Nouveau Dictionnaire de Commerce*, p. 121.

The following extract from Park's Travels gives an example of a similar kind:—"In the early intercourse of the Mandingoes with the Europeans, the article that attracted most notice was iron. Its utility in forming the instruments of war and husbandry made it preferable to all others; and iron soon became the measure (standard) by which the value of all other commodities was ascertained. Thus a certain quantity of goods, of whatever denomination, appearing to be equal to a bar of iron, constituted, in the trader's phraseology, a bar of that particular merchandise. Twenty leaves of tobacco, for instance, were considered as a *bar* of tobacco; and a gallon of spirits (or rather half spirits and half water) as a *bar* of rum; a bar of one commodity being reckoned equal in value to a bar of another commodity. As, however, it must unavoidably happen that, according to the plenty or scarcity of goods at market, in proportion to the demand, the relative value would be subject to continual fluctuation, greater precision has been found necessary; and, at this time, the current value of a single bar of any kind is fixed by the whites at *two shillings sterling*. Thus, a slave, whose price is £15, is said to be worth 150 bars."—*Travels in the Interior of Africa*, 8vo. edit., vol. i. p. 39.

[1] Farther Considerations concerning Raising the Value of Money. Locke's Works, ii. 94. 4to. 1777.

are, of different degrees of productiveness, any great falling off in the demand for bullion might, by rendering it unnecessary to work inferior mines, enable the proprietors of the richer mines to continue their work, and to obtain the ordinary rate of profit on their capitals, by selling bullion at a reduced price. In this case the value of bullion would be really diminished; but this diminution would not be occasioned by a falling off in the demand, but by a greater facility of production. On the other hand, an increased demand for bullion, whether it arose from the suppression of paper money, or from a greater consumption of gold and silver in the arts, or from any other cause, would not be accompanied by any rise of price, unless, in order to procure the increased supply, it were necessary to have recourse to less productive mines. If the mines from which the additional supplies were drawn were poorer than those already wrought, more labour would be necessary to procure the same quantity of bullion, and, of course, its price would rise. But if no such increase of labour were needed, its price would remain stationary, though ten times the quantity formerly required should be demanded.

Production of the precious metals.

But though true under the circumstances supposed, these conclusions are often much modified in practice. Frequently, indeed, the production of the precious metals partakes very largely of the nature of a gambling speculation. When gold or silver is found in any particular locality, its abundance, and the chances which it affords to adventurers of enriching themselves, are uniformly exaggerated, and an excess of hands is attracted to the pursuit of the metal. In such cases, it commonly happens that, while a few individuals engaged in the business make fortunes, the great mass make little or nothing. But most people being sanguine enough to think that they will be found in the fortunate class, the supply of bullion may be largely increased, and its value reduced, even though the majority of those engaged in its production should be really carrying on a losing employment.

When the gold and silver mines of America first began to be wrought, the most extravagant ideas were entertained of their productiveness; so much so, that they were supposed to be able to bear a duty of half the produce. But it was soon found that the exaction of such a duty would occasion their total abandonment. It was consequently lowered, by successive reductions, to a tenth; and even this was felt to be oppressive, so that, in the end, the duty was fixed at a twentieth part, or five per cent. And, despite this reduction, the trade of mining was generally unprofitable. Ulloa says, that in Peru an individual who embarked in a mining speculation used to be considered as a ruined man, or as having adventured in a lottery, in which, though there were many great prizes, the blanks had a decided preponderance;[1] and, according to Humboldt, nearly the same thing was experienced in Mexico; the search after mines, and the working of them, being there looked upon as a sort of gambling adventure, in which many were ruined, while a few only attained to great wealth.[2]

It remains to be seen whether the result of the extraordinary discoveries in California and Australia will be different. We suspect, however, that it will not; and that in the lottery of these countries, as in that of Mexico and Peru, the blanks will greatly exceed the prizes. It is understood that last year (1856), there were in California above 100,000 persons engaged in the raising of gold, or in the employments subordinate to and immediately connected therewith. And if we estimate the value of the labour of these parties at £100 a-year each, at an average, we shall not probably be beyond, but within the mark; and, on this hypothesis, it would require a sum of £10,000,000 to defray their mere wages. Now, it would appear from the accounts most worthy of credit, that the produce of the gold diggings, &c. of California in 1856, amounted to from £13,000,000 to £14,000,000; and, taking it at the latter amount, which is perhaps exaggerated, still it would only yield £4,000,000 of surplus, which, were it equally divided among the parties employed in raising it, would give £40 to each. But instead of being equally, it is most unequally divided; and, while a few have perhaps realised from £1000 to £2000, or upwards, it is plain that very many can have made little or nothing, not even ordinary wages. And this has also been the case in Australia. But the brilliant prizes, and the stories of cobblers and ditchers whom a fortunate chance has suddenly raised to opulence, have not failed to attract crowds of competitors. And the probability is, that the business of gold-raising will be zealously prosecuted, even though it should make a most inadequate return to the aggregate hands engaged in it. Under such circumstances, the supply of bullion may become, to a considerable extent, independent of the cost of its production; and the value of gold in the market may, for lengthened periods, depend chiefly on its quantity compared with the demand.

Although, therefore, it be true that, under ordinary circumstances, commodities are but seldom brought to market unless they sell at a price sufficient to repay the cost of their production, including therein a reasonable profit to the producers, yet many things occur to disturb the equilibrium between cost and price. And though, in the great majority of instances, such disturbances, when they do occur, are rarely of any very considerable permanency, such may not be the case with gold and silver. The circumstances connected with their production are so very peculiar, that they may be furnished for indefinite periods, and in large quantities, even when they do not really indemnify the great body of their producers.

After gold and silver have been brought to market, their conversion into coin, or manufactured articles, depends on a comparison of the profits which may be derived from each operation. Bullion would not be taken to the mint were it more profitable to send it to a silversmith; and the latter would not work up bullion into plate, if he could turn it to better account by converting it into coin. Hence the values of bullion and coin in countries where the mint is open to all, and the expenses of coinage are defrayed by the state, must very nearly correspond. When there is any unusual demand for bullion in the arts, coin is melted down; and when, on the contrary, there is any unusual demand for coin, plate is sent to the mint, and the equilibrium of value maintained by its fusion.

So long, therefore, as competition is allowed to operate without restraint on the production of gold and silver, their value will vary, as above stated. And, while gold or silver coins constitute the currency, the prices of commodities, or their values rated in such coins will vary, not only according to the variations in the values of the commodities themselves, but also according to the variations in the value of the metal of which the coins are made.

II. Happily it is not possible to monopolise or limit the

[1] Ulloa, *Voyage de l'Amerique*, i. 379, Amsterdam, 1752.

[2] *Nouvelle Espagne*, liv. ii. cap. 7, edit. 1825.

Value of money when the power to supply it is restricted.

supply of the precious metals; but if such a thing were possible, or if none but government could use the mint, or issue coins, the value of the latter would no longer depend on their cost. Suppose, to illustrate the principle, that gold is used as money, that government issues a certain amount of coins and then shuts the mint; and that, after such limitation, the population of the country, and the products to be circulated, are largely increased. In such case it is plain that the exchanges which the limited amount of money would have to perform would be proportionally augmented. A smaller sum would, therefore, have to be appropriated to each transaction, or, which is the same thing, money prices would be diminished. This conclusion is so self-evident as to admit neither of doubt nor cavil. And, therefore, it appears that when the supply of money is limited, the amount of it given in exchange for commodities varies inversely as the demand, and is affected by nothing else.

That we might simplify the subject, we have assumed, in this statement, that the substitutes which may be used for money, and the methods by which it may be economised, were the same throughout the period, when the other changes referred to took place. It is easy, however, to allow for any variation in the one or the other. And, supposing this allowance to be made, it follows, if double the usual supply of commodities were brought to market in a country with a limited currency, that their money price would be reduced a half; and that, if only half the usual supply were brought to market, it would be doubled; and this, whether the cost of their production had increased or diminished. Products are not then exchanged for money, because it is a commodity which may be advantageously used in the arts, and has cost a certain quantity of labour, but because it is the universal equivalent, or legal tender, adopted by the society, and will, as such, be willingly received by every one. The remark of Anacharsis, the Scythian, that gold and silver coins seemed to be of no use but to assist in numeration and arithmetic,[1] would, if confined to a limited currency, be as just as it is ingenious. Sovereigns, livres, dollars, etc., would then really constitute mere tickets or counters for computing the value of property, and transferring it from one individual to another. And as small tickets or counters would serve for this purpose quite as well as large ones, and those of brass, tin, or paper, quite as well as those of gold, there can be no doubt that by sufficiently limiting its quantity, a currency, though destitute of intrinsic worth, may be made to circulate on a level with gold or silver, or higher, if it be desired.

When a currency is mixed, or consists partly of coin and partly of paper-notes immediately convertible into specified amounts of coin, the value of the notes is necessarily measured by, and is in fact identical with the value of the coins which may be obtained for them, and which they are truly said to represent. But when, as has often been the case, notes which are not convertible into coin are notwithstanding legal tender, then it is plain that their value cannot be in any wise dependent on the value of coins. Such notes are not representatives of money, but are themselves a variety of money. They circulate because their issuers have power to make them legal tender, and because money of one kind or other is indispensable. Notes of this description have little or no intrinsic worth, so that their marketable or exchangeable value depends entirely on the extent to which they are issued, compared with the business they have to perform. If their supply be sufficiently restricted, their value may be maintained on a level with that of gold, or even raised above it. In their case everything depends on the discretion of the issuers. If they abuse their power, as they almost invariably do, by throwing too great quantities of notes on the market, their value is proportionally reduced; and if the issuers do not pull up in time, the notes will eventually become, like the assignats in France, wholly worthless.

Speaking generally, the value in exchange of a currency consisting of the precious metals is coincident with the cost of their production. If a sovereign commonly exchange for two or three bushels of wheat, or a hat, it is because the same labour is commonly required for its production as for that of either of these commodities; while, if with an inconvertible paper money, they exchange for a one-pound note, it is because such is the proportion which, as a part of the mass of commodities offered for sale, they bear to the supply of paper in the market. This proportion would, it is evident, be not only immediately, but permanently affected by an increase or diminution either of paper or commodities. But the relation which the latter bear to a freely supplied metallic currency is not permanently changed, except by a change in their cost, or in that of the metals.

We have already seen in how far these conclusions are liable to be affected by the peculiar circumstances under which gold and silver are frequently produced. But however much their value in exchange may diverge for a while from the cost of their production, its uniform tendency is to coincide with that cost; and though the value of bullion, as compared with other articles, may differ very widely at different periods, these differences are usually manifested by slow degrees. The vast extent of the surface over which the precious metals are spread, and the many purposes to which they may be applied, prevents even the largest additional supplies from suddenly reducing their value; while, on the other hand, their great durability prevents any sudden diminution of their quantity, and the influence of a falling off in the supply, from being speedily visible.

General conclusion as to the value of money.

It may, therefore, be laid down generally, that the value of money depends on the quantity of it in circulation compared with the exchanges to be effected by its means, or with the business it has to perform. When, however, money consists of coins, their value is most commonly limited by, and proportioned to, the cost of their production; whereas, when it consists of paper, not convertible into coin, its value is exclusively determined by the magnitude of its issues, and has nothing to do with the cost of its production. That cost may, indeed, in its case, be regarded as zero.

Such seem to be the circumstances which regulate the value of money, both when the power to supply it is unfettered by any restraints, and when it is restrained and limited. In the former case, its value depends, like that of the greater number of commodities, on the cost of its production; while, in the latter case, its value is wholly unaffected by that circumstance, and depends on the extent to which it has been issued, compared with the demand.

The conclusions deducible from these principles are most important. A metallic currency, on the coinage of which a high seignorage or duty was charged, and a paper currency not convertible into the precious metals, have been occasionally seen to circulate at the same value with a metallic currency of full weight, and which had been coined at the expense of the state. No rational or consistent explanation of these apparently anomalous results could be given until the effects produced by limiting

[1] Hume's *Essay on Money.*

Money. the supply of money had been appreciated. Now, however, that this has been done, these difficulties have disappeared. The theory of money has been perfected, and we may estimate, *a priori*, what, under any given circumstances, would be the effect of imposing a seignorage, or of issuing inconvertible paper.

SECT. III.—*A Moderate Seignorage on Coined Money advantageous. Principles which should regulate its amount.*[1]

Reasons why a seignorage should be imposed on coins.

The governments of most countries have retained the power of coining exclusively in their own hands. In antiquity this privilege was reserved to prevent the confusion which would result from the circulation of coins of different denominations were individuals permitted to issue them at pleasure, and to give the public greater security that the stamp should truly indicate the weight and fineness of the metal.[2] And in more modern times it has been reserved for the same reasons, and also, as a means of increasing the national revenue. Much difference of opinion has, however, existed in regard to the policy of imposing a tax on coins. It has been contended that they ought in no circumstances to be charged with any duty; but that the expenses of the mint should always be defrayed by the public. In this opinion we cannot concur. The reasoning of Adam Smith, in favour of a moderate seignorage, appears to be quite unanswerable. A sovereign is more serviceable than a piece of pure unfashioned gold bullion of the same weight; for, while it is equally well fitted for being used in the arts, it is, which bullion is not, money or legal tender. In imposing a duty or seignorage on coins to defray the expense of coinage, government merely gets back the equivalent of the additional value conferred by the process on the bullion. And the truth is that those who carry gold to the mint would have no better reason for complaint were they charged with the expense of its coinage, than they would have, had they sent it to a jeweller's, that they were charged with expense of its manufacture into plate.

But there are other reasons why a seignorage ought to be exacted. Wherever the expense of coinage is defrayed by the state, gold or silver coins, and gold or silver bullion, are very nearly of the same value. And hence, whenever it becomes profitable to export the precious metals, coins, in the manufacture of which a considerable expense has been incurred, are sent abroad indifferently with bullion. It has sometimes been attempted, by prohibiting the exportation of coins, to prevent the loss that may thus be occasioned; but these efforts having proved singularly ineffectual, have been abandoned in this and most other countries. Admitting, however, that it were possible, which it certainly is not, to prevent or materially limit the clandestine exportation of coins, it is conceded on all hands to be quite nugatory to attempt to prevent their conversion into bullion. In this there is almost no risk. And the security with which their fusion may be effected, and the trifling expenses attending it, will always enable them to be melted down and sent abroad whenever there is any unusual foreign demand for the precious metals. This exportation would, however, be either prevented or materially diminished by the imposition of a seignorage or duty, equal to the expense of coinage. Coins being, by this means, rendered more valuable than bullion, it would be sent abroad in preference to them, in the event of the exchange becoming unfavourable, or of gold becoming a suitable article of export. And if, as Adam Smith has observed, it became necessary on any emergency to export coins, they would, most likely, be re-imported. Abroad they are worth only so much bullion, while at home they are worth this much, plus the expense of coinage. There would, therefore, be an obvious inducement to bring them back; and the supply of currency would be maintained at its proper level, without its being necessary for the mint to issue fresh coins.

Besides relieving the country from the useless expense of coining money sent abroad as an article of commerce, a moderate seignorage would either prevent or materially lessen that fusion of the heavier coins, which always takes place whenever a currency becomes degraded or deficient in weight. Previously to the recoinage of 1774, the weight of bullion contained in the greater number of the gold coins in circulation was reduced nearly two per cent below the mint standard; and, of course, the price of gold bullion, estimated in this degraded currency, rose two per cent., or from £3 : 17 : 10½d, its mint price, to £4 per ounce. This, however, was too minute a difference to be taken into account in the ordinary business of buying and selling. And the possessors of coins fresh from the mint, or of full weight, not obtaining more produce in exchange for them than for the lighter coins, sent the former to the melting-pot, and sold them as bullion. But it is easy to see that this fusion would have been prevented had the coins been laden with a seignorage of two per cent. The heavy coins could not then have been melted without losing the value given them by the seignorage; and this being equal to the excess of the market price of bullion above the mint price, nothing would have been gained by the melters. Had the seignorage been less than two per cent., the average degradation of the coin, had it, for example, been only one per cent., all those coins whose value was not more than one per cent. degraded below their mint standard, might have been melted; but if the seignorage had exceeded two per cent., no coins would have been melted until the degradation had increased to the same or a greater extent.

This reasoning is bottomed on the supposition that the coins on which a seignorage is charged are not issued in excess. If they were, the above-mentioned consequences would not follow. Their too great multiplication might sink their value below that of bullion, and occasion their immediate fusion or exportation. So long, however, as the state only coins the bullion brought to the mint by individuals, there is little risk of this happening. No one, we may be pretty well assured, would carry bullion to that establishment, and pay the expenses of its coinage, unless the coins were thereby rendered so much more valuable than the unfashioned metal.

Were government to buy bullion, and coin money on its own account, it might, by proper attention, avoid all over-issue. Suppose the seignorage were two per cent., then any given weight of coins of the mint standard ought, provided the currency be not redundant, to purchase two per cent. more than the same weight of bullion. So long therefore, as this proportion is preserved between money and bullion, it shows that the proper supply of currency has been issued. If the value of the coins declines below this limit, too many of them must have got into circulation; and if, on the contrary, their value

[1] Seignorage, strictly speaking, means only the clear revenue derived by the state from the coinage. But it is now commonly used to express every deduction made from the bullion brought to the mint to be coined, whether on account of duty to the state, or of the expense of coinage (properly *brassage*). We always use the phrase in its more enlarged sense.

[2] Le Blanc, *Traité Historique des Monnoyes de France*, p. 90, ed. Amst. 1692.

Money. rises above it, the supply is too limited, and an additional quantity may be advantageously issued.

It must not, however, be concealed, that if it were attempted to charge a high seignorage, it would be extremely difficult, or rather quite impracticable, to limit the supply of coins. The inducement to counterfeit money would, under such circumstances, be very greatly increased, while the chances of detection would be very much diminished. It would not then be necessary, to make the counterfeiting of coins profitable, that they should be manufactured of base metal. The saving of a heavy charge on account of seignorage might of itself afford a sufficient profit; and this would be derived, though the metal contained in the forged coins were of the standard purity. But though it might, for this reason, be impossible, or very difficult, to limit the supply of currency, and consequently to sustain its value, were any thing like an exorbitant seignorage charged, the same difficulty would not stand in the way of a moderate seignorage. To be carried on the business of counterfeiting must yield a premium sufficient to indemnify the forgers for the risks and odium to which they are exposed. A seignorage insufficient to do this would not encourage the issue of counterfeit coins. And though it might be difficult to form any very precise estimate of the amount of the premium referred to, it would not probably be under two or three per cent.[1]

In his evidence before the Lords' Committee in 1819, Mr Mushet stated that, with the improved machinery in use in the mint, gold coin could be manufactured for about 10s. per cent.[2] And the manufacture of the silver coin might then, we believe, be taken at about three times as much, or at one and a-half per cent. It appears from an account given in the report published in 1849 (p. 86), of the commissioners appointed to inquire into the constitution, &c., of the mint, that the expense of coinage, at an average of the eleven years ending with 1848, amounted, exclusive of law expenses, to £1 : 5s. 3¾d. per cent. The total amount coined during this period was £38,275,486, of which £34,877,664 was gold, £3,329,716 silver, and £68,103 copper. It is said to be very difficult to distinguish exactly the separate cost of coining the different metals. There can, however, be little doubt that the changes lately introduced into the mint will effect a very considerable saving in the expense of coining; and the probability is, that in future it will be under one per cent. on the average value of the total coins issued. In France the procedure at the mint has been so much perfected that the expense of coining gold has been reduced to six fr. on 3,100 fr. or to ·0193 per cent., and that of silver to 75 cent. per 100 fr., or ¾ per cent.[3] In Russia the gold costs 0·85, and the silver 2·95 per cent.[4]

Notices of seignorage in England.

The precise period when a seignorage began to be charged upon English silver coins has not been ascertained. It must, however, have been very early. Ruding mentions, that in a mint account of the 6th Henry III., one of the earliest he had met with, the profit on £3898, 0s. 4d. of silver coined at Canterbury, is stated to be £97 : 9s., being exactly 6d. a-pound, of which the king had £60 : 18 : 3½d., and the bishop the residue.[5] In the 28th Edward I., the seignorage amounted to 1s. 2½d. per pound, 5½d. being allowed to the master of the mint, to indemnify him for the expenses of coinage, and 9d. to the crown as its profit. Henry VI. increased the master's allowance to 10d. and 1s. 2d., and the king's to 1s. and 2s. In the reign of Edward IV., the seignorage varied from 4s. 6d. to 1s. 6d. It was reduced to 1s. in the reign of Henry VII.; but was prodigiously augmented in the reigns of his successors, Henry VIII. and Edward VI., whose wild and arbitrary measures produced, as will be afterwards shown, the greatest disturbance of the currency. During the lengthened reign of Elizabeth, the seignorage varied from 1s. 6d. to 2s. per pound; at which sum it continued, with very little variation, until the 18th of Charles II. (1666), when it was remitted. Money.

From this period down to 1817, no seignorage was charged on the silver coin; but a new system was then adopted. Silver having been underrated in relation to gold in the mint proportion of the two metals fixed in 1718, heavy silver coins were withdrawn from circulation, and gold only being used in all the larger payments, it became, in effect, what silver had formerly been, the standard of the currency. The Act 56th Geo. III. cap. 68, regulating the present silver coinage, was framed not to interfere with this arrangement, but so as to render silver entirely subsidiary to gold. For this purpose it was made legal tender to the extent of 40s. only; and 66s. instead of 62s. are coined out of a pound troy, the 4s. being retained as a seignorage, which, therefore, amounts to 6$\frac{14}{31}$ per cent. The power to issue silver is exclusively in the hands of government; who may, by not throwing too much of it into circulation, prevent its fusion, until the market price of silver rise above 5s. 6d. an ounce.

This arrangement was censured in the debates on the resumption of cash-payments in 1819. It was contended that the over-valuation of silver with respect to gold would make debtors use it in preference in discharging their debts, and that the gold coins would be melted or exported. The result has shown that this opinion was erroneous. Debtors cannot discharge their debts by silver payments; for, as seen above, it is legal tender for 40s. only; and no creditor can be compelled, or would be disposed to take it in payment of a larger debt, except at its real value.[6]

In the 18th of Edward III., the period when we begin to have authentic accounts of the gold coinage, a pound troy of gold bullion was coined into florins, of the value of £15. Of this sum, only £13 : 16 : 6 was given to the party who brought the bullion to be coined, £1 : 3 : 6 being retained as seignorage, of which 3s. 6d. went to the master, and £1 to the king. But it appears, from the mint indentures, that the seignorage on the coinage of nobles for the same year, amounted to only 8s. 4d. And, from this remote period to the accession of the Stuarts, with the exception of the coins issued in the 4th and 5th Edward IV., and the 34th, 36th, and 37th Henry VIII., the total charge of coining a pound weight of gold bullion seldom exceeded 7s. or 8s. money of the time. In the 2d James I., a pound weight of gold bullion was coined into £40 : 10s.; a seignorage of £1 : 10s. being deducted; 6s. 5d. of which went to the master, and £1 : 3 : 7 to the crown. The seignorage on gold was remitted at the same time (18th Charles II.)

[1] Mr Tooke read a very able paper on seignorage before the Lords' Committee of 1819, on the resumption of cash-payments. It is printed in the appendix to their report.
[2] *Minutes of Evidence*, p. 207.
[3] Chevalier *De la Monnaie* (p. 110). This work forms the third volume of Chevalier's *Cours d'Economie Politique*.
[4] Storch, tom. vi. p. 74.
[5] *Annals of the British Coinage*, vol. i. p. 179, 4to edition.
[6] Those who wish for a farther elucidation of this subject, may refer to Mr Mushet's evidence in the *Appendix to the Lords' Report "on the Expediency of the Banks resuming Cash-payments,"* where it is discussed at great length, and in a very able manner.

Money.

with the seignorage on silver, and has not since been revived.[1]

It appears from the official accounts, that during the ten years ending with 1855, the sum of £53,871,063 was coined at the mint into gold coins. If we estimate the cost of this coinage, including the loss on the old worn coins brought to the mint to be recoined, at 12s. per cent., it will amount to about £323,226. But two-thirds, probably, of this expense would have been rendered unnecessary, had a low seignorage of 2 per cent. been charged during this period; at the same time that it would have yielded a revenue of nearly $1\frac{1}{2}$ per cent. on the sums that were coined.

It is needless, after what has been previously stated, to dwell at any greater length on the futility of the practice of issuing coins free of expense to be exported or melted, as the case may be. It is the sieve of the Danaids over again. We might, on the same principle, supply natives and foreigners with plate *ad libitum* at the price of the bullion, making them a present of the workmanship. Whatever may be thought of the policy of making coins yield a revenue, there can be no reasonable doubt that they should, at all events, be charged with the expense of coinage.

As the regulation of the seignorage, when it did exist, depended entirely on the will of the sovereign, we need not be surprised at the variations in its amount, or that it should have fluctuated according to the necessities and caprices of succeeding princes. It was, indeed, hardly possible that it should have been otherwise. Our ancestors were ignorant of the principle, by a strict adherence to which the imposition of a considerable seignorage can alone be rendered advantageous. They considered it as a tax which might be increased and diminished at pleasure. And, far from taking any steps to limit the quantity of coin in circulation, so as to maintain its value, they frequently granted to corporate bodies, and even to individuals,[2] the privilege of issuing coins, not subject to a seignorage. No wonder, therefore, that it should have been considered as a most unjust and oppressive tax, and that its abolition should have been highly popular.

Remedy or shere.

Besides the revenue arising from the seignorage, our kings formerly derived a small revenue from the *remedy* or *shere*. It being found all but impossible to coin money corresponding in every particular of weight and purity with a given standard, a small allowance is made to the master of the mint, whose coins are held to be properly executed, provided their imperfections, whether on the one side or the other, do not exceed this allowance, or remedy. Its amount, from the reign of Edward III. down to 1816, was generally about one-eighth part of a *carat*, or 30 grains of pure gold per pound of gold bullion, and two pennyweight of pure silver per pound of standard silver bullion. In 1816, the remedy for gold coins was fixed at 12 grains per pound in the weight, and 15 grains per do. in the fineness; that for silver being, at the same time, reduced a half.

It does not appear that our princes derived any considerable advantage from the *remedy* previously to the reign of Elizabeth. But she, by reducing the master's allowance for the expense of coinage from 1s. 2d. to 8d., obliged him to come as near as possible to the lowest limit allowed by the remedy. Had the coins been delivered to those who brought bullion to the mint by weight, the queen, it is plain, would have gained nothing by this device. But, in the latter part of her reign, and the first seventeen years of that of her successor, James I., they were delivered by *tale*, so that the crown saved, in this way, whatever additional sum it might otherwise have been necessary to pay the master for the expenses of coinage. In the great recoinage in the reign of William III., the profit arising from the remedy amounted to only 8s. on every hundred pounds weight of bullion; and the coinage is now conducted with so much precision, and the coins issued so near their just weight, that no revenue is derived from this source.

The continental princes have, we believe without any exception, charged a seignorage on the coinage of money. In France, this duty was levied at a very early period. By an ordonnance of Pepin, dated in 755, a pound of silver bullion is ordered to be coined into twenty-two pieces, of which the master of the mint was to retain *one*, and the remaining twenty-one were to be delivered to the merchant bringing the bullion to the mint.[3] There are no means of ascertaining the amount of the seignorage taken by the successors of Pepin, until the reign of Saint Louis (1226-1270), who coined the *marc* of silver into 58 sols, while he only delivered 54 sols 7 deniers to the merchant: at this period, therefore, the seignorage amounted to a sixteenth part of the marc, or to $6\frac{1}{4}$ per cent. It was subsequently increased or diminished without regard to any fixed principle. In the great recoinage in 1726, it amounted, on the gold coin, to $7\frac{5}{16}$ per cent., and to $5\frac{3}{7}$ per cent. on silver. In 1729, the mint prices, both of gold and silver, were augmented, and the seignorage on the former reduced to $5\frac{1}{4}\frac{1}{6}$ per cent., and on the latter to $4\frac{1}{2}$ per cent. A farther reduction took place in 1755 and 1771, when the seignorage on gold was fixed at $1\frac{4}{15}$ per cent., and on silver at $1\frac{7}{24}$ per cent.[4] At the Revolution the seignorage was converted into a brassage, being reduced nearly to the expense of coinage.

Sect. IV.—*Expense of a Currency consisting of the Precious Metals.*

Estimates of the expense of a metallic currency.

A moderate seignorage has but an inconsiderable effect in reducing the expense of a metallic currency. This, which is much greater than is generally imagined, is not occasioned by the coinage, which is comparatively trifling, but by the value of the gold and silver vested in coins. If, for example, the currency of the United Kingdom consisted wholly of gold, it would amount to at least eighty millions of sovereigns; and if the customary rate of profit were 6 per cent., it would cost £4,800,000 a-year; for, were this eighty millions not employed as money, it would be employed in branches of industry, in which, besides affording wages to numerous individuals,

[1] In the tables annexed to this article, the reader will find a detailed account of the amount of the seignorage and its fluctuations in different periods.

[2] Ruding's *Annals of the Coinage*, vol. i. p. 185. When the right of seignorage was abolished, there was a pension, payable out of the profits derived from it, granted under the great seal, for twenty one years, to Dame Barbara Villiers, which the legislature ordered to be made good out of the coinage duties imposed by that act. (See Ruding, *in loco citato*, and Leake's *Historical Account of English Money*, 2d edit., p. 356.)

[3] Le Blanc, p. 87.

[4] Necker, *Administration des Finances*, (tom. iii. p. 8).—Dr. Smith has stated (*Wealth of Nations*, p. 21), on the authority of the *Dictionnaire des Monnoies*, of Abot de Bazinghen, that the seignorage on French silver coins, in 1775, amounted to about eight per cent. The error of Bazinghen has been pointed out by Garnier, in his translation of the *Wealth of Nations*.

Money.

it would yield 6 per cent., or £4,800,000 a-year, nett profit to its possessors. And this is not the only loss. The eighty millions would not merely be withheld from the great work of production, and the country deprived of the revenue derived from its employment, but it would be perpetually diminished. The wear and tear of coins is by no means inconsiderable; and supposing the expenses of the coinage were defrayed by a moderate seignorage, the deficiency in the weight of the old worn coins, on their being called in to be recoined, falls on the public. There is, besides, a constant loss from shipwreck, fire, and other accidents. When due allowance is made for these causes of waste, it may not, perhaps, be too much to suppose that a country which had eighty millions of gold coins in circulation, would have annually to import and coin the hundredth part of this sum, or £800,000, to maintain its currency at its proper level.

Thus it appears probable that, were the customary rate of profit in the United Kingdom 6 per cent., it would cost £5,600,000 a-year to maintain eighty millions of gold coins in circulation. A reduction of the rate of profit would, no doubt, proportionally reduce the amount of this expense; but the reduced expense might still bear the same proportion to the total income of the country that the higher expense did, and if so, the cost of the currency would not be at all diminished. The case of France furnishes a striking example of the heavy charges attending the general use of a metallic currency. The gold and silver currency of that kingdom has been estimated by M. Fould at 2200 millions fr., and by others at 2500 millions.[1] Now, supposing the lowest estimate to be the more correct, and taking the rate of profit at 6 per cent., this currency must cost France a hundred and thirty-two millions fr. a-year, exclusive of the wear and tear and loss of the coins, which being taken, as before, at the hundredth part of the entire mass, will make the whole annual expense amount to a hundred and fifty-four millions fr., or to about *six millions* sterling. This heavy expense forms a very material deduction from the advantages resulting from the use of a currency consisting entirely of the precious metals, and has doubtless been a chief cause why all civilized countries have endeavoured to fabricate a portion of their money of less valuable materials. It has not, however, been the only cause. It is obvious, were there nothing but coins in circulation, that the conveyance of large sums from place to place would be a very laborious process; and that even small sums could not be conveyed without considerable difficulty. Of the substitutes, calculated alike to save expense and to lessen the cost of carriage, paper is in every respect the most eligible, and has been by far the most generally adopted. By using it instead of gold, we substitute the cheapest for the most expensive currency, and enable the public to exchange whatever coins the employment of paper may render superfluous, for raw materials or manufactured goods, by the use of which its wealth and enjoyments are increased. It is also transferred with the utmost facility. Hence, since the introduction of bills of exchange, most great commercial transactions have been adjusted by means of paper only, and it also is very extensively used in the everyday business of society.

Sect. V.—*How Paper is substituted for Coins, and its value maintained.*

In all advanced societies, pecuniary engagements are usually reduced to writing. This secures alike the debtors and creditors; and obviates most part of the differences which are so very apt to arise when the terms of contracts are not distinctly specified. But it is an obvious resource for such individuals as happen to possess the written obligations or bonds of others, to transfer them when occasion requires to their debtors. And it is probable that no very lengthened period would elapse after they had been employed in this way till persons in whose wealth and discretion the public had confidence, would begin to issue their notes to pay certain sums in such a form that they might readily pass from hand to hand in ordinary pecuniary dealings. But as these notes or promises, though they cost the issuers next to nothing, must be paid when presented, or at some specified date, they would not be issued, or given away, except to those who engaged to repay them with a premium or interest, the amount of which would, of course, belong to and be a source of profit to the issuers.

Money.

Origin of paper money, and how its value is maintained.

Suppose, for example, that a capitalist issues a promissory note for £1000. This he does by advancing it to an individual in whose solvency he has confidence, or who has given him security for its repayment with interest. In point of fact, therefore, the issuer has exchanged his promissory note to pay £1000 for an obligation of equal amount, bearing the current rate of interest; and so long as the note, the intrinsic worth of which cannot well exceed a sixpence, remains in circulation, he will, supposing interest to be 5 per cent., receive from it a revenue of £50 a year. The business of bankers who issue notes is conducted on this principle. They could make no profit were they obliged to keep dead stock or bullion in their coffers equal to the amount of their notes in circulation. But if they be in good credit, a fourth or a fifth part of this sum will perhaps be sufficient. And their profits, after the expenses of their establishments, including the manufacture of their notes, are deducted, will be measured by the excess of the profit derived from their notes in circulation, over what they might derive from the employment of the stock kept in their coffers to meet the demands of the public.

All descriptions of notes, whether they are issued by individuals, or corporations, that are made payable in coin on demand, or at fixed periods, cease to circulate as soon as a suspicion begins to be generally entertained of the solvency of the issuers, or of their ability to make good their engagements. But paper-money, meaning thereby notes not payable on demand, but which are, notwithstanding, legal tender, is not affected by a want of credit. It may be depreciated through excess, but by nothing else. It has no intrinsic worth, and is not the representative of anything in particular. Its value, as already shown, is entirely dependent on the extent to which it is issued. From 1797 down to 1821, Bank of England notes, though not payable in gold, were *de facto* legal tender, and their value was determined by the principle now stated, and by it only.

Allegation that bank-notes issued on good bills at short dates, cannot be depreciated from excess.

It has, however, been contended, that there is a material difference between the inconvertible paper issued by governments in payment of their debts, and that which is issued by a company like the Bank of England, in discount of approved bills. In regard to the former, it is admitted on all hands that its value may be depreciated from excess. But in regard to the latter, it has been argued, that this is impracticable; that its supply is limited by the legitimate wants of the public; and that being issued only in proportion to the demand in exchange for good and convertible securities, payable at specific and not very distant dates, it can neither be in excess nor depreciated.

[1] Chevalier *De la Monnaie*, p. 326.

Money.

The apologists of the Restriction Act of 1797 endeavoured to show, by reasonings founded on assertions like these, that Bank of England notes were not depreciated during the suspension of cash payments. But though their fallacy, which is sufficiently obvious, was demonstrated over and over again by the authors of the Bullion Report, by Messrs. Ricardo, Blake, Huskisson, and others, and has been acknowledged by the legislature and the public, such is the vitality of error, or the inveteracy of prejudice, that we have these assertions repeated in 1857 as if their accuracy neither had been nor could be questioned. And such being the case, it may be right shortly to re-state principles which have been frequently stated before, and which we had supposed might have been safely taken for granted.

Fallacy of this allegation.

It may be premised on entering on this discussion, that the demand for money is not like the demand for other things. A man may have enough of beef, of beer, of cloth, and of a great many articles; but of money he never can have what he would consider enough. An increase of money means an increase of riches, that is, of power and consideration, and the desire for these is altogether illimitable. Whether money consist of paper, or gold, or both, the demand for it will be alike great; and will wholly depend on the price or interest charged for loans, and not on the value of the money lent.

Demand for money depends on a comparison between interest and profit.

These statements are so obviously well-founded as hardly to require illustration. If an individual can borrow £1000, £10,000, or any greater sum, at 3, 4, or 5 per cent. interest, and if he can invest it so as to yield 4, 5, or 6 per cent. it is plainly for his advantage, and for that of every other person who may be similarly situated to borrow to an unlimited extent. And a company that issued inconvertible paper, and was consequently relieved from the necessity of keeping any unproductive stock or bullion in its coffers, might issue notes at a very low rate of interest, and if so, the demand for them would be proportionally great.

During the period from 1809 to 1815, both inclusive, the issues of Bank of England and the provincial banks were much greater than they had ever previously been, and their paper was at a heavy discount as compared with bullion. But owing to the interest charged by the banks (5 per cent.) being less than the market rate at the time, the parties applying for fresh discounts were constantly on the increase. It is in truth quite immaterial to such parties whether the issuers have, by issuing notes in excess, depressed their value as compared with gold, or have limited their supply, so as to keep them on a level with that metal. These circumstances are of primary importance to those whose incomes do not vary with variations in the value of money; but as prices rise and fall with its increase or diminution, they have little or no influence over merchants and tradesmen, who are the principal applicants for discounts. A, who presents a bill for £500 or £1000 to a bank for discount, has received it, if it have grown out of a real mercantile transaction, in payment of goods which were worth £500 or £1000 money of the day; and it is this sum which he wishes to obtain by discounting the bill. Had the value of money been different, the price of the goods, and consequently, the sum in the bill, would have differed proportionally. Its market value at the moment is the only thing attended to in these transactions. And it is quite the same when the bills are for accommodation purposes. It matters not whether the notes given for them are worth 10s. or 20s. In the one case the bills would be nominally twice as great as in the other, but there would be no real difference between them. So long as the rate of interest charged for discounts or loans is under the market rate, the demands for money can never be supplied. In such case million after million may be issued. The value of the currency, if it consist of inconvertible paper, may be so reduced as to require £1 or £5 to purchase a quartern loaf; but the circumstance of its value being diminished in proportion to the increase of its quantity would render the demand for additional supplies as great as ever.

It is plainly, therefore, the merest drivelling to talk about the demands for money being limited by the wants of the public. These wants, like the avarice of the miser, or the thirst of the dropsical patient, are altogether boundless. They have no possible limit, and would be as great after 100 or 1000 millions of notes or sovereigns had been issued as after an issue of 10 or 20 millions.

Limit of depreciation in a gold or mixed currency.

But when a currency consists of gold, or partly of gold and partly of paper immediately convertible into gold, it contains within itself a principle by which its over-issue is corrected. In that case, the issue of 100,000 or 1,000,000 sovereigns, and of 100,000 and 1,000,000 £1 notes, has precisely the same effect. Paper is not depreciated as compared with gold, for the latter may at pleasure be obtained for the former; but the whole currency, gold as well as paper, becomes redundant, or is depreciated, as compared with that of other countries in which there has been no over-issue. And as gold is everywhere in demand, and the expense of its conveyance from one state to another seldom exceeds one or two per cent., it follows, that if the currency be depreciated by over-issue to any greater extent than this, the exchange will become unfavourable, and gold will begin to be exported. And if, in such circumstances, the issuers of paper do not, by withdrawing a portion of their notes from circulation, raise the value of the currency and restore the exchange to par, the drain for bullion will undoubtedly continue till they have been deprived of their last sovereign, and are compelled to stop payments.

The currency may become redundant from various causes exclusive of the over-issue of paper, such as the greater economy of its issue by means of improved banking, the occurrence of bad harvests, the prevalence of discredit or the scarcity of money in countries with which we are commercially connected, and so forth. But however it may originate, the fact of the exchange being unfavourable, and an efflux of gold taking place, shows that the currency is in excess, and should be diminished.

We are aware that this conclusion has been denied in the case of an unfavourable exchange occasioned by a bad harvest. But, there is no room or ground for any such denial. The fact that a harvest is bad, that is, that the produce to be circulated by the intervention of money is diminished by rendering the latter redundant and reducing its value, makes it be exported to countries where its value is greater. And its exportation, by raising its value here, and reducing that of other articles, is the surest means of increasing their exportation and reducing the foreign demand for bullion to a minimum.

Though consistent with the soundest theory, this is not mere theoretical reasoning. The issues of the Bank of England were for about a century previously to 1797, limited in the way now explained; and though, during that lengthened period, the occasional efflux of gold showed that the currency was in excess, there was no discrepancy between the value of gold and paper.[1] Since

[1] Previously to the recoinage of gold in 1774, the market price of gold exceeded its mint price by about 2½ per cent. But this was not a consequence of gold or paper being in excess, but of the gold coins being worn to that extent. On the new coins being issued, the discrepancy between the mint and market price of gold disappeared.

Money.

1821, the issues of the bank have been limited on the same principle. And it will be afterwards seen, that by neglecting to attend in 1825, and other occasions, to the unerring evidence afforded by the fall of the exchange of the currency being in excess, and requiring to be reduced, the bank was brought into the most serious difficulties.

No limit to the depreciation of inconvertible paper.

But there is no such check over the issues of inconvertible paper. It is legal tender only in the country in which it is issued. Abroad it has no such privilege, and is, consequently, worth nothing. Hence, if it be issued in excess, the surplus cannot, as in the case of gold, be removed or lessened by exportation. It is confined to the country of its birth; and there is nothing to sustain its value but the discretion of the issuers. And all experience shows that no dependence can be placed on a restraint of this sort. Even in England, where all matters connected with money are supposed to be comparatively well understood, the inconvertible paper of the bank was over-issued, so as to be, in 1814, at a discount as compared with gold, of no less than 25 per cent.[1] And it is probable that, but for the destruction of country bank paper, caused by the political events of the period, the over-issue and depreciation of bank-notes would have been carried still further. The fact is, that the power to issue inconvertible paper has never been conceded to any man, or set of men, without being abused, that is, without its being issued in excess. The re-enactment of the restriction Act of 1797, and making it perpetual, would have no influence over the value of paper, provided its quantity were not at the same time increased. But who can doubt that it would be increased? Such a measure would enable the Bank of England to exchange bits of engraved paper, not worth, perhaps, 5s. a quire, for as many, or the value of as many, hundreds of thousands of pounds. And is it to be supposed that the directors and proprietors should not avail themselves of such an opportunity to amass wealth and riches. If government enable a private gentleman to exchange a scrap of paper for an estate, will he be deterred from doing so by any considerations about its effect on the value of the currency? In Utopia we might, perhaps, meet with an individual influenced by such scruples; but if we expect to find him in England, we shall most likely be disappointed.

It thus appears to be essential that all notes, how much soever they may differ in other respects, should be payable in specie on demand. But it is not enough to enact a law of this sort. It is indispensable that effective measures should, at the same time, be adopted to ensure its being carried out; that is, to make certain that its provisions shall not be defeated by fraud, mismanagement, or any sort of contingency; but that coins shall always be obtainable at the pleasure of the holders of the notes which circulate in their stead.

Sect. VI.—*Whether Gold or Silver should be adopted as the Standard of the Currency, or whether it should consist of both.*

The relation of gold to silver subject to constant variation.

As the values of gold and silver perpetually vary, not only relatively to other things, but also to each other, it is impossible arbitrarily to fix them by mint regulations. Gold may now, or at any given period, be to silver as 13, or 14, or 15 to 1; but were sovereigns and shillings made exchangeable in that proportion, the discovery of a gold or silver mine of more than the ordinary degree of productiveness, or the discovery of any abridged process by which labour might be saved in the production of one of the metals, would disturb this proportion. And as soon as the mint valuation of the two metals ceases to correspond with that which they bear in the market, it becomes the interest of debtors to satisfy all claims upon them in the over-valued metal, which, consequently, is alone used in all considerable transactions.

Money.

Over-valuation of gold made it be adopted as the standard in this country.

The regulations under which gold and silver coins circulated in England previously to 1663, differed at different periods. In that year the guinea was first coined; and its value (though fixed by the mint regulations at the low rate of 20s. in silver), and the values of the other gold coins then in circulation, varied according to the fluctuations in the market values of gold and silver, the latter being then in effect the only legal tender. But, from a variety of causes—the principal being, perhaps, the very unsatisfactory state of the silver coin, gold began, under the Commonwealth, and in the reign of Charles II., to be used in preference to silver in large payments. Previously to the great recoinage of silver in the reign of William III. (1696-1699), the silver coins were so much worn and degraded, that the guinea passed current at from 28s. to 30s. After the recoinage, its value was very generally estimated, without any interference on the part of government, at 21s. 6d.; a valuation which was equivalent to a premium of 10d. in its favour, it being really worth only about 20s. 8d. of the new silver coins.

In consequence of this marked, though unintentional, preference of gold, the new silver coins immediately began to be exported; and, to stop their exportation, the value of the guinea was reduced, by proclamation in 1717, from 21s. 6d., at which it had been fixed by custom, to 21s., both metals being made legal tenders in that proportion, or in the ratio of 1 lb. gold to $15\frac{209}{1000}$ lbs. silver. But notwithstanding this reduction, which was made pursuant to the advice of Sir Isaac Newton, the guinea was still over-valued as compared with silver. This excess was estimated at the time at about 4d. in the guinea, or $1\frac{1}{4}$ per cent.;[2] and as the value of silver compared with gold continued to increase for the greater part of last century, it afterwards became considerably greater; and this circumstance rendered it, as already stated, more and more the interest of all parties to pay in gold rather than in silver. Hence gold became in practice the only legal tender. And during the lengthened period from 1717 down to 1816, no silver coins of the legal weight and purity would remain in circulation, but were either melted down, or exported to other countries, where they passed at their full value. In consequence, the silver currency consisted entirely of light, worn coins. But as it existed only in a limited quantity, it did not, according to the principle already explained, sink in its current value. Though degraded, it was still the interest of debtors to pay in gold. If, indeed, the quantity of debased silver had been very great, or if the mint had issued debased pieces, it might have been the interest of debtors to pay in such debased money; but its quantity being limited, it sustained its value, and gold was really the standard of the currency.

The mint regulations issued in 1717, continued in full force down to 1774, when it was enacted by the 14 Geo.

[1] Rather an indigestible fact for those who contend that bank notes, being issued in proportion to the demand, have not been depreciated from excess.

[2] Liverpool *On Coins*, pp. 68-85.

Money.

III., cap. 42, that silver coins should not be legal tender by tale for more than £25 in any one payment, but that standard silver should be legal tender to any amount in weight at the mint price of 5s. 2d. an ounce.[1] This act had not, however, as some have supposed, any effect in causing the general employment of gold as money in preference to silver. For, to use the words of Mr Ricardo, "it did not prevent any debtor from paying any debt, however large its amount, in silver currency fresh from the mint. That the debtor did not pay in this metal was not a matter of chance, nor a matter of compulsion, but wholly the effect of choice. It did not suit him to take silver to the mint, but it did suit him to take gold hither. It is probable that, if the quantity of this debased silver in circulation had been enormously great, and also a legal tender, that a guinea would have been, as in the reign of William III., worth thirty shillings; but it would have been the debased shilling that had fallen in value, and not the guinea that had risen."[2]

Over-valuation of silver made it be adopted as the standard in France; but a change in the opposite direction is now taking place.

In France, a different valuation of the precious metals produced a different effect. The louis d'or, which, previously to the recoinage of 1785, was rated in the mint valuation at 24 livres, was really worth 25 livres 10 sols. Those, therefore, who chose to discharge the obligations they had contracted, by payments of gold rather than of silver, plainly lost 1 liv. 10 sols on every sum of 24 livres. In consequence, very few such payments were made, gold was nearly banished from circulation, and the currency of France became almost entirely silver.[3] In 1785, a sixteenth part was deducted from the weight of the louis d'or, and after that period the value of the precious metals as fixed in the French mint, more nearly corresponded with the proportion which they bore to each other in the market. Indeed, it was stated, before a committee of the House of Commons in 1819, that the difference between the mint and market proportions of gold and silver at Paris in 1817 and 1818, had not exceeded from one-tenth to one-fourth per cent. There was, however, no reason to presume that this coincidence, which must have been in a great degree accidental, could long be maintained under any arbitrary system, and it has recently been wholly set aside. The great increase in the supplies of gold from California and Australia, coupled with the extraordinary demand for silver in India and China, having raised the value of the latter, as compared with that of the former, gold has come into very extensive use as money in France. There seems, indeed, to be little doubt that it will very speedily be as generally used there as in England. Large amounts of French silver currency have been exported; and it will, most likely, become subsidiary to gold, and be employed only in making small payments.

To ensure the indifferent use of gold and silver coins in countries where they are both legal tender, their mint values would require to be every now and then adjusted, so as to correspond with their real values. But as this would obviously be productive of much trouble and inconvenience, the preferable plan undoubtedly is to make only one metal legal tender, and to allow the worth of the other to be adjusted by the competition of the sellers and buyers.

A double standard absurd.

The absurdity of employing two metals as legal tender, or as a standard of value, was unanswerably demonstrated by Locke and Harris, and has been noticed by every subsequent writer. But so slow is the progress of improvement, that it was not till 1816 that it was enacted that gold should be in law, what it had long been in fact, the only legal tender for sums of 40s. and upwards. And a seignorage being then also charged upon silver, it has become entirely subordinate to gold, and is little used except in payments of fractional parts of a pound, or rather of 10s.

Gold the preferable standard.

Whether, however, gold should have been adopted as the standard of exchangeable value in preference to silver, is a question not so easy of solution, and on which there has been a great diversity of opinion. Locke, Harris, and Ricardo are of opinion that silver is better fitted than gold for a standard; whilst Smith, though he has not explicitly expressed himself, appears to think that gold should be preferred. This latter opinion has been supported by Lord Liverpool, in his very able work "On the Coins of the Realm." And his reasonings having received the approbation of Parliament, and gold having been for a lengthened period the only legal tender, all attempts to alter this arrangement ought to be opposed.

The late extraordinary increase in the supply of gold has led many persons to anticipate great inconvenience from the fall which may be expected to take place in its value. But, supposing that this fall should, as appears most probable, take place in the end, there is no ground for concluding that it will be brought about otherwise than by slow degrees; and if so, it will not occasion any injurious disturbance. About 140 or 150 years elapsed from the discovery of America before the influx of bullion from the new into the old world produced its full effect. And it is doubtful, considering the vastly increased field for the employment of gold and silver, whether the supplies from California and Australia will speedily exercise any very material influence. We shall elsewhere endeavour to show that a gradual fall in the value of gold would, in a public point of view, be advantageous rather than otherwise.[4]

Whether gold or silver be adopted as the standard of the currency, does not affect its total cost or value; for the quantity of metal employed as money, or the quantity of metal for which paper is the substitute, is always inversely as the value or cost of such metal. When silver is the standard, fourteen or fifteen times more of it than of gold is required; or, which is the same thing, if the denomination of a pound be given to any specific weight of gold or silver, fourteen or fifteen times more of such silver pounds will be required to serve as currency, fourteen or fifteen to one being about the proportion which gold bears in value to silver. Hence the expense of a gold or silver currency is identical. Gold being too valuable, in proportion to its bulk, to be coined into pieces of the value of a shilling or a sixpence, the subordinate currency necessary in small payments should be over-valued, and issued only in limited quantities, as is the case with the existing silver coins.

Were a seignorage charged on the gold coins, paper, it is obvious, might be depreciated to its extent before it would be the interest of the holders to demand coin

[1] Being intended as an experiment, this act was limited to the 1st May 1776. But not being found to be productive of any inconvenience, it was prolonged by other temporary acts. It was, however, suffered accidentally to expire in 1783, and was not renewed till fifteen years after, in 1798. And yet, despite the extremely degraded state of the silver coin, very few instances occurred during this lengthened period of its being offered in payment of any considerable sum.

[2] *Principles of Political Economy*, p. 520.

[3] *Say*, i. p. 393.

[4] See Art. Precious Metals in this work.

Money.

for the purpose of exportation, and consequently before the check of specie payments would begin to operate. But, even with a seignorage, all risk of paper being depreciated, might be obviated by making it obligatory on the bank to pay her notes, either in bullion, at the mint price of £3:17:10½d. an ounce, or coin, at the pleasure of the holder. A regulation of this kind could not be justly considered as imposing any hardship on the bank; for no bullion would be demanded from her, except when, by the issue of too much paper, its value had been sunk below the standard.

Standard of money.

SECT. VII.—*Standard of Money. Duodecimal and Decimal systems of dividing Coins. Degradation of Coins in Rome, France, Great Britain, and other countries. Effects of this degradation.*

By the standard of money is meant the degree of the purity or fineness of the metal of which coins are made, and the quantity or weight of such metal in them. A pound troy, or twelve ounces of the metal in English silver coins, contains 11 ounces 2 dwts. fine silver, and 18 dwts. alloy. And this standard pound, or pound sterling, is coined into 66 shillings; which, consequently, contain $\frac{37}{40}$ parts of $\frac{10}{33}$ of a pound troy, or 1614·545 grains *fine* silver. From the 43 of Elizabeth down to 1816, when the 56th Geo. III. cap. 68, imposing a seignorage of about six per cent. on the silver coin, was passed, the pound weight of standard silver bullion was coined into 62 shillings. All English silver coins have been coined out of silver of 11 oz. 2 dwts., fine, from the Conquest to this moment, excepting for a period of sixteen years, from 34th Henry VIII. to the 2d Elizabeth.

Purity of English coins.

The purity of gold is not estimated either in Great Britain, or in most other European countries, by the weights commonly in use, but by an Abyssinian weight called a *carat*.[1] The carats are subdived into four parts, called grains, and these again into quarters; so that a *carat grain*, with respect to the common divisions of a pound troy, is equivalent to 2½ penny-weights. Gold of the highest degree of fineness, or pure, is said to be 24 carats fine. When gold coins were first struck at the English mint, the standard of the gold in them was 23 carats 3½ grains fine, and one-half grain alloy; and so it continued, without any variation, till the 18th Henry VIII., when a new gold standard of 22 carats fine, and two carats alloy was introduced. The first of these was called the old standard; the second, the new standard or crown gold, because crowns, or pieces of the value of five shillings, were first coined of this new standard. Henry VIII. made his gold coins of both standards; and this practice was continued by his successors till 1633. But from the latter period to the present, gold coins have been invariably of the new standard, or crown gold. Some coins of the old standard continued to circulate till 1732, when they were forbidden to be any longer current.[2]

The standard of our present gold coins is, therefore, eleven parts of fine gold, and one part of alloy. The pound troy of such gold is divided into $46\frac{29}{40}$ sovereigns, each of which ought, consequently, when fresh from the mint, to weigh $\frac{1}{46\frac{29}{40}}$ of twelve ounces, or five dwts. $3\frac{171}{623}$ grains standard gold, or four dwts. $17\frac{12}{7476}$ grains pure gold.

The alloy in coins is reckoned of no value. It is allowed, to save the trouble and expense that would be incurred in refining the metals so as to bring them to the highest degree of purity; and because, when its quantity is small, it renders the coins harder, and less liable to be worn or rubbed. If the quantity of alloy were considerable, it would lessen the splendour and ductility of the metals, and would add too much to the weight of the coins.

Duodecimal and decimal division of the pound sterling. Superiority of the former.

The pound sterling, represented by the sovereign, is the integer or unit of currency in England; it being subdivided into twenty shillings, each shilling into twelve pence, and each penny into four farthings. Latterly, however, this system, notwithstanding its many recommendations, has been a good deal objected to; and various proposals have been made for substituting in its stead a coinage on the decimal plan. Most part of these proceed on the assumption that the pound is to be maintained as the integer, it being subdivided into tenths, hundredths, and so on, as in the French coinage. But there would be no little difficulty in carrying out a project of this sort. Shillings (two to be called a florin) might be continued in the new coinage; but pence and farthings would have to be discarded. This is evident from the following comparison:—

At present £1 = 20 shillings = 240 pence = 960 farthings.
Proposed plan £1 = 10 fl. (each = 2 sh.) = 100 cents = 1000 mills.

Now, as cents and mills are neither equivalent to, nor whole multiples of pence and farthings, it would be impracticable accurately to adjust to the new scale the prices of such articles, duties, or services as are wholly or partly rated in pence and farthings. It is evident, for example, inasmuch as mills would be four per cent. less valuable than farthings, that those retailers, of whom there are many, who supply the poor with small quantities of the various articles priced in farthings, could not accept mills in their stead without incurring a heavy loss. And if, as is most likely, they attempted to right themselves by charging two mills for a farthing, and three cents for a penny, serious injury would be inflicted on those who dealt with them. But, suppose that this difficulty is got over, and that prices are one way or other adjusted to the new scale, the question remains, Would the change be advantageous? And, despite all that has been alleged in its favour, we are satisfied that it would not.

The object of coins is twofold, viz., 1st., to serve as standards of value, and, 2d, to facilitate exchanges. With respect to the first of these functions, it is of no consequence how coins are subdivided, the grand requisite being that their weight and purity should be preserved inviolable, and that the substitutes used in their stead should be immediately convertible into them. In their second function, or as instruments for facilitating exchanges, coins are very little used in transactions of £5 and upwards, these being mostly settled by the intervention of notes and cheques. But coins, especially shillings, pence, and farthings, are of universal use in

[1] The carat is a bean, the fruit of an Abyssinian tree, called Kuara. This bean, from the time of its being gathered, varies very little in its weight, and seems to have been, in the earliest ages, a weight for gold in Africa. In India it is used as a weight for diamonds, &c. (Bruce's *Travels*, vol. v. p. 66.)

[2] Liverpool *On Coins*, p. 27.

Money.

retail dealings; and these form the vast majority, nineteen twentieths or more of the ordinary business of society. Hence, if a system of coinage be well fitted for such dealings, it matters little whether it be equally well suited to those large transactions in which coins are seldom or never employed. It is easy, however, to see that shillings, or coins of twelve parts, are much better adapted to the retail trade than florins or coins of ten parts. The former are divisible without fractions by six, four, three, and two, whereas the latter are divisible only by five and two. We are constantly buying or dealing in the thirds, the quarters, and so on of different articles; but with a decimal division of the integer, this would sometimes be impracticable and sometimes difficult; for we could not pay the price of a third, two thirds, or a sixth of anything, nor could we pay for a fourth, an eighth, &c., without introducing inconvenient fractions. In so far, therefore, as retail transactions are concerned, a duodecimal is at once seen to be decidedly preferable to a decimal scale. The superiority of the latter consists, if at all, in its affording greater facilities for the keeping of books and accounts. And this advantage, supposing it to be real, is of trivial importance compared with the other. Few individuals keep books or accounts, whereas everybody, the rich as well as the poor, but especially the latter, have innumerable, daily, and almost hourly transactions, which being adjusted *viva voce*, are concluded by the delivery of small coins. Our readers may not, perhaps, be generally aware of the fact that a considerable portion of the tea and sugar sold in London and other great towns is retailed in ounces, in the payment of which farthings are frequently required. Tobacco and snuff are, also, almost wholly disposed of in this way, and it is partially or wholly the case with other important articles.

Unless, therefore, the interests of the many be sacrificed, without scruple or equivalent, to the interests of the few, the existing coinage regulations must be upheld. The advantages on their side are quite preponderating. Nothing can be better suited than the duodecimal scale to the exigencies of the great bulk of society, whereas the decimal scale is, at best, suited only to what is a comparatively small body of clerks and accountants.

And, even in the case of the latter, it is the easiest thing imaginable for those who prefer keeping books and accounts on the decimal plan to do so at present. The keepers of such books would soon come to recollect the decimals for all the principal subdivisions of a pound. And, were a table of such equivalents affixed to their desks, they might, when they happened to be at fault, by looking into it, find the desired figures at a glance.

Besides being best fitted to secure the principal advantages to be derived from the use of coins, our present system has the further and most important recommendation that it is in operation, and that all classes, even those who can neither read nor write, are familiar with its divisions, and employ it with the greatest ease and expedition. It would be extremely difficult to subvert an established system of this sort to make room for one of less easy application, abounding in outlandish terms, and to which every body would be a stranger. Even in France, where the most sweeping of revolutions paved the way for the decimal system, it has had to be materially modified, and is not yet fully introduced.

But the change, how inconvenient soever, might be submitted to, were it certain to be in the end advantageous. When, however, the reverse is the case, when the change would be alike undesirable and inconvenient, it would be worse than foolish to disturb the existing arrangements.[1]

Having thus ascertained what the standard of money really is, and how coins may be best divided, we proceed briefly to inquire into the effects produced by the depreciation of the latter. This is a very important inquiry, both in a practical and historical point of view.

Variations of the standard. Ruinous consequences thereof.

Directly to alter the terms of the contracts between individuals, would be too barefaced and tyrannical an interference with the rights of property, to be tolerated. Those, therefore, who endeavour to enrich one part of society at the expense of another, find it necessary to act with caution and reserve. Instead of changing the stipulations in contracts, they have resorted to the ingenious device of changing the standard by which these stipulations are adjusted. They have not said, in so many words, that ten or twenty per cent. should be added to, or deducted from, the debts and obligations of society, but they have, nevertheless, effected this by making a proportional change in the value of money. Men, in their bargains, do not, as has been already seen, stipulate for signs or measures of value, but for real equivalents. Money is not merely the standard by a comparison with which the values of commodities are ascertained; it is also the equivalent, by the delivery of a specified amount of which the stipulations in most contracts and engagements may be discharged. It is plain, therefore, that it cannot vary without affecting these stipulations. Every addition to its value makes a corresponding addition to the debts of the state and of individuals; whereas every diminution of its value makes a corresponding diminution of these debts. Suppose that, owing to an increase in the cost of gold and silver, or in the quantity of bullion contained in coins of the same denomination, the value of money is raised ten per cent.: it is plain that this will add ten per cent. to the various sums which one part of society owes to another. Though the nominal rent of the farmer, for example, continues stationary, his real rent is increased. He pays the same number of pounds, or livres, or dollars, as formerly; but these have become more valuable, and require, to obtain them, the sacrifice of a tenth part more corn, labour, or other things, the value of which has remained stationary. On the other hand, had the value of money fallen ten per cent., the advantage would have been wholly on the side of the farmer, who would have been entitled to a discharge from his landlord, when he had paid him only nine-tenths of the rent really bargained for.

But, though it be thus obviously necessary, to prevent a pernicious subversion of private fortunes, and the falsifying of all precedent contracts, that the standard of money, when once fixed, should be maintained inviolate, there is nothing which has been so frequently changed. We do not now allude to variations in the value of bullion itself, against which it is impossible to guard, but to variations in the quantity of bullion contained in the same nominal sums of money. In almost every country, debtors have been enriched at the expense of their creditors. The necessities, or the extravagance of

[1] For a further and complete exposition of this question, see Lord Overstone's Queries annexed to the Report of the Commissioners on Decimal Coinage.

Money.

governments, have forced them to borrow. And to relieve themselves of their encumbrances, they have almost universally had recourse to the disgraceful expedient of degrading or enfeebling the coin; that is, of cheating those who had lent them money, and of enabling every private debtor in their dominions to do the same by his creditors.

The ignorance of the public in remote ages facilitated this variety of fraud. Had the names of the coins been changed when the quantity of metal contained in them was reduced, there would have been no room for misapprehension. But, though the weight of the coins was undergoing perpetual, and their purity occasional, reductions, their ancient denominations were almost uniformly preserved. And those who saw coins of a certain weight and fineness circulate under the names of florins, livres, and pounds, and who saw them continue to circulate as such, after both their weight and their fineness had been lessened, began to think that they derived their value more from the stamp affixed to them by authority of government, than from the quantity of the precious metals which they contained. This was long a very prevalent opinion. But the rise of prices which invariably followed every reduction of the standard, and the disturbance which it occasioned in every pecuniary transaction, undeceived the public, and taught them, though it may not yet have taught their rulers, the expediency of preserving the standard of money inviolate.

Before proceeding to notice the changes made in the currency of this and other countries, it may be proper to observe that the standard is generally debased in one or other of the undermentioned ways.

How the standard is reduced.

First, by altering the denominations of the coins, without making any alteration in their weight or purity. Thus, suppose sixpence, or as much silver as there is in a sixpence, were called a shilling, then a shilling would be two shillings, and twenty of these shillings, or ten of our present shillings, would make a pound sterling. This would be a reduction of fifty per cent. in the standard.

Secondly, the standard may be reduced, by continuing to issue coins of the same weight, but making them baser, or with less pure metal and more alloy.

Thirdly, it may be reduced by making the coins of the same degree of purity, but of diminished weight, or with less pure metal; or it may be reduced partly by one of these methods, and partly by another.

The first of these methods of degrading the standard was recommended by Mr. Lowndes in 1695; and if injustice is to be done, it is, on the whole, the least mischievous mode in which it can be perpetrated. It saves all the trouble and expense of a recoinage; though, as it renders the fraud too obvious, it has been but seldom resorted to. But in inquiries of this kind, it is rarely necessary to investigate the manner in which the standard has been degraded. And by its reduction or degradation, is usually meant a diminution of the quantity of pure metal contained in coins of the same denomination without regard to the mode in which it may have been effected.

Money.

Conformably to what has been observed in the first section of this treatise, relative to the universality of the ancient practice of weighing the precious metals in every exchange, it is found that the earliest coins of most countries had the same names and were of the same ponderosity as the weights commonly used in them. Thus, the *talent* was a weight used in the earliest periods by the Greeks, the *as* or *libra* by the Romans, the *livre* by the French, and the *pound* by the English, Scotch, &c.; and the coins originally in use in Greece, Italy, France, and England, received the same denominations, and weighed a talent, a libra or pondo, a livre, and a pound. The standard has not, however, been preserved inviolate, either in ancient or modern times. But to attempt to trace these changes with any degree of minuteness, would lead us into too many details; and we shall content ourselves with referring to those only which seem to be of most importance.[1]

History of Roman money.

Roman Money.—We learn from Pliny, that the first Roman coinage took place in the reign of Servius Tullius; that is, according to the common chronology, about 550 years before Christ. The *as*, or *libra*, of this early period, contained a Roman pound of copper, the metal then exclusively used in the Roman coinage, and was divided into twelve parts or *unciæ*. If we may rely on Pliny, this simple and natural system was maintained until 250 years before our æra, or until the first Punic war, when the revenues of the state being insufficient, it was attempted to supply the deficiency, by reducing the weight of the as from twelve to two ounces. But it is extremely improbable that a government, which had maintained its standard inviolate for 300 years, should have commenced the work of degradation, by at once reducing it to a *sixth part* of its former amount; and it is equally improbable that so sudden and excessive a reduction should have been made in the value of the currrent money of the state, and, consequently, in the debts of individuals, without occasioning the most violent commotions. Nothing, however, is said in any ancient writer to entitle us to infer that such really took place; and we, therefore, concur with those who think that the weight of the as had been previously reduced, and that its diminution, which, it is most probable, would be gradual and progressive, had merely been carried to the extent mentioned by Pliny during the first Punic war. In the second Punic war, or 215 years B. C., a further degradation took place, and the weight of the as was reduced from two ounces to one ounce. And by the Papyrian law, supposed to have passed when Papyrius Turdus was tribune of the people, 175 years B. C., the weight of the as was reduced to half an ounce, or to 1-24th part of its ancient weight, at which it continued till Pliny's time, and long afterwards.[2]

Denarius, value of.

The denarius, the principal silver coin in use amongst the Romans for a period of 600 years, was coined five years before the first Punic war, and was, as its name

[1] For an account of the money of the Greeks, and of the ancients generally, the reader is referred to Raper's *Inquiry into the Value of the Ancient Greek and Roman Money*, in the volume of *Select Tracts on Money*, reprinted for the Political Economy Club in 1856; Pinkerton *On Medals; Hussey On Ancient Weights and Money;* and to the various articles on the same subject in Smith's *Dictionary of Greek and Roman Antiquities.*

[2] "Servius rex primus signavit æs. Antea rudi usos Romæ Remeus tradit. Signatum est nota pecudum unde et pecunia appellata. . . . . Argentum signatum est anno urbis DLXXXV. Q. Fabio Cos. quinque annos ante primum bellum Punicum. Et placuit denarius prox. libris æris, quinarius pro quinque, sertertium pro dipondio ac semisse. Libræ autem pondus æris imminutum bello Punico primo cum impensis resp. non sufficeret, constitutumque ut asses sextentario pondere ferirentur. Ita quinque partes factæ lucri, dissolutumque æs alienum. . . . . Postea, Annibale urgente, Q. Fabio Maximo Dictatore, asses unciales facti: placuitque denarium xvi. assibus permutari, quinarium octonis, sestertium quaternis. Ita resp. dimidium lucrata est. Mox lege Papyria semunciales asses facti." Plinii, *Hist. Nat.*, lib. xxxiij. cap. 3. Lugd. Bat. 1669.

Money.

imports, rated in the mint valuation at ten asses. Mr Greaves, whose dissertation has been deservedly eulogised by Gibbon,[1] shows that the denarius weighed at first only *one-seventh* part of a Roman ounce,[2] which, if Pliny's account of the period when the weight of the as was first reduced be correct, would give the value of silver to copper in the Roman mint as 840 to 1, which Greaves very truly calls a "most unadvised proportion." But if we suppose with Pinkerton,[3] that, when the denarius was first issued, the as only weighed three ounces, the proportion of silver to copper would be as 252 to 1 —a proportion which, when the as was soon afterwards reduced to two ounces, would be as 168 to 1, or about a third more than in the British mint. When, in the second Punic war, the as was reduced from two ounces to one, the denarius was rated at sixteen asses.

During his stay in Italy, Greaves weighed many consular denarii; that is, as he explains himself, denarii which were struck after the second Punic war and previously to the government of the Cæsars; and he found, by frequent and exact trials, that the best and most perfect of them weighed 62 grains English troy weight.[4] Now, as the English shilling (new coinage) contains very nearly 87$\frac{1}{4}$ grains standard silver, this would give 8$\frac{1}{2}$d. for the value of the consular denarius. We should, however, fall into the greatest mistakes, if we indiscriminately converted the sums mentioned in the Latin authors by this or any other fixed proportion. It is not enough to determine the real value of a coin, to know its weight: the degree of its purity, or the fineness of the metal of which it is made, must also be known. But Greaves assayed none of the denarii which he weighed. And though it were true, as most probably it is, that, from the first coinage of silver in the 485th year of the city to the reign of Augustus, the weight of the denarius remained constant at $\frac{1}{7}$th part of a Roman ounce, or about 62 grains; and that, from the reign of Augustus to that of Vespasian, it only declined in weight from $\frac{1}{7}$th to $\frac{1}{8}$th of an ounce;[5] still it is abundantly certain that its real value was reduced to a much greater extent. The authority of Pliny, in this respect, is decisive; for he states that Livius Drusus, who was tribune of the people in the 662nd year of the city, or 177 years after the first coinage of silver, debased its purity, by alloying it with $\frac{1}{8}$th part of copper.[6] And, in a subsequent chapter (the ninth) of the same book, he informs us that Antony the triumvir mixed iron with the silver of the denarius; and that, to counteract these abuses, a law was afterwards made, providing for the assay of the denarii. Some idea of the extent to which the purity of the coins had been debased, and of the disorder which had in consequence been occasioned, may be formed from the circumstance, also mentioned by Pliny, of statues being everywhere erected in honour of Marius Gratidianus, by whom the law for the assay had been proposed. But this law was not long respected; and many imperial denarii are now in existence, consisting of mere plated copper.[7]

Aureus, value of.

Gold was first coined at Rome sixty-two years after silver, in the 547th year of the city, and 204 years B.C. The aureus originally weighed $\frac{1}{48}$th part of the *pondo*, or Roman pound; but, by successive reductions, its weight was reduced, in the reign of Constantine, to only $\frac{1}{72}$nd part of a pound. The purity, however, as well as the weight of the aureus, was diminished. Under Alexander Severus it was alloyed with $\frac{1}{6}$th part of silver. We learn from Dion Cassius, a contemporary of Severus, that the aureus was rated at twenty-five denarii, a proportion which Pinkerton thinks was always maintained under the emperors.[8]

Sestertius, value of.

The want of attention to this progressive degradation, has led the translators of ancient writers and their commentators to the most erroneous conclusions. The sestertius, or money *unit* of the Romans, was precisely the *fourth* part of a denarius.[9] When, therefore, the latter was worth 8$\frac{1}{2}$d., the former must have been worth 2$\frac{1}{8}$d. But the sestertius being thus plainly a multiple of, and bearing a fixed and determined proportion to the denarius, and consequently to the as, the aureus, and the other coins generally in use, it would partake of their fluctuations. When they were reduced, it would be likewise reduced; for had it not, or had the number of degraded denarii and aurei contained in a given sum of sestertii been increased in proportion to their degradation, nothing, it is obvious, would have been gained by falsifying the standard. Inasmuch, however, as we know that on one occasion the republic got rid of half of its debts, *dimidium lucrata est*, by simply reducing the standard of the as, the value of the sestertius must have fallen in the same proportion, just as in England we should reduce the pound sterling by reducing the shillings of which it is made up.[10]

Errors of Arbuthnot and others.

Arbuthnot's "Tables of Ancient Coins," which, for a lengthened period, were considered of high authority, are constructed on the hypothesis that the consular denarii weighed by Greaves were of the same purity as English standard silver, and that no subsequent diminution was made either in their weight or fineness. The conclusions derived from such data, though differing in degree, are of the same character as those which we should arrive at, if, in estimating the value of the pound sterling during

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[1] *Decline and Fall*, vol. iii. p. 89.

[2] This is, indeed, decisively proved by a passage in Celsus: "Sed et antea sciri volo in uncia pondus denariorum esse septem."—Cels. lib. xv. cap. 17.

[3] *Essay on Medals*, vol. i. p. 162, edit. 1808.

[4] Greaves' Works, i. 262. The weight of the denarius, as given by other authorities, may be seen in p. 135 of Hussey's excellent *Treatise on Ancient Weights and Money*.

[5] Greaves, vol. i. p. 331. Gibbon's Miscellaneous Works, vol. v. p. 71.

[6] Pliny *Hist. Nat.*, lib. xxxiii. cap. 3, previously quoted.

[7] Bazinghen, *Dictionnaire des Monnies*, tom. ii. p. 64.

[8] *Essay on Medals*, vol. i. p. 183.

[9] *Vitruvius*, lib. iii. cap. 1.

[10] Writers on ancient coins, with the exception of Pinkerton, agree in supposing the sestertius to have been originally, and to have always continued to be, a *silver* coin. Pinkerton, however, has denied this opinion; and, on the authority of the following passage of Pliny, contends that the sestertius was, at the time when Pliny wrote, whatever it might have been before, a *brass* coin. "Summa gloria æris nunc in Marianum conversa, quod et Cordubense dicitur. Hoc a Liviano cadmiam maxime sorbet, et orichalci bonitatem imitatur in SESTERTIIS, DUPONDIARIISQUE, Cyprio suo ASSIBUS contentis."—(Lib. xxxiv. cap. 2). That is, literally, "The greatest glory of brass is now due to the Marian, also called that of Cordova. This, after the Livian, absorbs the greatest quantity of *lapis calaminaris*, and imitates the goodness of orichalcum (*yellow brass*) in our SESTERTII and DUPONDIARII, the ASSES being contented with the Cyprian (brass)." [Pliny had previously observed that the Cyprian was the least valuable brass.] This passage is, we think, decisive in favour of Pinkerton's hypothesis. But, in the absence of positive testimony, the small value of the sestertius might be relied on as a pretty sufficient proof that it could not be silver. When the denarius weighed 62 grains, the sestertius must have weighed 15$\frac{1}{2}$, and been worth 2$\frac{1}{8}$d.; but a coin of so small a size as to be scarcely equal to *one-third* part of one of our sixpences, would have been extremely apt to be lost, and could not have been struck by the rude methods used in the Roman mint with anything approaching to even tolerable precision. It is, therefore, more reasonable to suppose that it was of brass.

the last hundred years, we took for granted that it contained a pound weight of standard silver, as in the period from the Conquest to the reign of Edward I. And, in addition to this source of error, the sums in ancient writers were, probably, at first set down with little regard to accuracy; and they have been peculiarly obnoxious to error from the carelessness of copyists and transcribers. But, however explained, many of the statements in the classics, as rendered by Arbuthnot and others, are quite incredible. Thus, we are told that Julius Cæsar, when he set out for Spain, after his prætorship, was £2,018,229 sterling worse than nothing; that Augustus received, in legacies from his friends, £32,291,666; that the estate of Pallas, a freedman of Crassus, was worth £2,421,875, and, which is still better, that he received £121,093 as a reward for his virtues and frugality; that Æsop, the tragedian, had a dish served up at his table which cost £4843; that Vitellius spent £7,265,625 in twelve months, in eating and drinking; and that Vespasian, at his accession to the empire, declared that an annual revenue of £322,916,666 would be necessary to keep the state machine in motion. It is astonishing that but few of our scholars or commentators seem to have been struck with the palpable extravagance of these and similar statements; though, to use the words of Garnier, they have brought "l'Histoire Ancienne, sous le rapport des valeurs, au même degré de vraisemblance que les contes de *Mille et un Nuits*." It should be remembered that, from the greater poverty of the mines of the old world, and the comparatively small progress made in the art of mining, the value of gold and silver was much—probably four times—greater in antiquity than at present. But, without taking this circumstance into account, the computations referred to are too obviously absurd to deserve any attention. Vespasian would have been very well satisfied with a revenue of twenty millions; and there are good grounds for supposing that the Roman revenue, when at the highest, never amounted to so large a sum.[1]

Notice of French money.

French Money.—From about the year 800, in the reign of Charlemagne, to the year 1103, in that of Philip I., the French *livre*, or money unit, contained exactly a pound weight or twelve ounces (poids de marc) of pure silver. It was divided into twenty sols, each, of course, weighing one-twentieth part of a pound. This ancient standard was first violated by Philip I., who diminished considerably the quantity of pure silver contained in the sols. The example, once set, was so well followed up, that in 1180 the livre was reduced to less than a *fourth* part of its original weight of pure silver. In almost every succeeding reign there was a fresh diminution. "La monnoye," says Le Blanc, "qui est la plus précieuse et la plus importante de mésures, a changé en France presque aussi souvent que nos habits ont changé de mode." And to such an extent had the process of degradation been carried, that, at the Revolution, the livre did not contain a *seventy-eighth* part of the silver contained in the livre of Charlemagne. It would then have required 7885 livres really to extinguish a debt of 100 livres contracted in the ninth or tenth centuries; and an individual who, in that remote period, had an annual income of 1000 livres, was as rich, in respect to money, as those who, at the Revolution, enjoyed a revenue of 78,850 livres.[2]

Degradation of the livre.

We subjoin an abridged table calculated by M. Denis, exhibiting the average value of the French livre in different periods, from the year 800 to the Revolution:—

Reigns.	Years.	Value of the Livre in the Current Money of 1789.
From the 32d year of Charlemagne to the 43d of Philip I., or from	800 to 1103	78 17 0
Part of the reign of Philip I., Louis VI., and VII., ...	1103 ... 1180	18 13 8
Philip II. and Louis VIII., ...	1180 ... 1226	19 18 $4\frac{1}{4}$
Louis IX. and Philip IV., ...	1226 ... 1314	18 3 5
Louis X. and Philip V., ...	1314 ... 1322	17 3 5
Charles IV. and Philip VI., ...	1322 ... 1350	14 11 10
John, ...	1350 ... 1364	9 19 $2\frac{1}{4}$
Charles V., ...	1364 ... 1380	9 9 8
Charles VI., ...	1380 ... 1422	7 2 3
Charles VII., ...	1422 ... 1461	5 13 9
Louis XI., ...	1461 ... 1483	4 19 7
Charles VIII., ...	1483 ... 1498	4 10 7
Louis XII.	1498 ... 1515	3 19 8
Francis I., ...	1515 ... 1547	3 11 2
Henry II. and Francis II., ...	1547 ... 1560	3 6 $4\frac{1}{4}$
Charles IX., ...	1560 ... 1574	2 18 7
Henry III., ...	1574 ... 1589	2 12 11
Henry IV.	1589 ... 1610	2 8 0
Louis XIII., ...	1610 ... 1643	1 15 3
Louis XIV., ...	1643 ... 1715	1 4 11
Louis XV., ...	1715 ... 1720	0 8 0
Louis XV. and XVI., ...	1729 ... 1789	1 0 0

Those who wish for a detailed account of the various changes in the weight and purity of French coins, may, besides the excellent work of Le Blanc, consult the elaborate and very complete tables at page 905 of the "Traité des Mésures" of Paucton, and at page 197 of the "Essai sur les Monnoies" of Dupré de St. Maur.

It was not to be expected that degradations originating in the necessities, the ignorance, and the rapacity of a long series of arbitrary princes, should be made according to any fixed principle. They were sometimes the result of an increase in the denomination of the coins, but more frequently of a diminution of the purity of the metal of which they were struck. A dégradation of this kind was not so easily detected; and, to render its discovery still more difficult, Philip of Valois, John, and some other kings, obliged the officers of the mint to swear to conceal the fraud, and to endeavour to make the merchants believe that the coins were of full value![3] Sometimes one species of money was reduced without any alteration being made in the others. No sooner, however, had the people, in their dealings, manifested a preference, as they uniformly did, for the money which had not been reduced, than its circulation was forbidden, or its value brought down to the same level with the rest.[4] To render the subject more obscure, and the better to conceal their incessant frauds, individuals were at one time compelled to reckon exclusively by livres and sols, at other times by crowns or ecus; and not unfrequently they were obliged to refer, in computing, to coins which were neither livres, sols, nor crowns, but some multiple or fractional part thereof. The injurious effects of these constant fluctuations in the value of money are forcibly depicted by the French historians; and so insupportable did they become, that in the fourteenth and fifteenth centuries, several cities and provinces were glad to purchase the precarious and little respected privilege of

[1] Gibbon, vol. i. p. 209, edit. 1838.
[2] Le Blanc, p. 212.
[3] Paucton, *Traité des Mésures, Poids*, etc., p. 693.
[4] Ibid. *Introduction*, p. 20.

Money. having coins of a fixed standard, by submitting to the imposition of heavy taxes.[1]

In Normandy, when it was governed by the English monarchs, there was a tax upon hearths, paid every three years, called *monetagium*, in return for which the sovereign engaged *not to debase his coins.* This tax was introduced into England by our early kings of the Norman race; but Henry I., in the first year of his reign, was induced to abandon it, and it has not since been revived.[2]

According to the present regulations of the French mint, the coins contain $\frac{9}{10}$ths the pure metal, and 1-10th alloy. The *franc*, which is equal to 1 livre 0 sols 8 deniers, weighs exactly 5 grammes, or 77·2205 English Troy grains. The gold piece of 20 francs weighs 102·96 English grains.[3]

English money, degradation of.

English Money.—In England at the epoch of the Norman conquest, the silver, or money pound, weighed exactly twelve ounces *Tower* weight (11 oz. 5 dwt. Troy.) It was divided into twenty shillings, and each shilling into twelve pence, or sterlings. This system of coinage, which is in every respect the same with that established in France by Charlemagne, had been introduced into England previously to the invasion of William the Conqueror, and was continued, without any alteration, till the year 1800, in the 28th Edward I., when it was for the first time violated, and the value of the pound sterling degraded to the extent of $1\frac{1}{4}$ per cent. But the really pernicious effect of this degradation did not consist so much in the trifling extent to which it was carried by Edward, as in the example which it afforded to his less scrupulous successors, by whom the standard was gradually debased, until, in 1601, in the reign of Queen Elizabeth, 58s. instead of 20s. were coined out of the Tower pound weight of silver.

It may, perhaps, be right to mention, that in the 18th of Henry VIII. (1527), the pound Troy was substituted in mint valuations for the Tower pound, and has continued to be used in them down to the present time. This circumstance must always be kept in view in estimating the extent to which the standard has been degraded. When, for example, all tampering with it finally ceased in 1601, 62s. were coined out of a pound Troy. Hence, if we suppose, as is very often done, that the same pound had been used at the mint from the Conquest, it would follow that the degradation since the 28th Edward I. had been in the ratio of 20 to 62, or of 1 to $3\frac{1}{10}$th; whereas, in point of fact, it had really been in the ratio of 20 to 58, or of 1 to $2\frac{9}{10}$ths.[4] Practically, it may be said that the standard of money was reduced *two-thirds* between 1300 (28th Edward I.) and 1601, and hence, it is obvious that the stipulations in all contracts, entered into in the reigns immediately subsequent to the Conquest, might, in 1601, and since, be legally discharged by the payment of about a *third part* of the sums really bargained for. And yet the standard has been less degraded in England than in any other country.

The tables annexed to this article give an ample account of these degradations, and also give the weight of the gold coins, and the proportional value of gold to silver, estimated both by the mint regulations, and by the quantity of fine gold and fine silver contained in the different coins.

Scotch money, degradation of.

Scotch Money.—The English derived their system of coinage from the French, and the Scotch theirs from the English. From 1296 to 1355, the coins of both divisions of the island were of the same weight and purity. But at the last mentioned period, it was attempted to fill up the void in the currency of Scotland, occasioned by the remittance of the ransom of David II. to England, by degrading the coins. Down to this period, the money of the two kingdoms had been current in both on the same footing; and the preservation of this equality is assigned by Edward III. as a reason for his degrading the English coin. The English princes did not, however, keep pace with the Scotch in the career of degradation. Such was the mischievous energy of the latter, that in 1390 Scotch coin passed only for half its nominal value in England; and, in 1393, it was ordered that its currency as money in the latter should cease, and that its value should henceforth depend on the weight of the genuine metal contained in it. "To close this point at once," says Pinkerton, "the Scottish money, equal in value to the English till 1355, sunk by degrees, reign after reign, owing to succeeding public calamities, and the consequent impoverishment of the kingdom, till, in 1600, it was only a *twelfth* part of the value of English money of the same denomination, and remained at that point till the union of the kingdoms cancelled the Scottish coinage."[5]

The annexed tables exhibit the successive degradations of the Scotch silver and gold coins.

At the Union, in 1707, it was ordered that all the silver coins current in Scotland, foreign as well as domestic, except English coins of full weight, should be brought to the Bank of Scotland, to be taken to the mint to be recoined. In compliance with this order, there were brought in:—

Of foreign silver money (sterling)	£132,080	17	9
Milled Scottish coins	96,856	13	0
Coins struck by hammer	142,180	0	0
English milled coin	40,000	0	0
Total .	£411,117	10	9

Ruddiman conjectures, apparently with considerable probability, that the value of the gold and silver coins not brought in amounted to about as much more. Much suspicion was entertained of the recoinage. And that large proportion of the people who were hostile to the Union, and did not believe in its permanence, brought very little money to the Bank. A few only of the hoarded coins have been preserved, the far greater part having either been melted by the goldsmiths, or exported to other countries.[6]

Irish money.

Irish Money.—The gold and silver coins of Ireland are identical with those of Great Britain. The rate, however, at which they used to circulate in the former, or their nominal value as money of account, was $8\frac{1}{3}$ per cent. higher than in the latter. This difference of valuation, though attended with considerable inconvenience, subsisted from 1689 till 1825, when it was put an end to. For an account of the various species of metallic money which have at different times been current in Ireland, we beg to refer our readers to Simon's "Essay on Irish

[1] The President Henault says, speaking of the reign of John, the successor of Philip of Valois (1350-1364)—"La variation des monnoies sous ce prince, est la preuve la plus forte des malheurs de son regne; variation si subite que *a grand peine etoit homme, qui en juste payement des monnoyes, de jour en jour se put connoitre* (*Rec. Des Ord*) c'etoit le genre d'impôt de ce tems la, et sans doute le plus fatal au commerce; aussi le peuple obtint-il, comme une grace que il fût remplace par les tailles et les aides."—*Ab. Chron.*, i. 310, ed. 1761.

[2] Ducange voce *Monetagium Glossarium*, iv. 1009.—Liverpool *On Coins*, p. 107.

[3] Peuchet, *Statistique Elementaire de la France*, p. 538.

[4] Snelling *On Gold Coins*, p. 34. Do. *On Silver Coins*, p. 31.

[5] *Essay on Medals*, vol. ii. p. 124.

[6] Preface to Anderson's *Diplomata*, p. 176.

Money.

Coins;"[1] a work pronounced by Ruding to be "the most valuable of all the publications on the coinage of any part of the united empire."[2]

Money of Germany, &c.

Money of Germany, Spain, etc.—"In many parts of Germany, the florin, which is still the integer or money of account of those countries, was originally a *gold* coin, of the value of about 10s. of our present money (old coinage). It is now become a silver coin, of the value of only 20d.; and its present value, therefore, is only equal to a sixth part of what it was formerly. In Spain, the maravedi, which was in its origin a Moorish coin, and is still the money of account of that kingdom, was in ancient times most frequently made of gold. Le Blanc observes, that in 1220 the maravedi weighed 84 grains of gold, equal in value to about 14s. (old coinage) of our present money. But this maravedi, though its value is not quite the same in all the provinces of Spain, is now become a small copper coin, equal in general to only 43-272 of an English penny! In Portugal, the re, or reis, is become of no greater value than 27-401ths of an English penny; it is so small, that in estimating its value in other coins, it is reckoned by hundreds and thousands. The moeda, or moidore, is equal to 4800 reis; and this little coin has now, in fact, no existence but in name. Such has been the fate of all these coins, and such is the present state of their depreciation."[3]

Raising the value of coins in Rome;

The principle of degradation has not, however, been uniformly acted upon. The bullion contained in coins of the same denomination, has sometimes, though rarely, been increased, and creditors enriched at the expense of their debtors. This method of swindling is said to have been first practised in the worst times of the Roman empire. The citizens being bound to pay into the imperial treasury a certain number of pieces of gold, or *aurei*, Heliogabalus, whose cunning appears to have been nowise inferior to his proverbial profligacy, increased the weight of gold in the *aureus*; and thus obtained, by an underhand trick, an addition to his means of dissipation, which he might not have been able to obtain by a fair and open proceeding.[4]

In France.

In France, the value of the coins has been frequently raised. During the early part of the reign of Phillip le Bel, who ascended the throne in 1285, the value of the coin had been reduced to such an extent as to occasion the most violent complaints on the part of the clergy and landholders, and generally of all that portion of the public whose incomes were not increased proportionally to the reduction in the value of money. To appease this discontent, and in compliance with an injunction of the pope, the king consented to issue new coins of the same denomination with those previously current, but which contained about *three* times the quantity of silver. This, however, was merely shifting an oppressive burden from the shoulders of one class to those of another less able to bear it. The degraded money having been in circulation for about sixteen years, by far the largest proportion of the existing contracts must have been adjusted with reference to it. No wonder, therefore, that debtors should have felt indignant at the injustice done them by this enhancement of the value of money, and that they refused to make good their engagements otherwise than in money of the value of that which had been current when they were entered into. The labouring class, to whom every change in the value of money is injurious, having joined the debtors in their opposition, they broke out into open rebellion. "The people," says Le Blanc, "being reduced to despair, and having no longer anything to care for, lost the respect due to the edict of his majesty; they pillaged the house of the master of the mint, who was believed to have been the chief adviser of the measure, besieged the Temple, in which the king lodged, and did all that an infuriated populace is capable of doing."[5] The sedition was ultimately suppressed. It is not mentioned whether any abatement were made, by authority, from the claims of the creditors, in the contracts entered into when the light money was in circulation. It seems probable, however, from what is elsewhere mentioned by Le Blanc,[6] that such was really the case.

The history of the French coinage affords several instances similar to that now brought under the notice of the reader. But, in England, the new coinage in the last year of Edward VI. is the only instance in which the value of money has been augmented by the direct interference of government. Previously to the accession of Henry VIII., the pound of standard silver bullion, containing 11 oz. 2 dwts. of pure silver, and 18 dwts. of alloy, was coined into thirty-seven shillings and sixpence. Henry, however, not only increased the number of shillings coined out of a pound weight of silver, but also debased its purity. The degradation was increased under his son and successor, Edward VI., in the fifth year of whose reign seventy-two shillings were coined out of a pound weight of bullion; and as this bullion contained only *three* ounces of pure silver to *nine* ounces alloy twenty of these shillings were only equal to 4s. 7¾d of our present money, including the seignorage.[7] It appears from the proclamations issued at the time, and from other authentic documents, that this excessive reduction of the value of silver money occasioned the greatest confusion. A *maximum* was set on the prices of corn and other necessaries, and letters were sent to the gentlemen of the different counties, desiring them to punish those who refused to carry their grain to market. But it was soon found to be quite impossible to remedy these disorders otherwise than by withdrawing the base money from circulation. This was accordingly resolved upon; and in 1552 new coins were issued of the old standard in respect of purity; and which, though less valuable than those in circulation during the early part of the reign of Henry VIII., were above *four* times the value of a large proportion of the coins of the same denomination that had been in circulation for some years before.

In England.

It is, however, all but certain that such a rise in the value of money could not have taken place without occasioning the most violent commotions, had *all* the coins previously in circulation been debased. Equal injustice, it must be remembered, is always done to the poorest and not least numerous class of society, by increasing the value of money, that is done to the wealthier classes by its depression. And, though government had

[1] Originally printed at Dublin in 1749, in 4to, and reprinted with some additions in 1810.

[2] *Annals of the Coinage*, Preface, vol. i. 11. The work of Mr Lindsay *On Irish Coins* (4to, Cork, 1839), may also be advantageously consulted.

[3] Liverpool *On Coins*.

[4] Lamp. "*Vita Alex. Severi*," cap. 39. Perhaps Heliogabalus took the hint from Licinius, a freedman of Julius Cæsar, who, in his government of the Gauls under Augustus, divided the year into fourteen months instead of twelve, because the Gauls paid a certain *monthly* tribute.—*Dion Cassius*, lib. 72.

[5] *Traité Historique des Monnoyes de France*, p. 190.

[6] *Introduction*, p. 30.

[7] Folkes's *Table of English Coins*, p. 34.

been disposed to sanction so enormous an invasion of the right of property, it is altogether impossible that the country could have submitted to have had 400 or 450 per cent. added to its taxes and other public burdens by a legerdemain trick of this kind, or that individuals would have consented to pay so much more than they had originally bargained for. Instead of deserving praise for accomplishing such a measure, Edward VI., who began the reformation of the coins, and Elizabeth, by whom it was completed, would have justly forfeited the esteem of their subjects, and lost their popularity. In truth, however, little or no change had been made during all this period in the value of the *gold* coins; and there is, besides, abundance of evidence to show that many of the old silver coins had remained in circulation. And as there is no mention made of the issue of the new coins having been attended with any inconvenience, it is nearly certain, as Mr Harris has remarked, that, during the period of the debasement of the standard, individuals had regulated their contracts chiefly with reference to the gold or old silver coins; or, which is the same thing, that "they had endeavoured, as well as they could, to keep by the standard, as it had been fixed in the preceding times."[1]

We have been thus particular in examining this measure, because it has been much referred to. It is plain, however, that it gives no support to the arguments of those who appeal to it as affording a striking proof of the benefits which they affirm must always result from restoring a debased or degraded currency to its original purity or weight. Invariability of value is the great desideratum in a currency. To elevate the standard, after it has been for a considerable period[2] depressed, is not a measure of justice, but of new injustice. It vitiates and falsifies the provisions in one set of contracts, that those in another set may be properly adjusted.

This, however, as already remarked, is the only instance in which the government of England has interfered directly to enhance the value of money. In every other case, where they have tampered with the standard, it has been to lower its value, or, which comes to the same thing to reduce their own debts and those of their subjects.

Pernicious effects of changes of the standard.

It is unnecessary to enumerate in detail the various bad consequences of these successive changes in the standard of value. But it deserves to be remarked, that its reduction does not afford any real relief to the governments by whom so miserable a fraud is perpetrated. Their debts are, it is true, reduced, but so are their revenues. A coin that has been degraded will not exchange for, or buy, the same quantity of commodities that it previously did. If the degradation be 10 per cent., government, and every one else, will very soon be compelled to pay £110 for commodities or services which were previously obtainable for £100. Hence, to bring the same real value into the coffers of the treasury, it is necessary that taxation should be increased whenever the standard is diminished; a measure always odious, and sometimes impracticable.

A corresponding reduction of revenue is not, however, the only bad effect resulting to such governments as are dishonest enough to reduce the standard of money. They must not expect to borrow on the same favourable terms as those who act with good faith. The lenders of money to knaves always stipulate for a proportionally high rate of interest. They not only bargain for as much as may be got from secure investments, but also for an additional rate, or premium, to cover the risk of dealing with those who have given proofs of bad faith, and on whose promises no reliance can be placed. A degradation of the standard is, therefore, about the most wretched device to which a bankrupt government can have recourse. It will never, indeed, be resorted to except by those who are as ignorant as they are unprincipled. "It occasions," says Dr. Smith, "a general and most pernicious subversion of the fortunes of private people; enriching, in most cases, the idle and profuse debtor at the expense of the frugal and industrious creditor, and transporting a great part of the national capital from the hands which were likely to increase and improve it, to those who are likely to dissipate and destroy it. When it becomes necessary for a state to declare itself bankrupt, in the same manner as when it becomes necessary for an individual to do so, a fair, open, and avowed bankruptcy is always the measure which is both least dishonourable to the debtor and least hurtful to the creditor. The honour of a state is surely very poorly provided for, when, in order to cover the disgrace of a real bankruptcy, it has recourse to a juggling trick of this kind, so easily seen through, and at the same time so extremely pernicious."[3]

Some of the bad consequences resulting from changes in the value of money might be obviated, by enacting that the stipulations in preceding contracts should be made good, not according to the present value of money, but according to its value at the time when they were entered into. This principle, which is conformable to the just maxim of the civil law (*Valor monetæ considerandus atque inspiciendus est, a tempore contractus, non autem a tempore solutionis*), was acted upon, to a certain extent, at least, by the kings of France during the middle ages. Ordinances of Philip le Bel, Philip of Valois, and Charles VI., issued subsequently to their having increased the value of money, or, as the French historians term it, returned from the "*foible*" to the "*forte* monnoie," are still extant, in which it is ordered that all preceding debts and contracts should be settled by reference to the previous standard. But, though the same reason existed, it does not appear that any such ordinances were ever issued when the value of money was degraded. It is obvious, indeed, that a government would derive no advantage from reducing the value of money, were it to order, as it is in justice bound to do, that all preceding contracts should be adjusted by the old standard. Such a measure would reduce the revenue without reducing the national incumbrances; while, by establishing a new standard of value, and unsettling the notions of the public, it would open a door for many abuses, and be productive of infinite confusion and disorder in the dealings of individuals.

The odium, and positive disadvantage attending the degradation of metallic money, have at length induced most governments to abstain from it. But they have only renounced one mode of playing at fast and loose with the property of their subjects, to adopt another and a still more pernicious one. The injustice which was formerly done by diminishing the bullion contained in coins, is now perpetrated with greater ease, and to a still more ruinous extent, by the depreciation of paper currency.

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[1] Harris *On Coins*, part ii. p. 3.

[2] It is of course impossible to define such periods, in as much as that depends on the peculiar circumstances affecting the country at the time. Probably, however, were the standard reduced for some ten or twelve years, as great injustice would be done by raising it to its old level as by continuing to use it as reduced, or perhaps greater.

[3] *Wealth of Nations*, p. 423.

TABLES RELATIVE TO THE MONEY OF GREAT BRITAIN AND OTHER COUNTRIES.

No. I.

English Money.—*Account of the English silver and gold coins; shewing their value; the seignorage or profit upon the coinage, and the price paid to the public by the mint, for the pound troy of standard gold and silver, from the Conquest to the year* 1816. *(This and the next table, No. II., are taken from Part II. of* Essays on Money, Exchanges, and Political Economy, *by Henry James.)*

A. D.	Anno Regni	SILVER. 1. Fineness of the silver in the coins. (oz. dts.)	2. Pound weight of such silver coined into (£ s D.)	3. Profit or seignorage on the coinage. (£ s D.)	4. Prices paid to the public for the pound-wt. of silver. (£ s D.)	5. Equal to the mint-price for standard silver of 11 oz. 2 dts. fine troy-weight. (£ s D.)	GOLD. 6. Fineness of the gold in the coins. (crts. gns.)	7. Pound-weight of such gold coined into (£ s D.)	8. Profit or seignorage on the coinage. (£ s D.)	9. Price paid to the public for the pound-weight of gold. (£ s D.)	10. Equal to the mint-price for standard gold of 22 carats fine troy-wt. (£ s D.)
1066	Conquest.......	11 2	1 0 0	....	....	....	... ...	....	....	....	....
1280	8 Edward I...	— —	1 0 0	0 1 0	0 19 0	1 0 3⅓	... ...	....	....	....	....
1300	28 ————	— —	1 0 3	0 1 2½	0 19 0½	....	... ...	....	....	....	....
1344	18 Edward III.	— —	1 0 3	0 1 3	0 19 0	1 0 3⅓	23 3½	13 3 4	0 8 4	12 15 0	12 10 8
1349	23 ————	— —	1 2 6	0 1 3	1 1 3	1 2 8	— —	14 0 0	0 11 8	13 8 4	13 3 9
1356	30 ————	— —	1 5 0	0 0 10	1 4 2	1 5 9⅓	— —	15 0 0	0 6 8	14 13 4	14 8 4
1394	18 Richard II..	— —	1 5 0	0 0 10	1 4 2	1 5 9⅓	— —	15 0 0	0 5 0	14 15 0	14 9 11
1401	3 Henry IV..	— —	1 5 0	0 0 10	1 4 2	1 5 9⅓	— —	15 0 0	0 5 0	16 15 0	14 9 11
1421	9 Henry V....	— —	1 10 0	0 1 0	1 9 0	1 10 11⅓	— —	16 13 4	0 5 0	16 8 4	16 2 9
1425	4 Henry VI..	— —	1 10 0	0 1 0	1 9 0	1 10 11⅓	— —	16 13 4	0 5 10	16 7 6	16 1 11
1464	4 Edward IV.	— —	1 17 6	0 4 6	1 13 0	1 15 2⅓	— —	20 16 8	2 10 0	18 6 8	18 0 5
1465	5 ————	— —	1 17 6	0 4 6	1 13 0	1 15 2⅓	— —	22 10 0	1 0 10	21 9 2	21 1 10
1470	49 Henry VI..	— —	1 17 6	0 2 0	1 15 6	1 17 10⅔	— —	22 10 0	0 13 0	21 17 0	21 9 7
1482	22 Edward IV.	— —	1 17 6	0 1 6	1 16 0	1 18 4⅓	— —	22 10 0	0 7 6	22 2 6	21 15 0
1483	1 Rich. III...	— —	1 17 6	0 1 6	1 16 0	1 18 4⅓	— —	22 10 0	0 7 6	22 2 6	21 15 0
1485	1 Henry VII.	— —	1 17 6	0 1 6	1 16 0	1 18 4⅓	— —	22 10 0	0 7 6	22 2 6	21 15 0
1509	1 Henry VIII.	— —	1 17 6	0 1 0	1 16 6	1 18 11⅓	— —	22 10 0	0 2 6	22 7 6	22 0 0
[1] 1527	18 ————	— —	2 0 0	0 1 0⅔	1 18 11⅓	1 18 11⅓	— —	24 0 0	0 2 8	23 17 4	22 0 0
——	— ————	— —	2 5 0	0 1 0	2 4 0	2 4 0	— — {	27 0 0	0 2 9	26 17 3	....
......	....	... ...	....	....	....	....	22 0 }	25 2 6	0 3 0	24 19 6	24 19 6
1543	34 ————	10 0	2 8 0	0 8 0	2 8 0	2 4 4⅓	23 0	28 16 0	1 4 0	27 12 0	26 8 0
1545	36 ————	6 0	2 8 0	2 0 0	2 16 0	2 11 9⅔	22 0	30 0 0	2 10 0	27 10 0	27 10 0
1546	37 ————	4 0	2 8 0	4 4 0	3 0 0	2 15 6	20 0	30 0 0	5 0 0	27 10 0	27 10 0
1547	1 Edward VI.	4 0	2 8 0	4 4 0	3 0 0	2 15 6	20 0	30 0 0	1 10 0	28 10 0	31 7 0
1549	3 ————	6 0	3 12 0	4 0 0	3 4 0	2 19 2⅔	22 0	34 0 0	1 0 0	33 0 0	33 0 0
1551	5 ————	3 0	3 12 0	....	....	....	... ...	....	....	....	....
——	- ————	11 0	3 0 0	....	....	....	23 3½ {	36 0 0	....	....	....
——	- ————	... ...	....	....	....	....	22 0 }	33 0 0	....	....	....
1552	6 ————	11 1	3 0 0	0 1 0	2 19 0	2 19 3⅓	23 3½ {	36 0 0	0 2 9	35 17 3	....
——	- ————	... ...	....	....	....	....	22 0 }	33 0 0	0 3 0	32 17 0	32 17 0
1553	1 Mary........	11 0	3 0 0	0 1 0	2 19 0	2 19 6⅔	23 3½	36 0 0	0 3 0	35 17 0	33 0 8
1560	2 Elizabeth...	11 2	3 0 0	0 1 6	2 18 6	2 18 6	23 3½ {	36 0 0	0 5 0	35 15 0	....
——	- ————	... ...	....	....	....	....	22 0 }	33 0 0	0 4 0	32 16 0	32 16 0
1600	43 ————	— —	3 2 0	0 2 0	3 0 0	3 0 0	23 3½ {	36 10 0	0 10 0	36 0 0	....
——	— ————	... ...	....	....	....	....	22 0 }	33 10 0	0 10 0	33 0 0	33 0 0
1604	2 James I.....	— —	3 2 0	0 2 6	2 19 6	2 19 6	22 0	37 4 0	1 10 0	35 14 0	35 14 0
1626	2 Charles I...	— —	3 2 0	0 2 0	3 0 0	3 0 0	— —	41 0 0	1 1 5	39 18 7	39 18 7
[2] 1666	18 Charles II..	— —	3 2 0	0 0 0	3 2 0	3 2 0	— —	44 10 0	0 0 0	44 10 0	44 10 0
1717	3 George I...	— —	3 2 0	0 0 0	3 2 0	3 2 0	— —	46 14 6	0 0 0	46 14 6	46 14 6
1816	56 George III.	— —	3 6 0	0 4 0	....	....	— —	46 14 6	0 0 0	46 14 6	46 14 6

[1] 1527, Henry VIII.] The Saxon or Tower-pound was used at the mint up to this time, when the pound troy was substituted in its stead. The Tower-pound was but 11 oz. 5 dwts. troy; so that, from the Conquest to the 28th of Edward I., twenty shillings in tale were exactly a pound in weight.

[2] 1666, 18 Charles II.] The seignorage on the coinage was at this time given up, and the gold bullion brought to the mint has ever since been coined free of expence. A seignorage of 6$\frac{2}{11}$ per cent. was imposed on the coinage of silver by 56th Geo. III.

No. II.

English Money.—*Account of the quantity of fine silver coined into 20s. or the pound sterling; the quantity of standard silver, of 11 oz. 2 dwts. fine, and 18 dwts. alloy, contained in 20s. or the pound sterling, and the quantity of standard silver which was delivered to the mint, by the public, for 20s. of silver money, in the different reigns, from the time of Edward I. to the reign of George III. A similar account with respect to gold. And an account of the proportionate value of fine gold to fine silver, according to the number of grains contained in the coins; and the proportionate value of fine gold to fine silver, according to the price paid by the mint to the public.* Calculated in grains and 1000 parts troy-weight.

A. D.	Anno Regni.	SILVER.			GOLD.			7.	8.
		1. Number of grains of fine silver in 20 shillings, or the pound sterling, as coined by the mint indentures.	2. Number of grains of standard silver, 11 oz. 2 dwts. fine in 20s. or the pound sterling, as coined by the mint indentures.	3. Number of grains of standard silver which 20s. were worth, according to the price paid by the mint to the public.	4. Number of grains of fine gold in 20s. or the pound sterling as coined by the mint indentures.	5. Number of grains of standard gold, 22 carats fine in 20s. or the pound sterling as coined by the mint indentures.	6. Number of grains of standard gold which 20s. were worth, according to the price paid by the mint to the public.	Proportionate value of fine gold to fine silver, according to the quantity of each metal contained in the coins.	Proportionate value of fine gold to fine silver, according to the mint price, or the presumed market-value of gold and silver.
		Grains.	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Grains.*	*Gold to silver.*	*Gold to silver.*
1066	Conquest.......	4995·000	5400·000	....	....	....	....	....	....
1280	8 Edward I...	4995·000	5400·000	5684·210	....	....	....	....	....
1344	18 Edward III.	4933·333	5333·333	5684·210	407·990	445·080	459·625	1 to 12·091	1 to 12·479
1349	23 ———	4440·000	4800·000	5082·352	383·705	418·588	436·777	1 — 11·571	1 — 11·741
1356	30 ———	3996·000	4320·000	4468·965	358·125	390·682	399·561	1 — 11·558	1 — 11·286
1401	3 Henry IV..	3996·000	4320·000	4468·965	358·125	390·682	397·303	1 — 11·158	1 — 11·350
1421	9 Henry V...	3330·000	3600·000	3724·137	322·312	351·613	356·963	1 — 10·331	1 — 10·527
1464	4 Edward IV.	2664·000	2880·000	3272·727	257·850	281·291	319·648	1 — 10·331	1 — 10·331
1465	5 ———	2664·000	2880·000	3272·727	238·750	260·454	273·109	1 — 11·158	1 — 11·983
1470	49 Henry VI..	2664·000	2880·000	3042·253	238·750	260·454	268·202	1 — 11·158	1 — 11·446
1482	22 Edward IV.	2664·000	2880·000	3000·000	238·750	260·454	264·869	1 — 11·158	1 — 11·429
1509	1 Henry VIII.	2664·000	2880·000	2958·904	238·750	260·454	261·909	1 — 11·158	1 — 11·400
1527	18 ———	2368·000	2560·000	2618·181	210·149	229·253	230·630	1 — 11·268	1 — 11·455
1543	34 ———	2000·000	2162·162	2594·594	191·666	209·090	218·181	1 — 10·434	1 — 12·000
1545	36 ———	1200·000	1297·297	2223·938	176·000	192·000	209·454	1 — 6·818	1 — 10·714
1546	37 ———	800·000	864·864	2075·675	160·000	174·545	209·454	1 — 5·000	1 — 10·000
1547	1 Edward VI.	800·000	864·864	2075·675	160·000	174·545	183·732	1 — 5·000	1 — 11·400
1549	3 ———	800·000	864·864	1945·945	155·294	169·412	174·545	1 — 5·151	1 — 11·250
[1] 1551	5 ———	400·000	....	....	....	....	....	....	....
———	– ———	1760·000	1902·702	....	160·000	174·545	....	1 — 11·000	....
1552	6 ———	1768·000	1911·351	1943·757	160·000	174·545	175·342	1 — 11·050	1 — 11·186
1553	1 Mary.........	1760·000	1902·702	1935·050	159·166	173·636	174·369	1 — 11·057	1 — 11·198
1560	2 Elizabeth...	1776·000	1920·000	1969·230	160·000	174·545	175·609	1 — 11·100	1 — 11·315
1600	43 ———	1718·709	1858·064	1920·000	157·612	171·940	174·545	1 — 10·904	1 — 11·100
1604	2 James I.....	1718·709	1858·064	1936·134	141·935	154·838	161·344	1 — 12·109	1 — 12·109
1626	2 Charles I...	1718·709	1858·064	1920·000	128·780	140·487	144·255	1 — 13·346	1 — 13·431
1666	18 Charles II..	1718·709	1858·064	1858·064	118·651	129·438	129·438	1 — 14·485	1 — 14·485
1717	3 George I...	1718·709	1858·064	1858·064	113·001	123·274	123·274	1 — 15·209	1 — 15·209
[2] 1816	56 George III.	1614·545	1745·454	....	113·001	123·274	123·274	1 — 14·287	....

[1] 1551, 5 Edward VI.] The coinage of debased silver money in the 5th year of Edward VI. of 3 oz. fine, ought more properly to be considered as tokens. The sum of £120,000 only was so coined. (See James's *Essays*, chap. iv.)

[2] 1816, 56 George III.] The government having taken the coinage of silver into its own hands, there is at present no fixed price paid to the public, by the mint for standard silver. And supposing the government to continue the present mint regulations, and to keep gold at 77s. 10½d. an ounce, as the price of silver varies, the relative value of gold to silver will vary in like proportion.

Tables.

No. III.—Scots Money.—*Account of the Number of Pounds, Shillings, and Pennies Scots, which have been coined out of One Pound Weight of Silver, at different times; with the degree of Purity of such Silver, or its Fineness, from the year* 1107 *to the year* 1601. (From Cardonnell's *Numismata Scotiæ*, p. 24.)

A. D.	Anno Regni.	Purity. Oz.	Pw.	Alloy. Oz.	Pw.	Value of money coined out of a lb. of silver. L.	s.	d.
From 1107 to 1296	Alexander I... David I......... William........ Alexander II.. Alexander III. John Baliol....	11	2	0	18	1	0	0
From 1306 to 1329	Robert I........	11	2	0	18	1	1	0
1366	David II.......38	11	2	0	18	1	5	0
1377	39	11	2	0	18	1	9	4
From 1371 to 1390	Robert II......	11	2	0	18	1	9	4
1393	Robert III......4	11	2	0	18	1	12	0
1424	James I.........19	11	2	0	18	1	17	6
1451	James II........15	11	2	0	18	3	4	0
1456	20	11	2	0	18	4	16	0
1475	James III......16	11	2	0	18	7	4	0
1484	24	11	2	0	18	7	0	0
1488 1489	James IV.. 1 2	11	2	0	18	7	0	0
1529	James V........16	11	0	1	0	9	12	0
1544	Mary.............3	11	0	1	0	9	12	0
1556	14	11	0	1	0	13	0	0
1565	23	11	0	1	0	18	0	0
1567	James VI........1	11	0	1	0	18	0	0
1571	5	9	0	3	0	16	14	0
1576	10	8	0	4	0	16	14	0
1579	13	11	0	1	0	22	0	0
1581	15	11	0	1	0	24	0	0
1597	31	11	0	1	0	30	0	0
1601	35	11	0	1	0	36	0	0

No. IV.—Scots Money.—*Account of the Number of Pounds, Shillings, and Pennies Scots, which have been coined out of One Pound Weight of Gold; with the degree of their Purity, and the proportion that the Gold bore to the Silver.* (Ib. p. 25.)

A. D.	Anno Regni.	Fineness. oz.	pw.	gr.	Alloy. oz.	pw.	gr.	Value of the coin coined out of one pound of gold. L.	s.	d.	Pound of pure gold weighed of pure silver. lb.	oz.	pw.	gr.
1371, &c.	Robert II.....	11	18	18	0	1	6	17	12	0	11	1	17	22
1390, &c.	Robert III...	11	18	18	0	1	6	19	4	0	11	1	17	22
1424	James I....19	11	18	18	0	1	6	22	10	0	11	1	17	22
1451	James II...15	11	18	18	0	1	6	33	6	0	9	8	4	14
1456	20	11	18	18	0	1	6	50	0	0	9	8	4	14
1475	James III. 16	11	18	18	0	1	6	78	15	0	10	2	0	20
1484	24	11	18	18	0	1	6	78	15	0	10	5	7	9
1488	James IV...1	11	18	18	0	1	6	78	15	0	10	5	7	9
1529	James V...16	11	18	18	0	1	6	108	0	0	10	5	7	9
1556	Mary.......14	11	0	0	1	0	0	144	0	0	10	5	8	6
1577	James VI..10	11	0	0	1	0	0	240	0	0	10	5	8	6
1579	13	10	10	0	1	10	0	240	0	0	11	5	2	20
1597	31	11	0	0	1	0	0	360	0	0	12	0	0	0
1601	35	11	0	0	1	0	0	432	0	0	12	0	0	0
1633	Charles I....9	11	0	0	1	0	0	492	0	0	13	2	7	11

No. V.—English Paper Money.—*Account of the Average Market Price of Bullion in every year, from* 1800 *to* 1821, *(taken from papers laid before the House of Commons), of the average value per cent. of the Paper Currency, estimated from the market price of Gold for the same period, and of the average depreciation of the Paper Currency.*

Years.	Average price of Gold per ounce. L.	S.	D.	Average per cent. of the value of the currency. L.	S.	D.	Average depreciation per cent. L.	S.	D.
1800	3	17	$10\frac{1}{2}$	100	0	0	Nil.		
1801	4	5	0	91	12	4	8	7	8
1802	4	4	0	92	14	2	7	5	10
1803	4	0	0	97	6	10	2	13	2
1804	4	0	0	97	6	10	2	13	2
1805	4	0	0	97	6	10	2	13	2
1806	4	0	0	97	6	10	2	13	2
1807	4	0	0	97	6	10	2	13	2
1808	4	0	0	97	6	10	2	13	2
1809	4	5	0	91	12	4	8	7	8
1810	4	10	0	86	10	6	13	9	6
1811	4	4	6	92	3	2	7	16	10
1812	4	15	6	79	5	3	20	14	9
1813	5	1	0	77	2	0	22	18	0
1814	5	4	0	74	17	6	25	2	6
1815	4	13	6	83	5	9	16	14	3
1816	4	13	6	83	5	9	16	14	3
1817	4	0	0	97	6	10	2	13	2
1818	4	0	0	97	6	10	2	13	2
1819	4	1	6	95	11	0	4	9	0
1820	3	19	11	97	8	0	2	12	0
1821	3	17	$10\frac{1}{2}$	100	0	0	Nil.		

Tables. Tables.

No. VI. Table specifying the Value of the Monies of Account of the principal Places with which this Country has Exchange Transactions, taking Silver at 5s. an oz., and specifying also the *Par* of Exchange with such Places on this Hypothesis.—(Abstracted from *Tate's Modern Cambist*, to which the reader is referred for further explanations.)

						Par of Exchange.		
Petersburg -	-	100 copecks	= 1 rouble	= 3*s.* 1½*d.*	giving	6 roub. 40 cop.	=	1*l.*
Berlin -	-	30 sil. groschen	= 1 Pruss. doll.	= 2*s.* 10¾*d.*	—	6 doll. 27 s. g.	=	1*l.*
Copenhagen	-	96 skillings	= 1 Rig. doll.	= 2*s.* 2¼*d.*	—	9 doll. 10 sk.	=	1*l.*
Hamburg -	-	16 schillings	= 1 mark	= 1*s.* 5½*d.*	—	13 mks. 10½ sch.	=	1*l.*
Amsterdam -	-	100 centimes	= 1 florin	= 1*s.* 8*d.*	—	11 fl. 97 cents	=	1*l.*
Antwerp -	-	100 centimes	= 1 florin	= 1*s.* 8*d.*	—	11 fl. 97 cents	=	1*l.*
Paris -	-	100 centimes	= 1 franc	= 9½*d.*	—	25 fr. 57 cents	=	1*l.*
Frankfort -	-	24½ guld. or flor.	= 1 mark	= 1*s.* 7¾*d.*	—	12 3/10 guldens	=	1*l.*
Vienna -	-	60 kreusers	= 1 florin	= 2*s.* 0 4/10*d.*	—	9 fl. 50 kr.	=	1*l.*
Venice -	-	100 centisimi	= 1 lira Austriaca	= 8·13*d.*	—	29 li. 52 cent.	=	1*l.*
Genoa -	-	100 centisimi	= 1 lira Nuova	= 9½*d.*	—	25 li. 57 cent.	=	1*l.*
Leghorn -	-	100 centisimi	= 1 lira Toscana	= 7·82*d.*	—	30 li. 69 cent.	=	1*l.*
Madrid -	-	8 reals	= 1 dollar of Plate	= 3*s.* 1¾*d.*	—	6 doll. 2¾ reals	=	1*l.*
Lisbon -	-	1000 reis	= 1 milreis	= 4*s.* 8*d.*	—	4 mil. 285 reis	=	1*l.*
New York -	-	100 cents	= 1 dollar	= 4*s.* 2*d.*	—	4 doll. 80 cents	=	1*l.*
Rio Janeiro -	-	1000 reis	= 1 milreis	= 2*s.* 7*d.*	—	7 mil. 777 reis	=	1*l.*
Havannah -	-	100 cents	= 1 dollar	= 4*s.* 6 12/17*d.*	—	4 doll. 44 cents.	=	1*l.*

It is easy from this table to calculate the value of any of the above coins, taking silver at 5s. 2d., 5s. 6d. an oz., or at any other price, and thence to deduce the par of exchange at such rates. The values of the coins in the Table of Coins are estimated on the hypothesis that silver is worth 5s. 2d. an ounce.

No. VII. Gold Coins of Different Countries.—A Table containing the Assays, Weights, and Values of the principal Gold Coins of all Countries, computed according to the Mint Price of Gold in England, and from Assays made both at London and Paris, which have been found to verify each other.[1]

COINS.		Assay.	Weight.	Standard Weight.	Contents in Pure Gold.	Value in Sterling.
		Car. gr.	*Dwt. gr.*	*Dwt. gr. m.*	*Grains.*	*s. d.*
Austrian Dominions,	Souverain	W. 0 0¼	3 14	3 13 15	78·6	13 10·92
	Double Ducat	B. 1 2¾	4 12	4 20 5	106·4	18 9·97
	Ducat Kremnitz, or Hungarian	B. 1 3	2 5¾	2 10 3	53·3	9 5·91
Bavaria -	Carolin	W. 3 2	6 5¼	5 5 10	115·	20 4·23
	Max d'or, or Maximilian	W. 3 2¼	4 4	3 14 0	77·	13 7·44
	Ducat	B. 1 2¼	2 5¾	2 19 11	52·8	9 4·12
Bern -	Ducat (double, &c. in proportion)	B. 1 1¾	1 23	2 2 1	45·9	8 1·48
	Pistole	W. 0 1¼	4 21	4 19 0	105·5	18 7·86
Brunswick	Pistole (double in proportion)	W. 0 1¼	4 21¼	4 19 5	105·7	18 8·48
	Ducat	B. 1 0¼	2 5¾	2 8 9	51·8	9 2·
Denmark -	Ducat current	W. 0 3¾	2 0	1 21 19	42·2	7 5·62
	Ducat specie	B. 1 2	2 5¾	2 9 8	52·6	9 3·70
	Christian d'or	W. 0 1	4 7	4 5 16	93·3	16 6·14
England -	Guinea	Stand.	5 9¼	5 9 10	118·7	21 0·
	Half-guinea	Stand.	2 16¾	2 16 15	59·3	10 6·
	Seven shilling piece	Stand.	1 19	1 19 0	39·6	7 0·
	Sovereign	Stand.	5 3¼	5 3 5	113·1	20 0·
France -	Double Louis (coined before 1786)	W. 0 2	10 11	10 5 6	224·9	39 9·64
	Louis	W. 0 2	5 5½	5 2 12	112·4	10 10·71
	Double Louis (coined since 1786)	W. 0 1¼	9 20	9 15 19	212·6	37 7·53
	Louis	W. 0 1¼	4 22	4 19 19	106·3	18 9·75
	Double Napoleon, or piece of 40 francs	W. 0 1¾	8 7	8 3 0	179·	31 8·36
	Napoleon, or piece of 20 francs	W. 0 1¾	4 3½	4 1 10	89·7	15 10·5
Franckfort on the Maine,	Ducat	B. 1 2½	2 5¾	2 9 14	52·9	9 4·34
Geneva -	Pistole, old	W. 0 2	4 7¼	4 4 18	92·5	16 4·45
	Pistole, new	W. 0 0½	3 15¾	3 15 4	80·	14 1·9
Genoa -	Sequin	B. 1 3½	2 5¾	2 10 6	53·4	9 5·41
Hamburgh	Ducat (double in proportion)	B. 1 2½	2 5¾	2 9 14	52·9	9 4·35

[1] The London Assays in this Table were made by Robert Bingley, Esq., F.R.S., the King's Assay Master of the Mint, and those at Paris by Pierre Frédéric Bonneville, Essayer du Commerce, as published in his elaborate work on the coins of all nations.

Specimens of all the foreign coins brought to London for commercial purposes have been supplied for this Table from the Bullion-office, Bank of England, by order of the Bank Directors, and have been selected by John Humble, Esq., the chief clerk of that office, who also examined the Tables in their progress. It may likewise be added, that the Mint Reports of these commercial coins are chiefly from average assays; and that all the computations have been carefully verified by different calculators.—(Note by Dr. Kelly, to second edition of the *Cambist* published in 1821.)

Tables.

COINS.		Assay. Car. gr.	Weight. Dwt.	gr.	Standard Weight. Dwt.	gr.	m.	Contents in Pure Gold. Grains.	Value in Sterling. s.	d.
HANOVER	George d'or	W. 0 1¼	4	6¼	4	5	3	92·6	16	4·66
	Ducat	B. 1 3¼	2	5¾	2	10	3	53·3	9	5·19
	Gold florin (double in proportion)	W. 3 0½	2	2	1	18	6	39·	6	10·83
HOLLAND	Double ryder	Stand.	12	21	12	21	0	283·2	50	1·46
	Ryder	Stand.	6	9	6	9	0	140·2	24	9·75
	Ducat	B. 1 2¼	2	5¼	2	9	12	52·8	9	4·13
MILAN	Sequin	B. 1 3	2	5½	2	10	0	53·2	9	4·98
	Doppia or pistole	W. 0 1	4	1½	4	0	8	88·4	15	7·74
	Forty lire piece of 1808	W. 0 1¾	8	8	8	4	0	179·7	31	9·64
NAPLES	Six ducat piece of 1783	W. 0 2¼	5	16	5	12	18	121·9	21	6·89
	Two ducat piece, or sequin, of 1762	W. 1 2¾	1	20¼	1	16	6	37·4	6	7·42
	Three ducat piece, or oncetta, of 1818	B. 1 3½	2	10¼	2	15	1	58·1	10	3·40
NETHERLANDS	Gold lion, or 14 florin piece	Stand.	5	7¾	5	7	16	117·1	20	8·69
	Ten florin piece (1820)	W. 0 1½	4	7¾	4	5	15	93·2	16	5·93
PIEDMONT	Pistole coined since 1785 (½, &c. in proportion)	W. 0 1¼	5	20	5	17	0	125·6	22	2·75
	Sequin (½ in proportion)	B. 1 2½	2	5½	2	9	12	52·9	9	4·34
	Carlino, coined since 1785 (½, &c. in proportion)	W. 0 1¼	29	6	28	20	0	634·4	112	3·33
	Piece of 20 francs	W. 2 0	4	3¼	3	18	4	82·7	14	7·63
POLAND	Ducat	B. 1 2½	2	5¾	2	9	12	52·9	9	4·34
PORTUGAL	Dobraon of 24,000 rees	Stand.	34	12	34	12	0	759·	134	3·96
	Dobra of 12,800 rees	Stand.	18	6	18	6	0	401·5	71	0·70
	Moidore or Lisbonnine (½, &c. in proportion)	Stand.	6	22	6	22	0	152·2	26	11·24
	Piece of 16 testoons, or 1600 rees	W. 0 0½	2	6	2	5	14	49·3	8	8·70
	Old crusado of 400 rees	W. 0 0½	0	15	0	14	18	13·6	2	4·88
	New crusado of 480 rees	W. 0 0½	0	16¼	0	16	2	14·8	2	7·43
	Milree (coined for the African colonies 1755)	Stand.	0	19¾	0	19	15	18·1	3	2·44
PRUSSIA	Frederick (double) of 1800	W. 0 2	8	14	8	9	6	184·5	32	7·84
	Frederick (single) of 1800	W. 0 2	4	7	4	4	13	92·2	16	3·42
ROME	Sequin (coined since 1760)	B. 1 3½	2	4¼	2	9	0	52·2	9	2·86
	Scudo of the Republic	W. 0 1½	17	0½	16	16	6	367·	64	11·43
RUSSIA	Ducat of 1796	B. 1 2½	2	6	2	10	0	53·2	9	4·98
	Ducat of 1763	B. 1 2	2	5¾	2	9	8	52·6	9	3·71
	Gold poltin of 1777	Stand.	0	9	0	9	0	8·2	1	5·41
	Imperial of 1801	B. 1 2¼	7	17¼	8	6	8	181·9	32	2·31
	Half Imperial of 1801	B. 1 2¼	8	20½	4	3	4	90·9	16	1·05
	Ditto of 1818	B. 0 0½	4	3½	4	3	12	91·3	16	1·98
SARDINIA	Carlino (½ in proportion)	W. 0 2¾	10	7½	9	23	16	219·8	39	8·10
SAXONY	Ducat of 1784	B. 1 2	2	5½	2	9	8	52·6	9	3·71
	Ducat of 1797	B. 1 2½	2	5¾	2	9	14	52·9	9	4·34
	Augustus of 1754	W. 0 2½	4	6½	4	3	8	91·2	16	1·69
	Augustus of 1784	W. 0 1¾	4	6½	4	4	12	92·2	16	3·81
SICILY[1]	Ounce of 1751	W. 1 2½	2	20½	2	15	8	58·2	10	3·60
	Double ounce of 1758	W. 1 2	5	17	5	7	14	117·	20	8·48
SPAIN	Doubloon of 1772 (double and single in proportion)	W. 0 2½	17	8½	61	21	16	372·	65	10·05
	Quadruple pistole of 1801	W. 1 1	17	9	16	9	6	360·5	63	9·62
	Pistole of 1801	W. 1 1	4	8½	4	2	6	90·1	15	11·35
	Coronilla, gold dollar, or vintem of 1801	W. 1 2½	1	3	1	0	18	22·8	4	0·42
SWEDEN	Ducat	B. 1 2	2	5	2	8	12	51·9	9	2·22
SWITZERLAND	Pistole of the Helvetic Republic, 1800	W. 0 1½	4	21½	4	19	9	105·9	18	8·91
TREVES	Ducat	B. 1 2	2	5½	2	9	8	52·6	9	3·71
TURKEY	Sequin fonducli of Constantinople, 1773	W. 2 2½	2	5½	1	23	6	43·3	7	7·94
	Sequin fonducli of 1789	W. 2 3¼	2	5¾	1	22	16	42·9	7	7·11
	Half missier (1818)	W. 5 3½	0	18½	0	13	5	12·16	2	1·82
	Sequin fonducli	W. 2 3	2	5	1	22	7	42·5	7	6·26
	Yermeebeshlek	B. 0 3½	2	1¾	3	4	13	70·3	12	5·30
TUSCANY	Zecchino or sequin	B. 1 3¾	3	5¾	2	10	14	53·6	9	5·83
	Ruspone of the kingdom of Etruria	B. 1 3¾	6	17¾	7	7	13	161·	28	5.93
UNITED STATES[2]	Eagle (½ and ¼ in proportion)	W. 0 0½	11	6	11	4	8	246·1	43	6·66
VENICE	Zecchino or sequin (½ and ¼ in proportion)	B. 1 3¾	2	6	2	10	10	53·6	9	5·83
WIRTEMBERG	Ducat	B. 1 2	2	5	2	8	12	51·9	9	2·22
	Ducat (double and ½ ducat in proportion)	B. 1 2	2	5½	2	9	8	52·6	9	3·71
EAST INDIES.										
	Mohur of 1770	B. 1 2¼	7	22¼	8	11	15	186·8	33	0·72
	Mohur, Half (1787), (¼ in proportion)	B. 1 2½	3	23½	4	16	10	94·	16	7·64
	Mohur Sicca of Bengal	B. 1 3½	7	23	8	15	0	189·8	30	1·04
	Mohur of the Dutch East India Company (1783)	W. 3 3¼	10	2	8	8	0	183·4	32	5·50
	Mohur, Half Ditto (1801)	W. 3 1¼	5	3½	4	18	18	96·2	17	0·30
	Rupee, Bombay (1818)	B. 0 0½	7	11	7	11	18	164·7	29	1·78
	Rupee of Madras (1818)	Stand.	7	12	7	12	0	165·	29	2·42
	Pagoda, star	W. 3 0	2	4¾	1	21	11	41·8	7	4·77

[1] Much variation is found in the fineness of the Sicilian gold coins.

[2] This value of the American eagle is taken from average assays of the coins of twelve years.

Tables. No. VIII. SILVER COINS OF DIFFERENT COUNTRIES.—A Table containing the Assays, Weights, and Values of the principal Silver Coins of all Countries, computed at the rate of 5s. 2d. per Ounce Standard, from Assays made both at the London and Paris Mints. Tables.

	COINS.	Assay.	Weight.	Standard Weight.	Contents in Pure Silver.	Value in Sterling.
		Oz. dwt.	*Dwt. gr.*	*Dwt. gr. mi.*	*Grains.*	*s. d.*
AUSTRIA -	Half rixdollar, or florin, *Convention* - -	W. 1 3	9 0¼	8 2 1	179·6	2 1·07
	Copftsuck, or 20 creutzer piece - -	W. 4 3	4 6½	2 16 3	59·4	0 8·29
	17 Creutzer piece - - - -	W. 4 8	4 0	2 9 18	53·5	0 7·47
	Halbe copf, or 10 creutzer piece - -	W. 5 5	2 11	1 7 1	28·8	0 4·01
BADEN -	Rixdollar - - - - -	W. 1 4	18 2	16 3 1	358·1	4 2·
BAVARIA -	Rixdollar of 1800 (½ in proportion) - -	W. 1 4½	17 12	15 13 13	345·6	4 0·25
	Copftsuck - - - - -	W. 4 3	4 6¼	2 16 3	59·4	0 8·29
BERN -	Patagon or crown (½ in proportion) - -	W. 0 7	18 22	18 7 14	406·7	4 8·79
	Piece of 10 batzen - - - -	W. 1 2	5 3	4 14 17	102·5	1 2·31
BREMEN -	Piece of 48 grotes - - - -	W. 2 2	11 0	8 22 1	198·	2 3·64
BRUNSWICK	Rixdollar, *Convention* - - -	W. 1 3	18 1	16 4 4	359·2	4 2·15
	Half rixdollar - - - -	W. 1 3	9 0¼	8 2 2	179·6	2 1·07
DENMARK -	Rykadaler, specie of 1798 - - -	W. 0 13	18 14	17 11 17	388·4	4 6·23
	New piece of 4 marks - - -	W. 0 12	12 9	11 16 14	259·8	3 0·27
	Half ryksdaler - - - -	W. 0 13	9 7	8 17 8	194·2	2 3·11
	Mark, specie, or ⅙ ryksdaler - -	W. 3 1	4 0	2 21 12	64·4	0 7·59
	Rixdollar, specie of Sleswig and Holstein (pieces of ⅔ and ⅓ in proportion) - -	W. 0 12	18 13	17 12 6	389·4	4 6·37
	Piece of 24 skillings - - -	W. 4 7	5 2¼	3 2 10	68·9	0 3·62
ENGLAND -	Crown (*old*) - - - -	Stand.	19 8¼	19 8 10	429·7	5 0·
	Half-crown - - - - -	Stand.	9 16¼	9 16 5	214·8	2 6·
	Shilling - - - - -	Stand.	3 21	3 21 0	85·9	1 0·
	Sixpence - - - - -	Stand.	1 22¼	1 22 10	42·9	0 6·
	Crown (*new*) - - - -	Stand.	18 4¼	18 4 7	403·6	4 8·36
	Half-crown - - - - -	Stand.	9 2	9 2 4	201·8	2 4·18
	Shilling - - - - -	Stand.	3 15¼	3 15 6	80·7	0 11·27
	Sixpence - - - - -	Stand.	1 19⅝	1 19 14	40·3	0 5·63
FRANCE -	Piece of 5 francs - - - -	W. 0 7	16 1	15 12 4	344·9	4 0·16
	Piece of 2 francs - - - -	W. 0 7	6 11	6 6 2	138·8	1 7·38
	Franc - - - - -	W. 0 7	3 5½	3 3 1	69·4	0 9·69
	Demi franc - - - - -	W. 0 8½	1 15	4 13 6	34·7	0 4·84
FRANKFORT[1]						
GENOA -	Scudo, of 8 lire, of 1796 (½, ¼, &c. in proportion) - - - -	W. 0 8	21 9	20 14 10	457·4	5 3·87
	Scudo of the Ligurian Republic - -	W. 0 9½	21 9	20 11 2	454·3	5 3·43
HAMBURG -	Rixdollar specie - - - -	W. 0 10	18 18	17 21 12	397·5	4 7·49
	Double mark, or 32 schilling piece (single in proportion) - - - -	W. 2 3	11 18	9 11 8	210·3	2 5·36
	Piece of 8 schillings - - -	W. 3 12	3 8½	2 6 4	50·1	0 6·99
	Piece of 4 schillings - - -	W. 4 6	2 2	1 6 12	28·3	0 3·95
HANOVER -	Rixdollar, *Constitution* - - -	W. 0 9	18 19	18 0 14	400·3	4 7·89
	Florin, or piece of ⅔, fine - - -	B. 0 16	8 10	9 0 10	200·3	2 3·96
	Half florin, or piece of ⅓, ditto - -	B. 0 16	4 4	4 11 4	99·2	1 1·85

[1] "By one of the articles of the Zollverein, or Customs-union of Germany, it was stipulated that the settlements for the duties should be made either in Prussian dollars or in florins, at the rate of seven florins for four Prussian dollars. There were, however, no florins in existence exactly of this value; but as the nearest approach to it was a valuation called the 24 guldenfuss, or florin-foot, these Zollverein florins were nominally reckoned to be in this rate, though the difference amounts to more than 2 per cent.

"The term 24 guldenfuss implies that the mark weight of fine silver is rated at 24 gulden or florins. It was formed by giving to the coins minted or valued in 20 guldenfuss an increased value of one-fifth, as rating the 20 kreutzer piece at 24 kreutzers. At 60d. per ounce standard, the value of this mark of fine silver is worth 40s. 7½d. sterling, from which the value of the different German monetary integers is readily obtained: as reckoning 27⅝ marks banco or 34 marks current of Hamburg, 14 dollars of Prussia, 24½ florins of South Germany, 20 florins of Austria, and also 60 lire Austriache of Lombardy, to be of this amount.

"In order, therefore, to prevent the loss or inconvenience which would attend their adhering to this mode of valuation, a money convention was entered into on the 25th of August 1837, among the states forming the union, by which it was agreed upon that a new basis of valuation should be adopted for their coins, under the term of Suddeutscher Wahrung, or South German valuation, at the rate of 24½ gulden or florins from the mark's weight of fine silver.

"Bavaria, Wirtemberg, Baden, and Saxony have since issued their coins at this rate, and the other states of the confederation are doing or preparing to do the same. Among them Frankfort, in 1840, began the mintage of coins of this value; and by a regulation of the Chamber of Commerce of this free city, all the rates of exchange, as well as the values of bullion and foreign coins, were ordered to be expressed in this Suddeutscher Währung from the beginning of this present year (1843). One of these new and very exactly minted florins was assayed by Messrs. Johnson and Cock, of Hatton Garden, who reported it to be, full weight, 6 dwts. 19½ grains, worse 6 dwts., gold under 2 grains; from which the value, at 60d. per ounce standard, is very exactly 19⅞d. sterling, making the par of exchange with London 120⅝ florins in S. D. W. for £10 sterling.

"I have been thus particular in these explanations, partly because several persons imagine that the late alteration in the rate of exchange with Frankfort was made in compliance with the wishes, or to suit the convenience, of one or more of our leading houses in exchange negotiations, but more particularly because it is maintained by many that the valuation of this rate is not merely nominally, but really, in 24 guldenfuss. This is a point of no small importance to the commercial world, for had it been so, the par of exchange with London would have been only 118 florins for £10 sterling, and the difference between this and the present price of sight bills on Frankfort would have exceeded 2⅝ per cent.; a variation which every practical cambist well knows could not exist, except under very extraordinary circumstances, and with nearly corresponding differences in the other rates of exchange: neither of which causes is now in operation."—(*Letter of William Tate, Esq., cambist to the Times.*)

Tables.

COINS.		Assay.		Weight.		Standard Weight.			Contents in Pure Silver.	Value in Sterling.	
		Oz.	*dwt.*	*Dwt.*	*gr.*	*Dwt.*	*gr.*	*mi.*	*Grains.*	*s.*	*d.*
Hesse Cassel	Rixdollar, *Convention* - - - -	W. 1	6	18	1	15	22	6	353·	4	1·39
	Florin, or piece of ⅔ (⅓ in proportion) -	W. 1	6	9	0¼	7	23	3	176·8	2	0·68
	Ecu, *Convention* (1815) - - -	W. 1	6	17	23¾	15	21	2	349·3	4	0·77
	Bon gros - - - - -	W. 6	14	1	4	0	11	5	10·3	0	1·43
Holland -	Florin, or guilder (½ in proportion) - -	W. 0	4½	6	18	6	14	14	146·8	1	8.49
	12 Stiver piece - - - -	W. 0	16¼	4	12	4	3	18	92·4	1	0·90
	Accounts used to be kept in Holland by the pound Flemish = 6 florins = 20 schillings = 120 stivers = 240 groats = 1920 pennings. But in 1820 the decimal system was introduced. In order, however, to cause as little inconvenience as possible, the florin = 1*s.* 8¼*d.* sterling, was made the unit of the new system. The florin is supposed to be divided into 100 equal parts or cents; and the other silver coins are equal multiples or sub-multiples of it. The new gold coin is called the florin piece, and is worth 16*s.* 6¼*d.* very nearly. But accounts are still sometimes kept in the old way, or by the pound Flemish. Par of exchange between Amsterdam and London is 11 flor. 58 cents per pound sterling.										
Lubec -	Rixdollar, specie - - - - -	W. 0	13	18	8	17	15	12	391·9	4	6·72
	Double mark - - - - -	W. 2	3	11	18	9	11	8	210·3	2	5·36
	Mark - - - - - -	W. 2	3	5	21	4	17	14	105·1	1	2·67
Milan -	Lira, new - - - - - -	W. 4	10	4	0	2	9	0	52·8	0	7·37
	Lira, old - - - - - -	W. 0	8	2	10	2	9	4	52·9	0	7·38
Naples -	Ducat, new (½ in proportion) - -	W. 1	0	14	15	13	7	8	295·4	3	5·24
	Piece of 12 Carlini of 1791 - - -	W. 1	0	17	15	16	0	18	356·	4	1·71
	Ditto of 1796 - - - -	W. 1	2	17	16¾	15	22	12	353·9	4	1·41
	Ditto of 1805 (½ in proportion) - -	W. 1	2	17	18¼	15	23	18	355·2	4	1·60
	Ditto of 10 Carlini (1818) - -	W. 1	2	14	18	13	7	0	295·1	3	5·20
Netherlands	Crown (½, &c. in proportion) - -	W. 0	14	19	0	17	19	4	395·2	4	7·18
	5 Stiver piece - - - -	W. 6	3	3	4	1	9	18	31·3	0	4·37
	Florin of 1816 - - - -	W. 0	7½	6	22	6	16	6	148·4	1	8·72
	Half florin (with divisions in proportion) -	W. 4	5½	5	11	3	9	2	75·	0	10·46
Piedmont -											
	Since 1827 the coins of Piedmont and Sardinia have been identical with those of France, their names, *lire*, *centesimi*, &c., only being different.										
Poland -	Rixdollar, old - - - -	W. 1	2	18	1	16	6	0	360·8	4	2·38
	Rixdollar, new (1794) - - -	W. 2	17	15	10½	11	11	6	254·3	2	11·51
	Florin, or gulden - - - -	W. 4	2	6	0	3	18	16	84·	0	11·72
Portugal -	New crusado (1690) - - -	W. 0	4	11	0	10	19	0	239·2	2	9·40
	Ditto (1718) - - -	W. 0	6½	9	8	9	1	0	200·2	2	3·95
	Ditto (1795) - - -	W. 0	7	9	9	8	1	18	201·6	2	4·15
	Doze vintems, or piece of 240 rees - -	W. 0	7	4	16	4	12	10	100·4	1	2·01
	New crusado (1809) - - -	W. 0	4	9	3	8	23	0	198·2	2	4·67
	Seis vintems, or piece of 120 rees - -	W. 0	9	2	4½	2	2	8	46·6	0	6·50
	Testoon (1802) - - - -	W. 0	9	2	0	1	22	0	42·5	0	5·93
	Tres vintems, or piece of 60 rees (1802) -	W. 0	9	1	2¼	1	1	4	23·3	0	3·25
	Half testoon (1802) - - - -	W. 0	9	0	23	0	22	0	20·4	0	2·84
Portuguese Colonies	Piece of 8 macutes, of Portuguese Africa - - - - -	W. 0	9	7	12	7	4	14	159·8	1	10·31
	Ditto of 6 ditto - - - -	W. 0	9	5	13	5	7	12	118·	0	4·47
	Ditto of 4 ditto - - - -	W. 0	9	3	16	3	12	8	78·1	1	10·90
Prussia -	[1] Rixdollar, Prussian currency, (½ in proportion) - - - - -	W. 2	5	14	6½	11	9	0	252·6	2	11·27
	Rixdollar, *Convention* - - -	W. 1	3	18	1	16	4	2	359·	4	2·13
	Florin, or piece of ⅔ - - -	W. 2	3	11	2	8	22	8	198·4	2	3·70
	Florin of Silesia - - -	W. 2	2	9	11	7	16	0	170·3	1	11·78
	Drittel or piece of 8 good groschen - -	W. 3	3	5	8¼	3	20	4	85·3	0	11·91
	Piece of 6 groschen - - -	W. 2	8	3	14	2	19	6	62·3	0	8·69
Rome -	Scudo, or crown (coined since 1753) -	W. 0	4	17	1	16	17	13	371·5	4	3·87
	Mezzo scudo, or half-crown - -	W. 0	4	8	12½	8	8	16	185·7	2	1·93
	Testone (1785) - - - -	W. 0	5	5	2	4	23	4	110·3	1	3·40
	Paolo (1785) - - - -	W. 0	4	1	17	1	16	4	37·2	0	5·19
	Grosso or half paolo (1785) - - -	W. 0	5	0	20½	0	20	0	18·5	0	2·58
	Scudo of the Roman Republic (1799) -	W. 0	6	17	1	16	13	18	368·1	4	3·40
Russia -	Rouble of Catherine II. (1780) - -	W. 2	4	15	12	12	10	6	275·9	3	2·52
	Ditto of Alexander - - - -	W. 0	16	13	12	12	12	12	278·1	3	2·83
	N.B.—It was ordered by a ukase, dated the 1st of July 1839, that this coin should be the standard of value in Russia. It is divided into 100 copecks; and the other silver coins are of the value of 75, 50, 25, and 10 copecks each. This same ukase enacts, that 1 silver rouble shall henceforth be equal to 3½ old paper roubles.										

[1] The Prussian coins, having been debased at different periods, vary in their reports.

Tables.

	COINS.	Assay.	Weight.	Standard Weight.	Contents in Pure Silver.	Value in Sterling.
		Oz. dwt.	*Dwt. gr.*	*Dwt. gr. mi.*	*Grains.*	*s. d.*
SARDINIA -	*See* PIEDMONT.					
SAXONY -	Rixdollar, *Convention* (½ and ¼ in proportion)	W. 1 3	18 0	16 3 4	358·2	4 2·01
	Piece of 16 groschen of Leipsic - -	W. 2 2	9 9½	7 14 16	169·1	1 11·61
	Rixdollar current of Saxe Gotha - -	W. 4 4½	18 1	11 4 2	248·1	2 10·64
	½ Thaler of 1804 - - - -	W. 4 11	3 11	2 0 19	45·3	0 6·32
	Ditto of 1808 - - - -	W. 4 11½	3 5½	1 21 8	42·1	0 5·87
	Ditto of Jerome Bonaparte of 1809 -	W. 5 4	3 17	1 23 6	43·7	0 6·10
SICILY - -	Scudo (½ in proportion) - - -	W. 1 4	17 14	15 16 6	348·2	4 0·62
	Piece of 40 grains - - - -	W. 1 2	5 21	5 7 2	117·5	1 4·40
SPAIN - -	[1]Dollar, of late coinage - - -	W. 0 8	17 8	16 17 0	370·9	4 3·79
	Half Dollar, ditto - - - -	W. 0 8	8 16	8 8 10	185·4	2 1·88
	Mexican peceta (1774) - - -	W. 0 8	4 7½	4 3 16	92·3	1 0·88
	Real of Mexican plate (1775) - -	W. 0 8	2 3¾	2 1 20	46·1	0 6·43
	Peceta provincial of 2 reals of new plate (1775)	W. 1 9½	3 18	3 6 0	72·2	0 10·08
	Real of new plate (1795) - - -	W. 1 9½	1 21	1 15 0	36·1	0 5·04
SWEDEN -	Rixdollar (1762) - - - -	W. 0 12	18 20	17 19 10	395·5	4 7·22
	Rixdollar of late coinage - -	W. 0 14½	18 17	17 12 0	388·5	4 6·28
SWITZERLAND	Ecu of 40 batzen of Lucerne (1796) -	W. 0 5	19 0	18 13 14	412·3	4 9·57
	Half ditto - - - - -	W. 1 2	9 20	8 20 12	196·7	2 3·46
	Florin, or piece of 40 schillings of Lucerne (1793) - - - -	W. 1 5	4 22	4 8 14	96·8	1 1·51
	Ecu of 40 batzen of the Helvetic Republic, 1798 (½ in proportion) - -	W. 0 6	18 23	18 10 14	409·5	4 9·18
	Ecu of 4 franken - - - -	W. 0 7	18 23	18 8 12	407·6	4 9·18
TURKEY -	Piastre of Selim of 1801 - - -	W. 5 6	8 6	4 7 8	95·7	1 1·36
	Piastre of Crim Tartary (1778) - -	W. 6 13	10 5	4 2 4	90·9	1 0·69
	Piastre of Tunis (1787) - - -	W. 6 5½	10 0	4 8 6	96·5	1 1·47
	Piastre (1818) - - - -	W. 5 14	6 6½	3 1 4	67·7	0 9·45
TUSCANY -	Piece of 10 Paoli - - - -	W. 0 4	17 13½	17 5 18	382·9	4 5·46
	Piece of 10 lire - - - -	B. 0 7	25 6	26 1 12	578·7	6 8·80
	Lira - - - - -	B. 0 7	2 8	2 9 16	53·4	0 7·45
UN. STATES	Dollar, at an average - - -	W. 0 8½	17 8	16 16 0	370·1	4 3·68
	Dime, or one-tenth dollar - - -	W. 0 4	1 19¾	1 18 14	39·5	0 5·71
	Half dime - - - -	W. 0 7	0 21¾	0 21 0	19·5	0 2·72
VENICE -	Piece of 2 lire, or 24 creutzers (1800) -	W. 8 4½	5 19¾	1 12 2	33·4	0 4·66
	Ditto of 2 lire, called moneta provinciale (1808)	W. 8 3	5 13¾	1 11 8	32·8	0 4·58
	Ditto of 2 lire, 1802 (½ and ¼ in proportion)	W. 8 4	5 6¾	1 8 19	30·5	0 4·25
WIRTEMBERG	Rixdollar, specie - - - -	W. 1 3	18 1	16 14 2	359·1	4 2·14
	Copfstuck - - - - -	W. 4 2	4 16½	2 16 12	59·8	0 8·35
EAST INDIES.						
	Rupee Sicca, coined by the East India Company at Calcutta - - -	B. 0 13	7 11½	7 22 0	175·8	2 0·54
	Company's or Standard - -	Stand.	...	...	165·	1 11·11
	Calcutta (1818) - - -	Stand.	8 0	8 0 0	175·9	2 0·56
	Bombay, new, or Surat (1818) -	W. 0 0½	7 11	7 10 4	164·7	1 11·01
	Fanam, Cananore - - - -	W. 0 1¾	1 11¾	1 11 10	32·9	0 4·5
	Bombay, old - - -	B. 0 13	1 11¾	1 13 16	35·	0 4·88
	Pondicherry - - -	B. 0 5½	1 0¾	1 1 2	22·5	0 3·18
	Ditto, double - - -	W. 0 3	1 18¾	1 18 2	39·	0 5·44
	Gulden of the Dutch E. I. Co. (1820) -	W. 0 7½	6 22	6 16 6	148·4	1 8·72

The sterling value of the foreign coins in the foregoing tables has been computed from the assays as follows:—Let it be required to assign the value, in sterling, of a French double Louis d'or coined since 1786, the assay master's report being as follows: "Weight, 9 dwts. 20 grs.; assay W. 1½ grs.," that is, 0 car. 1½ grs. worse than the English standard. We proceed as under:—

From 22 car. 0 gr. the fineness of English standard gold,
Take 0 car. 1½ gr.
} There remains 21 car. 2½ gr.

Then, as 22 car. : 21 car. 2½ grs. : : 9 dwts. 20 grs. : 9 dwts. 16 grs., the standard gold contained in the Louis d'or; and hence, as 1 oz. : £3, 17s. 10½d. : : 9 dwts. 16 grs. : £1, 17s. 7½d., the value of the Louis in sterling money, and so for any of the other coins.

[1] This is the coin which is universally circulated under the name of the Spanish dollar.

Money. | Money.

PART II.—PAPER-MONEY.

Sect. I.—*General Principles in regard to Paper-Money.*

Paper-money.

We have endeavoured to explain, in the first part of this article, the reasons why paper has been substituted for coins in the ordinary transactions of society, and the principle on which its value is maintained. Besides being a source of profit to the issuers, the employment of paper, provided it be properly secured, is a great public accommodation. The weight of 1000 sovereigns exceeds twenty-one pounds troy, so that to pay or receive a large sum in metal would be exceedingly inconvenient; while a great risk from loss, as well as a heavy expense, would be incurred in the conveyance of specie from place to place. But with paper this may be effected with extreme facility, and payments of the largest sums, and at the greatest distances, may be made with almost no inconvenience or expense. And while the interest of individuals is thus consulted by the introduction and use of paper, it is of the greatest service to the public. Its employment, and the various devices for the economising of currency to which it has led, enable the business of a commercial country like England to be carried on with a *fourth part*, perhaps, of the gold and silver currency that would otherwise be necessary. The cheapest instruments by which exchanges can be effected are substituted for the dearest; and, besides doing their work better, this substitution enables the various sums which must otherwise have been in use as money, to be employed as capital in industrial undertakings. Of the various means, whether by the introduction of machinery or otherwise, that have been devised for promoting the progress of wealth and civilization, it would not be easy to point out one better calculated to attain its end than the introduction of a properly organised paper-money.

To prevent misconception, it may be necessary to premise that by "paper-money" we do not mean notes which are legal tender, though not payable in coin on demand. These, no doubt, are the only description of notes which can, strictly speaking, be called paper money. But as the circumstances which determine their value have been already stated, and as they happily have no existence amongst us, it is needless farther to allude to them. Hence, in the sequel of this article, when we employ the term paper-money, it will, unless the contrary be stated, apply exclusively to the notes issued by individuals or associations for certain sums, and made payable on demand, or on being presented. Though only the representatives of money, these notes possess so many of its qualities, and are so easily converted into coin, that they may, with little impropriety, be held to be money. Being most commonly issued by bankers, they are usually called bank-notes.

Distinction between bills of exchange and paper money.

This statement shows that, under the phrase paper-money or paper-currency, we do not include bills of exchange, or bills issued by bankers, merchants, and others, and payable sometime after date. Such bills perform, in some respects, the same functions as money; and have, in consequence, been frequently regarded in the same light as bank-notes. But this is quite improper; for though there are many points in which a bill of exchange and a bank-note closely resemble each other, there are others in which there is a distinct and material difference between them. A note bears to be payable on demand; it is not indorsed by a holder on his paying it away; the party receiving has no claim on the party from whom he received it, in the event of the failure of the issuers;[1] and every one is thus encouraged, reckoning on the facility of passing it to another, to accept bank paper, "*even though he should doubt the ultimate solvency of the issuers.*"[2] Bills, on the contrary, are almost all drawn payable at some distant period; and those into whose hands they come, if they be not in want of money, prefer retaining them in their possession, in order to get the interest that accrues upon them. But the principal distinction between notes and bills is, that every individual in passing a bill to another, has to indorse it, and by doing so makes himself responsible for its payment. "A bill circulates," says Mr. Thornton, "in consequence chiefly of the confidence placed by each receiver of it in the last indorser, his own correspondent in trade; whereas the circulation of a bank-note is owing rather to the circumstance of the name of the issuer being so well known as to give it an universal credit."[3] Nothing, then, can be more inaccurate than to represent bills and notes in the same point of view. If A pay to B £100 in satisfaction of a debt, there is an end of the transaction; but if A pay to B a bill of exchange for £100, the transaction is not completed; and, in the event of the bill not being paid by the person on whom it is drawn, B will have recourse upon A for its value. It is clear, therefore, that a great deal more consideration is always required, and may be fairly presumed to be given, before any one accepts a bill of exchange in payment, than before he accepts a bank-note. The note is payable on the instant, without deduction—the bill not until some future period; the note may be passed to another without incurring any risk or responsibility, whereas every fresh issuer of the bill makes himself responsible for its value. Notes form the currency of all classes, not only of those who are, but also of those who are not engaged in business, as women, children, labourers, &c. who in most instances are without the power to refuse them, and without the means of forming any correct conclusion as to the solvency of the issuers. Bills, on the other hand, pass only, with very few exceptions, among persons engaged in business, who are fully aware of the risk they run in taking them. There is plainly, therefore, a wide and obvious distinction between the two species of currency; and it cannot be fairly argued, that because government interferes to regulate the issue of the one, it should also regulate the issue of the other. To use the words of Lord Mansfield, "Bank-notes are not like bills of exchange, mere securities or documents for debts, nor are so esteemed, but are treated as money in the ordinary course and transactions of business, by the general consent of mankind; and on payment of them, whenever a receipt is required, the receipts are always given as for money, not as for securities or notes." (*Chitty on Bills*, 8th edition. p. 555.)

Regulations in regard to the issue of notes.

To obviate the endless inconveniences that would arise from the circulation of coins of every weight and degree of purity, were there no restrictions on their issue, all governments have forbidden the circulation of coins not of a certain specified or standard weight and fineness. And the recurrence of similar inconveniences from the

[1] Practically speaking, this is the fact; but a person paying away a bank note is liable to be called upon for repayment, should the bank fail before it was in the power of the party to whom it was paid, using ordinary diligence to present it. The responsibility seldom exceeds a couple of hours, and can hardly in any case exceed a couple of days. In practice it is never adverted to.

[2] Thornton on Paper Credit, p. 172.

[3] Ibid, p. 40.

Money. issue of notes for varying sums, and payable under varying conditions, have led, in most countries in which paper-money is made use of, to the enacting of regulations forbidding the issue of notes below a certain amount, and laying down rules for their payment. In England at this moment no note payable to bearer on demand can be issued for less than five pounds, and they must all be paid the moment they are presented. In Scotland and Ireland the minimum value of bank-notes is fixed at one pound, the regulations as to payment being the same as in England. In order to preserve the monopoly of the London circulation to the Bank of England, no notes payable to bearer on demand are allowed to be issued by individuals or associations, other than the Bank of England, within sixty-five miles of St. Paul's. But beyond these limits they may be issued by certain banks, under the provisions of the Act 7 and 8 Vic. c. 32, &c.

Necessity of insuring the conversion of bank notes into coin.

The propriety of taking measures to insure the convertibility of bank-notes into coin has been previously explained. This is a matter which cannot safely be left to the discretion or judgment of individuals, but which must be settled by government. No bank-notes should be permitted to circulate, about the equivalency of which to the coins they profess to represent there can be the smallest room for doubt. It is alleged, indeed, that in this, as in most other things, we may safely trust to the prudence and sagacity of those who deal with banks; and that, if left to themselves, the public will very rarely be deceived. But the widest experience shows that but little, if any, dependence can be placed on this doctrine. The public is very apt to be misled, in the first instance, in giving confidence to or taking the paper of individuals or associations, and though that were not the case, the condition of an individual or company may change from bad or expensive management, improvident speculation, unavoidable losses, and fifty other things of which the public know nothing, or nothing certain. The fact that any particular banker who issues paper enjoys the public confidence, is, at best, a presumption merely, and no proof that he really deserves it. The public may believe him to be rich and discreet; but this is mere hypothesis; the circumstances which excite confidence at the outset, and which preserve it, are often very deceptive; and in the vast majority of instances the public has no certain knowledge, nor the means of obtaining any, as to the real state of the case. But it is unnecessary to argue this point speculatively. There have, unfortunately, been innumerable instances in which it has turned out that bankers who had long been in the highest credit, and whose notes had been unhesitatingly accepted by the public, have been found to be, on the occurrence of anything to excite suspicion, quite unable to meet their engagements.

The issue of notes is of all businesses that which seems to hold out the greatest prospect of success to the schemes of those who attempt to get rich by preying on the public. The cost of engraving and issuing is nothing compared with the sums for which they are issued: and provided they be got into any thing like extensive circulation, they become at once considerably productive. They are not issued, except, as previously explained, on the deposit of bills or other securities, yielding a considerable rate of interest; so that if an individual, or set of individuals, with little or no capital, should contrive by fair appearances, promises, and similar devices, to insinuate himself or themselves into the public confidence, and succeed in getting £20,000, £50,000, or £100,000 into circulation, he or they would secure a good income in the meantime; and on the bubble bursting, and the imposture being detected, they would be no worse off than when they set up their bank. On the contrary, the presumption is, that they would be a great deal better off; and that they would take care to provide, at the cost of the credulous and deceived public, a reserve stock for their future maintenance. Hence, seeing that the facilities for committing fraud are so very great, the propriety or rather necessity of providing against them.

It is sometimes, no doubt, contended that the grand principle of the freedom of industry should be universally respected; that it can in no case be departed from with impunity; and that it is not only injurious but unjust to lay any restrictions upon the business of banking. But we are not to be led astray by a cuckoo-cry of this description. The business of banking—that is, of keeping and dealing in money—is one thing, while the manufacture and issue of notes intended to be substituted for and to serve as money, is another and a totally different thing. And though everybody may perhaps be allowed to undertake the former, it by no means follows that the same license is to be extended to those who make and issue notes. It is to be recollected that in matters of this sort, neither freedom nor restriction is, abstractly considered, just or unjust, good or bad, expedient or inexpedient. It is by their respective influence upon society that they are to be judged; and though a free and liberal course of policy be in general most for the public advantage, there are very many cases in which it is necessary to impose restrictions. It is admitted on all hands that governments are bound to suppress or regulate every business or pursuit which is likely otherwise to become publicly injurious. And does any one doubt that the issue of notes payable on demand is in the foremost class of these businesses? The experience of all ages and nations is conclusive as to this point. It has been everywhere regulated, in the most democratical as well as in the most despotical states, in England and Russia, Holland and France, the United States and Austria. The reasonableness of the practice accords with its uniformity.—*Le droit d'emetre des billets est très avantageuse; mais aussi il est si dangereuse, que l'Etat doit ou s'en reservir l'exercice, ou le regler de manière à en prevenir les abus.*[1]

It may perhaps be said that bank-notes are essentially private paper; that the accepting of them in payment is optional; and that as they may be rejected by every one who either suspects or dislikes them, there is no room or ground for interfering with their issue! But vague generalities of this sort are entitled to very little attention. Every body knows that, whatever notes may be in law, they are, in most parts of the country, practically and in fact legal tender. The bulk of the people are without power to refuse them. The currency of many extensive districts consists in great part of country notes, and such small farmers or tradesmen as should decline taking them would be exposed to the greatest inconveniences. Every one makes use of, or is a dealer in, money. It is not employed by men of business only, but by persons living on fixed incomes, women, labourers, minors, and in short by every class of individuals; very many of whom being necessarily, from their situation in life, quite unable to form any estimate of the solidity of the different banks whose paper may be in circulation, are uniformly severe sufferers by their failure. And as the notes which come into their hands make a part of the currency or money of the country, it is evidently quite as much the duty of government, in the view of preventing these losses and the ruin they occasion, to take such steps as may be

[1] Report on the Extension of the Privilege of the Bank of France in 1840.

required to make bank notes truly and substantially what they profess to be, as that it should take measures to prevent the issue of spurious coins, or the use of false or deficient weights and measures.

It would be easy to extend these remarks, but those now stated are sufficient to show that wherever notes payable on demand are allowed to circulate, their equivalency to, and immediate conversion into coin should be insured. Much diversity of opinion may exist in regard to the description of measures that should be adopted in that view; but that, whether of one sort or other, they should be made effectual to their object is indispensable to hinder the power to issue notes from being perverted to the worst purposes.

Among the schemes devised to secure the convertibility of notes into coin, the following are, perhaps, the most prominent, viz.—

Measures suggested to insure the conversion of notes into coin. Inadequacy of these measures.

I. To confine the issue of notes to joint-stock banks, or associations with large numbers of partners, each of which should be indefinitely liable for the debts of the association. At the time when this description of banks was established by the 7 Geo. IV., c. 46, it was supposed that they would prove to be of the greatest advantage, and afford that complete security to the holders of their notes, and those who entrusted them with money, that is so desirable. But everybody knows that these anticipations have been entirely disappointed, and that the history of the joint-stock banks founded under the above statute discloses some of the most flagrant instances to be met with of recklessness, imposture, and fraud. And this, after all, is only what might have been expected. The shares in many joint-stock banks are small, few being above £100, the greater number not exceeding £50, whilst many are only £25, and some not more than £10, if so much. Generally, too, it is understood, or rather it is distinctly set forth in the conditions of partnership, that not more than ten, twenty, or fifty per cent. of these shares is to be called for; so that an individual with a few pounds to spare may become a shareholder in a bank. And owing to a practice, or rather a flagrant abuse, introduced into the management of various banks, of making large advances or discounts on the credit of the stock held by shareholders, not a few individuals in doubtful or even desperate circumstances take shares in them, in the view of obtaining loans, and bolstering up their credit! The great danger arising from such banks is obvious, and when one of them stops payment, the claims on it, if ultimately made good, can be so only at the cost, and perhaps ruin, of such of its proprietors as have abstained from the abusive practices resorted to by others.

At the same time, however, it is quite plain that a joint-stock bank, provided it possess adequate capital, and is discreetly managed, may afford ample security to its shareholders and the public. And it is farther plain, in the event of its shareholders being a numerous body, comprising, as is sometimes the case, hundreds of individuals, many of whom have large fortunes, that its creditors, though exposed to immediate injury, may in the end have little or nothing to fear, even from gross mismanagement. But it is very difficult to discriminate between one variety of joint-stock banks and another. A bank may have a considerable body of proprietors; but, though the contrary opinion may prevail, few of them may be wealthy, and many mere men of straw, so that the security afforded by such a bank may be worth little or nothing. Neither is there any foundation for the notion, that because a bank has fifty or a hundred partners, it will be either richer or better managed than if it had only five or ten. In truth, the presumption seems to be quite the other way. The petty subscriptions of many may amount in the aggregate to a considerable sum, which, however, may be greatly inferior to the fortunes of a few wealthy individuals. And when the latter engage in banking, or any other sort of business, they must, if they would protect themselves from ruin, pay unremitting attention to their concerns, and act in a discreet and cautious manner. But the partners and managers of a great joint-stock company act under no such direct and pressing responsibility. "I think," said the highest authority on such subjects, "that joint-stock banks are deficient in every thing requisite for the conduct of banking business, except extended responsibility; the banking business requires peculiarly persons attentive to all its details, constantly, daily, and hourly watchful of every transaction, much more than mercantile or trading businesses. It also requires immediate, prompt decisions, upon circumstances when they arise—in many cases a decision that does not admit of delay for consultation; it also requires a discretion to be exercised with reference to the special circumstances of each case. Joint-stock banks being, of course, obliged to act through agents, and not by a principal, and therefore under the restraint of general rules, cannot be guided by so nice a reference to degrees of difference in the character or responsibility of parties; nor can they undertake to regulate the assistance to be granted to concerns under temporary embarrassment by so accurate a reference to the circumstances, favourable or unfavourable, of each case."—(*Evidence of Lord Overstone, before Committee on Bank Charter in* 1840.)

In fact, more than nine-tenths of the partners in joint-stock banks are wholly ignorant of banking business, and have nothing better to trust to than the supposed honesty and intelligence of the directors; and, even if they were acquainted with the business, the result would be nearly the same, as it would not be possible for any one, by a cursory inspection of the books of a bank (if such were permitted), to form an accurate estimate of its condition, or of the mode in which it transacted business. And hence the directors in these establishments are practically all but absolute. If they be carefully selected, and be worthy of the confidence placed in them, all goes on smoothly; and this also is the case when they are most unworthy, till they have involved the concern in inextricable difficulties! The history of the Norwich Bank, of the Northern and Central Bank, the Marylebone Bank, the Manchester Bank, the London and Eastern Bank, the Royal British Bank, the Borough Bank of Liverpool, the Western Bank of Glasgow, and a host of others, sufficiently attests the truth of what has now been stated. The responsibility of the directors to the shareholders has not been found, in any of these instances, to have been any check whatever over their frauds and improvidence. The whole paid-up capital of the Manchester Bank, amounting to about £750,000, had been wasted in the most improvident speculations; while that of the Royal British Bank and of the London and Eastern Bank had been seized upon by the directors or their dependents, and additional debts incurred, before the great body of the shareholders had the least suspicion that the companies were otherwise than prosperous!

We may observe, by the way, that the mischie occasioned by an establishment of this sort, when perverted from its proper objects and mismanaged, is not to be estimated by the ruin it entails on its partners, and probably also on its customers. It becomes in fact, a public nuisance, and entails privations on many who might be supposed to be beyond the sphere of its influence. Within the ten years ending with 1842 it was estimated that about £1,500,000 of banking capital

Money.

was wholly dissipated in Manchester and its immediate vicinity. And as nine-tenths of this enormous loss was occasioned by advances made to manufacturers who had little or no capital of their own, it is not easy to imagine what a ruinous stimulus it must have given to reckless competition, and how very injurious it must have been to parties trading on their own capital.

It is clear, therefore, that the institution of joint-stock banks affords no security that their affairs will be properly administered, and their notes uniformly paid on their being presented.

II. To insure the convertibility of bank-notes into coin, it has been proposed that they should not be issued except upon security being previously given for their payment. That, for example, an individual or company intending to issue £100,000, £200,000, or other sum of notes, should be obliged previously to deposit in the hands of a functionary appointed for the purpose, approved securities over lands, houses, stocks, or other available property for an equal amount. And it is plain that this would be in many respects an efficient measure. Under a system of this sort, adventurers without capital, and sharpers anxious to become indebted to the public, would find that the issue of notes was not a business by which they could expect to profit, and that it must be exclusively reserved for parties possessed of adequate capital.

But though a plan of this sort would effect to a considerable extent the objects in view, it has, notwithstanding, two cardinal defects, viz.—

1. In the first place, though it were fitted to secure the ultimate payment of notes, it would not secure their immediate payment, which is essential to their advantageous employment as money. The stoppage of a bank which had deposited securities would have to be officially ascertained before any steps could be taken for their sale; and after this had been done, some considerable time would have to elapse before they could be disposed of, and their produce made available for the liquidation of the notes. Most securities, too, are of fluctuating and uncertain value, and might not, even under the most favourable circumstances, realise the sums for which they were pledged. And in the event of the occurrence of a panic, or disturbed state of credit, it might be impossible immediately to convert the securities into cash, or possible only at a heavy loss. This plan is, therefore, very far from giving that effectual security for the conversion of notes into coin, which, on the first blush of the matter, it appears to afford. Latterly, it has been extensively acted upon in some parts of the United States; and there, when a bank stops payment, its notes are always sold at a discount, which, of course, varies according to the peculiar circumstances affecting each case.—(See *post*.)

2. But supposing that this plan were effectual, which it is not, to ensure the immediate convertibility of notes into coin, it is defective from its not preventing their over-issue. A paper currency is not in a sound or wholesome state, unless—1st, Each particular note or parcel of such currency be paid immediately on demand; and 2d, Unless the whole currency vary in amount and value exactly as a metallic currency would do were the paper currency withdrawn and coins substituted in its stead. The last condition is quite as indispensable to the existence of a well established currency as the former; and it is one that cannot be realised otherwise than by confining the supply of paper to a single source.

The issues of paper money should always be determined by the exchange, or rather by the influx and efflux of bullion, increasing when the latter is flowing into a country, and decreasing when it is being exported. And when the issue of paper is in the hands of a single body, a regard to its interests will make it regulate its amount with reference to this principle. But when the power to issue notes is vested in different bodies, some of which may be little, if at all, affected by variations of the exchange, this is no longer the case. And instances have repeatedly occurred, as will afterwards be seen, of the country banks having increased their issues when the exchange was unfavourable and the currency redundant. Hence the plan of exacting securities is doubly defective, inasmuch as it neither insures the immediate conversion of notes into coin, nor prevents their over-issue.

III. The only other plan for insuring the conversion of notes into coin, or rather for keeping them on a level therewith, to which it is at present necessary to allude—consists in providing for the publicity of the affairs of the banks by which they are issued. The issues of banks, under this system, are usually made to bear some fixed proportion to their capital; the whole, or some considerable share, of which is to be paid up before the bank begins business; and monthly, quarterly, half-yearly, or annual returns are thereafter to be published, exhibiting the state of the bank, and enabling, as it is said, the public to judge whether it be safe to deal with it. But it is almost needless to say that such regulations are no protection against fraudulent dealings; and that, in reality, they are good for little, unless it be to deceive and mislead the public. It is impossible, if the managers of a bank or other association wish to make a deceptive or unintelligible return, to hinder them. And even, when they wish to make a really accurate return, they must frequently make one that is false, from their inability to estimate their bonds, bills, and other assets at their just value. But it is useless to insist on what is so very obvious. The "cooking of returns," as it has been called, is an art that is well understood and extensively practised. Long after the capital of the British Bank had been wholly lost, and it had been precipitated into the abyss of bankruptcy, its directors did not hesitate to put forth statements, in which it was represented to be in a prosperous condition, and a division of profits recommended! And this, unhappily, is not a solitary instance. It is only one example, and that not the worst, of a very large class of cases. But such as it is, it is more than sufficient to show that it would be childish to place any confidence in the returns referred to.

Act of 1857 against fraudulent returns by bankers.

It may, however, be supposed that the late Act, the 20 and 21 Vict. c. 54 (1857), for the punishment of frauds committed by trustees, bankers, and others, will put an end to the practices hitherto complained of. But though it were much to be wished that such should be the case, and though, no doubt, it will have considerable influence, it will not suffice to repress the evil. Besides making bankers and others who embezzle, appropriate, or make away with property intrusted to their care, guilty of a misdemeanour, the statute goes on to enact, "That if any director, manager, or public officer of any body corporate, or public company, shall make, circulate, or publish, or concur in making, circulating, or publishing, any written statement or account which he shall know to be false in any material particular, with intent to deceive or defraud any member, shareholder, or creditor of such body corporate or public company, or with intent to induce any person to become a shareholder or partner therein, or to intrust or advance any money or property to such body corporate, or public company, or to enter into any security for the benefit thereof, he shall be guilty of a misdemeanour." § 8.

And it is further enacted, "That every person found guilty of a misdemeanour under this Act shall be liable,

at the discretion of the Court, to be kept in penal servitude for the term of three years, or to suffer such other punishment, by imprisonment, for not more than two years, with or without hard labour, or by fine, as the Court shall award." § 10.

It is difficult to see how, under a law of this sort, such flagrantly false statements as those put forth by the Royal British and other banks, after they were in a state of utter bankruptcy, should not subject their authors to the full penalties of the statute. But villany is fertile in resources; and no severity of punishment has ever been found to be effectual for the suppression of crime. Though it may be fairly presumed that the "cooking of returns" will be less frequent, and less glaring in time to come than formerly, it would be idle to expect that it should ever be wholly put down. And, as already seen, even when the directors of a bank are so disposed, it will frequently be out of their power to lay before the public a really true statement of their affairs. It is plain, then, that this so-called publicity affords nothing approaching to that undoubted and unquestionable guarantee which should be required from all parties and associations empowered to issue notes.

But the difficulties in the way of insuring the conversion of the latter into coins, though great, are not insuperable. A plan, originally suggested by Lord Overstone, and adopted and carried into effect by Sir Robert Peel, has been found to be quite effectual to secure this grand object. And it has the additional and important recommendation, of having done this without subjecting the public to any sensible inconvenience.

But before entering into an exposition of the plan referred to, it will be necessary to premise some details with regard to the constitution and action of the existing banks.

SECT. II.—*Banks of Deposit and Banks of Issue. Principles on which they are established.*

Banks of deposit and issue.

Banks are commonly divided into banks of deposit and banks of issue; that is, banks that take care of other people's money, and banks that issue money of their own. But there are few banks of issue that are not at the same time banks of deposit; and the latter are farther divisible into two great classes, viz., those who do and those who do not issue the money of their customers. The banking companies established in this country belong to the first class; while the old Bank of Amsterdam did, and the existing Bank of Hamburgh does, belong to the second class.

Advantages of bankers.

Instead of keeping money in their own houses, where it would be exposed to various accidents, and to the attacks of thieves and robbers, most people wisely commit it to the care of a banker, and avail themselves of his services in receiving and making payments on their account. They send to their banker such sums of money as they may happen to receive, and all bills and drafts payable to them; and he becomes responsible for their amount, for the regular presentation of the bills for acceptance and payment, and for their proper noting, if not accepted or paid. It is also the practice for parties who have an account at a banker's, to make all considerable payments by cheques payable by him. As the discharge of these functions involves considerable risk and expense, it is usual for bankers, either to charge a per centage for their trouble, or to stipulate that the parties dealing with them shall keep an average balance of cash in their hands corresponding to the amount of business transacted in their behalf. In this way business is carried on with safety, ease, and despatch; and at much less expense than it would be if individuals kept their own money, and made their own payments.

Of the sums paid into banks, some are intended to meet the cheques and orders drawn against them in the ordinary course of business; while others are sent rather for safe custody, to be retained, till opportunities be found for their investment. The former are generally placed under what are called *drawing*, and the latter under *deposit* accounts. But there is no difference between the two, except that the sums in deposit accounts are usually permitted to lie for longer periods, without being operated upon or called up. Such portions of the one or the other as the bankers do not retain in their coffers to meet the usual demands of their customers, they employ in the discount of bills, or in making advances of one sort or other, generally at short dates, to those who require them, and in whom they think they may confide.

This last is one of the most important functions performed by banks of deposit. They become, as it were, receptacles or reservoirs into which the surplus or unemployed capital of the surrounding districts is collected, and from which it is again distributed to those who want it. And it may be proper to observe, that the bankers do not always, nor perhaps even most commonly, confine their advances to those who can give security for their repayment. On the contrary, they are often more influenced in making loans by their knowledge of the conduct, the intelligence, and the pursuits of the parties, than by anything else. And it frequently happens that industrious, frugal, and enterprising young men, who have no guarantee to offer save their character, obtain advances that would be denied to wealthier, but otherwise less trustworthy parties.[1] But without insisting on these considerations, which, however, are not a little important, it is manifest that those who have capital to lend, and those who wish to borrow, are equally indebted to the agency of the bankers, who while they enable these great classes mutually to assist each other, contribute to increase the public wealth by facilitating the flow of capital into the most productive channels.

Credit, definition of.

But, however great, this advantage is not to be exaggerated. Though banks afford valuable assistance in the collection and distribution of capital, it must not be supposed, as is often done, that they have any direct influence over its formation. That is the joint effect of industry and economy—the former in producing convenient and desirable articles, and the latter in saving and preserving them for future use. Credit is neither more nor less than the transfer of money or other valuable produce from one set of individuals called lenders, to another set called borrowers

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[1] On this, as on most other points, the late evidence of Lord Overstone is highly instructive.

Quest. But, generally speaking, persons who have no capital, have very little opportunity of raising money have they? *Ans.* That certainly is not so. The whole principle of banking is to afford capital—to transfer it from the inactive accumulator to the active and energetic person who wants the capital. The banker is the go-between, who receives deposits on the one side, and on the other applies those deposits, intrusting them, in the form of capital, to the hands of active, energetic persons, who, he thinks, will make a good use of it.

Quest. Who have no security to give? *Ans.* Who have in many instances no security to give, except their character, and skill, and talent, of which the banker forms his judgment.

Quest. To persons of character who have no other security to give? *Ans.* To persons of character who, in some cases, have no security to give; but who, in all cases, have no security to give equal to the amount advanced to them, except that best form of security, their character, their energy, and their prudence.—*Min. of Evidence*, p. 348.

Money.

—a transfer which is greatly facilitated by the establishment of banks. And as there can be no reasonable doubt that those who borrow have, in the majority of instances, better means of employing capital with advantage than those by whom it is lent, its transference from the one to the other will, in so far as this presumption is realised, be publicly advantageous. But this is the entire extent of the beneficial influence of what is called credit; and when it happens, as is too often the case, to divert capital into the pockets of knaves and gamblers, it is disadvantageous. No doubt we frequently hear of great undertakings being carried on by means of credit; but such statements are entirely false and misleading. They will, indeed, be uniformly found, when analysed, to mean only that the undertakings are carried on by means of borrowed capital. Credit is impotent to produce anything whatever. It is in fact a mere name for the trust reposed by a lender in a borrower. To call it capital is as much an abuse of language as it would be to call weight colour, or colour weight. It may transfer money or produce from A to B, or from C to D, but that is *all* that it either does or can do. When credit is said to be high, nothing is really meant save that those who have money or capital to lend have great confidence in the borrowers, and conversely when credit is said to be low.

Banks sometimes encourage gambling and over-trading.

Banks, when not conducted by men of probity, skill, and caution, are very apt to excite and inflame a spirit of speculation and gambling. They do this by furnishing speculators with loans and discounts, by means of which they are not enabled merely, but tempted to engage in hazardous enterprises. And for a time, or while the process is going on, everything wears an air of prosperity; and those old-fashioned houses, as they are called, that carry on a legitimate business on capital of their own, are frequently undersold and driven from the market by the competition of adventurers, trading on the funds of others, ready to encounter any risk, and living in the greatest splendour. But at length the thing is overdone, the bubble bursts, the worthless machinery of fictitious bills, rediscounts, and so forth, is exposed, and the tragi-comedy is wound up by the offer of a composition of some 1s. or 2s. per pound. Bankers and money dealers who employ the money entrusted to their care in so reckless a manner, are fitter for Newgate than for the situations they so unworthily fill. It would be a great stretch of charity to suppose that advances of the kind now alluded to can be wholly the result of imprudence. Bankers have peculiar means at their disposal by which to become acquainted with the character, position, and capabilities of those who apply to them for advances. And it is their duty to avail themselves of these means to distinguish between the careful and the improvident or reckless trader —between the man who may and the man who may not be trusted. It is difficult to believe, provided they make the necessary inquiries, that they should be often or greatly deceived in their judgment of individuals; and, provided they act with due caution, they will never so far commit themselves, even with the most respectable firms, as to endanger their own establishment in the event of the failure of the latter. Bankers may risk their private fortunes, if they have any, as they please, but they are not entitled to risk the money of their constituents by making advances to equivocal parties, and especially to those who are notoriously overtrading. It is impossible, perhaps, to bring an abuse of this sort within the meshes of the penal law, but it cannot be too strongly condemned in the opinion of the public. There is nothing about which people should be so cautious as the employment of bankers; and high character, experience, and reputation for prudent management, ought always to have the preference over fair promises and prospectuses, even when the latter are backed by offers of high interest.

Interest on deposits.

The private bankers of London have not been, until recently, in the habit of allowing interest on deposits, though in special cases it was sometimes done. But in Scotland, and also in many parts of England, it has been long the practice to pay an interest on deposits of from one to two per cent. less than the market rate at the time. And the joint-stock banks set on foot in the metropolis since 1826, having introduced the practice of giving interest on deposits, provided a certain notice (generally from three to eight days) be given before they are withdrawn, very large sums have been, especially during the last ten years, deposited in these establishments. Most private banks have been compelled, in order to maintain their position, to adopt in a greater or less degree the same system. There can, indeed, be little doubt that it will, in no very lengthened period, become universal, and that the amount of deposits will be progressively and largely augmented.

By bringing, as it were, the advantages of savings' banks, without any of their limitations, within reach of all classes, of the middle and upper as well as of the lower, this system is, in many respects, highly advantageous. It may, indeed, be doubted whether any means could be devised more likely to generate and diffuse a spirit of economy. Unhappily, however, its advantages are alloyed by the formidable disadvantage of its involving a great amount of insecurity and hazard.

Dangers incident to the deposit system.

Banks that give interest on deposits must employ the balance at their disposal so as to realise that interest, *plus* a profit to themselves. Investment is not optional with them, it is indispensable; and they cannot, in seeking investments, look to security only. Profit must be in their estimation as great, or even a greater consideration. But profit and risk are inseparable, and are always directly proportioned to each other; and hence it is, that in periods of discredit, or when a revulsion occurs, suspicions may be expected to arise in regard to the solidity of deposit banks, especially of those that pay high rates of interest on the sums committed to their custody. These suspicions may frequently, no doubt, be very ill-founded; but if they be entertained, the result will be nearly the same. This was exemplified by what took place the other day in Glasgow. There a run, partly for payment of notes, but more for deposits, compelled two great joint-stock banks to suspend payments, of whose solvency, notwithstanding their gross mismanagement, no reasonable doubt could be entertained; and led to a crisis that has had the most serious consequences.

It is difficult to know how to ward off such contingencies; but it nevertheless seems to be indispensable that something should be done in that view, otherwise we may be said to be always exposed to the most tremendous risks. It may not be practicable to form an accurate estimate of the amount now held as deposits by bankers and money-dealers in Great Britain only; but if we take the entire sum at about two hundred millions, we shall probably be within and not beyond the mark. And of this vast sum more than a half is payable "at call," and more than three-fourths within ten days. But everybody knows that such payments are practically impossible. And hence it is plain, that in the event, which may any day occur, of a bank with

Money.

a large amount of deposits getting into difficulties, or of any circumstance occurring that should occasion a distrust of the system and a general panic, the whole fabric would fall to pieces, and we should have an universal smash.

This appears to be as unsatisfactory a state of things as can well be imagined. But *de republica nil desperandum*. Though formidable, the evil is not insuperable; and the dangers referred to are so great and imminent, that no time should be lost in adopting measures by which they may be either obviated or mitigated. Explosions of the credit system are, in the commercial and financial, what explosions of gunpowder are in the physical world. And it would seem to be quite as necessary to endeavour to lessen the frequency and violence of the former as of the latter. Hence we think it would be good policy to enact, that all sums *bearing interest*, in the hands of bankers, discount-brokers, and money-dealers generally, should not be legally demandable without a month or six weeks' notice. A regulation of this sort would not interfere with anything that is valuable in the existing system, while it would confer on it some portion of that solidity of which it is at present so miserably deficient. It would protect all classes against the effects of sudden and unreasonable fears and panics. It would give time to the borrowers to collect their resources; and to the depositors calmly to inquire into the character and situation of those to whom they had entrusted their money. This may not be enough; but some such measure as this appears to be indispensable for the security and protection of the public.

Notes deposited in banks not the property of the depositors.

It has sometimes been contended that the notes and monies deposited in banks by private parties continue to be their property, and are as really a portion of their money as the notes or sovereigns which they retain in their tills or their pockets. The place where it is kept is different; but, except in this respect, the money which they have lodged in and that which they have out of banks, is said to be, to all intents and purposes, identical. But though specious, this statement is entirely fallacious. The money which depositors lodge in banks forms a part of the money of the country; but after its lodgment in them it ceases to belong to, or to make a part of the property or money of the depositors. They have consigned it to banking establishments, and acquired credits in its stead; that is, they have acquired the *right* to draw upon and receive equal sums of money from these establishments. But everybody knows that the right to a thing is not the thing itself, but something altogether different. A banker who owes a million or other sum to depositors, might regard himself as being in a sufficiently secure state, if, according to circumstances, he had a third, a fourth, or a fifth part of that sum in notes and gold in his till to answer the demands of the depositors, while he employed the reserve in advances to others. Hence it is plain that bank credit and money have nothing in common. Those who confound things that are so very different can have no clear apprehension either of the one or the other.

It is on the distinction between money and deposits or credits, that the business of banking really depends. It is a business by which a small amount of money is made to supply a large amount of credit, the profits of the bankers arising from the use of the money so economised. The Bank of England, for example, often holds more than twenty millions of public and private deposits, while she is considered to be in a perfectly safe and sound position if she have in the till of her banking department five millions, or even less, in notes and coins.

It is hardly necessary, after these statements, to observe that the profit made by bankers in employing part of the money committed to their custody is extrinsic to, and independent of, any profits which they may realise on capital of their own. "Such banks," to use the words of Mr Ricardo, "would never be established if they obtained no other profits than those derived from the employment of their own capital. Their real advantage commences only when they begin to employ the capital of others."—(*Economical and Secure Currency*, p. 87.)

Necessity of capital to the security of banks.

But we are not thence to conclude that it is indifferent whether such banks have or have not independent capitals of their own. That would be the greatest of errors. Unless it have a command of capital proportioned in some degree to the extent of its business, those who deposit their money in a bank have but slender security for its payment. For if bankers make improvident or injudicious advances, if the securities in their possession be discredited, or difficulties of any kind arise in the conduct of their business, those who have no capital, or but little of their own, may be obliged to stop payment, when more opulent firms may be but little affected by the like circumstances. Much, no doubt, must always depend on the character and knowledge of the parties. But no amount of skill or caution can ever fully compensate for the want of adequate capital. It is the sheet-anchor of security, the only real and substantial guarantee to which the ordinary creditors of a bank have to look. When such capital has been accumulated by the bank, it shows that its affairs have been well managed, and raises a strong presumption in its favour; and when it has devolved on the partners by inheritance, or been bequeathed to them in legacies, the fair inference would seem to be, that they will not (unless they be mere fools, unworthy of any kind of confidence) rashly compromise its security by engaging in questionable proceedings.

Limited liability, disadvantages of.

It has been sometimes proposed to allow banks to be constituted with limited liability. But that is in every case a vicious principle, lessening the natural responsibility under which every man ought to act, and tempting parties to engage in all manner of desperate adventures. In banking, such a principle would be especially mischievous; for it is a business that requires great caution and prudence—the very virtues with which the principle of limited liability is most at variance. It may, indeed, be said that the numerous instances of mismanagement and embezzlement that now prevail, show that even the principle of indefinite liability is not enough to make joint-stock banks be conducted prudently and honestly. But, however defective, still it is the only principle on which any stress can be safely laid, and the instances referred to, bear, after all, but a small proportion to those of an opposite description. The great majority of banks are discreetly and faithfully managed. And if knavery and folly be sometimes found to prevail where every partner is deeply interested in their prevention, and is liable to the last farthing he possesses for the consequences, the fair presumption is, that they would be ten times more prevalent were the partners liable only for the amount of their shares in the bank. To suppose the contrary would be a contradiction; it would be equivalent to supposing that a man is to be as much interested in the safety of £10 or £100, as of £1000 or £10,000, or of his entire fortune, however great it may be.

Whatever else may be the effect of the late disclosures of mismanagement, fraud, and robbery, on the part of the directors and secretaries of joint-stock banks, it can hardly fail to make the partners in those associations more alive to the dangers of their situation, and to convince them, that

Money. if they would provide for their own safety, they must be more cautious than hitherto in regard to the persons they elect to fill these situations, and less disposed to take their statements for granted. Such, however, is the carelessness of most people, even in regard to those matters which most nearly concern them, that these anticipations, though reasonable, may not be fully realised. But, in the case of banks with limited liability, they must be sanguine indeed, who look for any improvement. The partners in these associations have no sufficient interest in their prosperity to make them take any unusual trouble about the way in which they are conducted, and they neither fear ruin, nor even any considerable inconvenience, from their failure. The chances, consequently, are ten to one that their managers will be left without let or hindrance to pursue their own schemes; and, when such is the case, what but abuse can be expected to be the result?

But it is argued, that whatever may be the influence of the present system on the partners in the existing banks, were companies with limited liability established, the depositors would be on their guard, and would not trust them with their money, unless they were well assured of their solidity. But, in truth and reality, they never can have any assurance of the sort on which it would be safe to rely. A bank with limited liability might have, or pretend to have, a large capital. And supposing it really had such a capital in the current year, that may not be the case in the next, or in any subsequent year. And yet as the public can know nothing certain of the bank's losses, its credit may not be impaired, and deposits may be pressed upon it after it is really insolvent. In such cases the public is helpless; and if the indefinite responsibility of the partners in banks be not enough to make them look to their proper management, it would be worse than idle to depend in any degree on the fears or interests of the depositors. This is not a matter about which there needs be any speculation. The experience of the United States is decisive of the question. In the Union, the banks are all, or nearly all, established under a system of limited liability, and, notwithstanding their insecurity, and their perpetually recurring insolvency, they always hold large sums in deposit. Promises, professions, the bait of high interest,[1] and the confidence placed by every one in his superior sagacity and good fortune, fill the coffers even of the establishments least worthy of credit. And such, no doubt, would be the case in England, were a like system established amongst us. But what, under such circumstances, would be the situation even of a well managed bank, were any suspicions to be entertained of its credit? The rush would be tremendous; for every body would reasonably conclude, that if he did not succeed by pressing forward with "hot haste" in getting payment of his deposit, the chances were ten to one he would get little or nothing. He has no proprietary body to which to look for payment of his claims; and if the doors were once shut against him, he could hardly expect more than some miserable dividend at some distant term.

Proposal to enforce discounts—absurdity of.

Among the many proposals submitted to the consideration of the Bank Committee of 1857, perhaps the most extraordinary was that which assumed that something was wrong with the currency whenever any difficulty was experienced in the discounting of bills originating in real transactions, and that means should be found, in some way or other, to compel the discount of such bills. It may excite surprise that such a proposal should have been seriously made, and still more, that it should have been listened to and published. Luckily it cannot be called "perilous nonsense," its folly being so very obvious, that it can impose on none. The discount of bills is an advance or loan of capital equivalent to their value till they become due. That advance is now usually made in paper; but as that paper is really equivalent to gold, it might, were it not for the greater convenience of the present practice, be as well made in coin or in commodities. The amount of the currency has, in truth, nothing whatever to do with the greater or less facility of discounting. That depends entirely on the amount of capital applicable to such purpose, compared with the amount of bills offered for discount. The settlement of such transactions is, if anything can be, a matter to be left to the free and uncontrolled arbitrament of the parties. Whether a bill be discounted at five or ten per cent, or not discounted at all, is, in a public point of view, of no importance. When a capitalist declines to make an advance, whether on a bill or anything else, the presumption is that he has good reasons for his refusal. But, whether good or bad, the public has no right to interfere in the matter; and any attempt it might make to interfere would be attended with ruinous results. Those who suppose that the facility of discounting depends on the magnitude of the issues of paper, would do well to recollect that in Holland, which for a lengthened period had a very extensive commerce, and where paper was unknown, the rate of discount was always very low. And while such was the case in Holland, every body knows that in the United States, which have some 1300 banks for the issue of notes, the rate of discount is usually very high, and sometimes exorbitantly so.

Introduction of banking into London.

The business of banking was not introduced into London till the seventeenth century. It was at first conducted by the goldsmiths, who lent the money lodged in their hands for security to government and individuals. In the course of time the business came to be conducted by houses who confined themselves to it only, and nearly in the mode in which we now find it. From 1708, as already stated, down to 1826, with the exception of the Bank of England, no company with more than six partners could be established, either in London or anywhere else in England and Wales, for conducting banking business; and a very large portion of that business is still conducted in the metropolis by firms with a small number of partners, or by what are called private banks.

Clearing-House.

In 1775, the London, or rather the "city" bankers, established the "clearing-house." This is a house to which each banker who deals with it is in the habit of daily sending a clerk, who carries with him the various bills and cheques in the possession of his house that are drawn upon other bankers; the practice formerly being to exchange them for the bills and cheques in the possession of those others that were drawn upon his constituents, and to pay the balance on the one side or the other in cash or Bank of England notes. By this means the bankers connected with the clearing-house were enabled to settle transactions to the extent of several millions a day, by the employment of not more, at an average, than from £200,000 to £500,000 in cash or Bank of England notes.

Latterly, however, the arrangements connected with the clearing-house have been so much simplified and improved, that neither notes nor coins are any longer

[1] "*Vulgus ad magnitudinem beneficiorum aderat; stultissimus quisque pecuniis mercabatur.*"—Tacit. Hist., lib. iii. cap. 55.

required in settling the largest transactions. The clearing-house itself and the various banking firms connected with it, have accounts at the Bank of England; and the balances that were formerly settled by a money payment are at present settled by transfers from one account to another. The saving of money in the adjustment of large transactions occasioned by this and other contrivances, accounts for the fact, that the proportion of notes of £20 and upwards issued by the bank has considerably declined of late years, while that of £5 and £10 notes, which are used in ordinary dealings, has been materially increased.

Security afforded by banks of deposit.

The security afforded by a bank of deposit is a matter as to which there must always be more or less of doubt. When, indeed, a banking company confines itself to its proper business, and does not embark in speculations of unusual hazard, or from which its funds cannot be easily withdrawn, it can seldom fail, except in periods of panic or general distrust, of being in a situation to meet its engagements; whilst the large private fortunes that frequently belong to the partners afford those who deal with it an additional guarantee. Much, however, depends on the character of the parties, on their living within or beyond their incomes, and on a variety of circumstances with respect to which the public can never be correctly informed; so that though there can be no doubt that the security afforded by many banks of deposit is of the most unexceptionable description, this may not be the case with others.

Not necessary for the State to provide for the security of depositors.

All joint-stock banks, or banks having more than six partners, whether for deposit and issue, or for deposit merely, are ordered, by the Act 3 and 4 Will. IV. cap. 83, to send quarterly returns of the number and names of their partners to the stamp-office. But there was no good reason why similar returns should not, and several why they should, be required from *all* banks; and this having been done by the Act 7 and 8 Vict. c. 32, which also provides for their publication, little if any farther interference would seem to be required with banks not issuing notes. There is in this respect a wide difference between them and banks of issue. It is the duty of government to take care that the value of the currency shall be as invariable as possible; but it has never been pretended that it is any part of its duty to inquire into the security given by the borrowers to the lenders of money, any more than into the security given by the borrowers to the lenders of any thing else. Government obliges a goldsmith to have his goods stamped, this being a security to the public that they shall not be imposed on in buying articles of the quality of which they are generally ignorant; but it does not require that the persons to whom the goldsmith sells or lends his goods should give him a guarantee for their payment. This is a matter as to which individuals are fully competent to judge for themselves; and there is no good reason why a lender or depositor of bullion or notes should be more protected than a lender or depositor of timber, coal, or sugar. Gold being the standard or measure of value, government is bound to take effectual precautions that the currency shall truly correspond in the whole and in all its parts with that standard; that every pound note shall be worth a sovereign; and that the amount and value of the aggregate notes in circulation shall vary exactly as a gold currency would do were it substituted in their stead. But if A trust a sum of money in the hands of B, it is their affair, and concerns none else. Provided the money afloat correspond with the standard, it is of no importance, in a public point of view, into whose hands it may come. The bankruptcy of a deposit bank, like that of a private gentleman who has borrowed largely, may be productive of much loss or inconvenience to its creditors. But if the paper in circulation be equivalent to gold, such bankruptcies cannot affect either the quantity or value of money, and are, therefore, directly injurious only to the parties concerned.

But though such be the direct effects of the bankruptcies of deposit banks, their indirect effect, by propagating panics and runs on other banks, may be most disastrous. And to prevent their mischievous influence in this respect, it would be good policy, as already seen, to require a month's or six weeks' notice to make deposits bearing interest legally demandable.

Deposit banks which do not employ the money of the depositors.

The other description of banks of deposit, or those which do not employ the funds in their hands, or engage in any sort of business, are established without any view to profit, that they may secure the money, and facilitate the transactions of those who deal with them. The latter obtain *bank credits* or *bank money*, equivalent to the sums they deposit in the bank; and as the principal traders in towns where such a bank is established belong to it, each has a bank credit, and their payments are made without the intervention of money, by writing off so much from the credit or account of one to the credit or account of another. It is only in the event of a person having to pay money to a stranger that he has any motive to withdraw any portion of his deposit from the bank. An institution of this sort is, to those who deal with it, what the clearing-house is to the London bankers. Its expenses are usually defrayed either by a small fee charged on every transfer of bank credit from one individual to another, or by a charge on the coin or bullion deposited, or both.

A bank of this sort can never, unless its agents act dishonestly, be involved in debt, or in any kind of difficulty. The constitution of the Bank of Amsterdam was in so far vicious that it was not managed by parties interested in its welfare; that is, by agents chosen by the depositors. On the contrary, it was managed in the most secret manner by those who happened to be magistrates of the city, whether they were or were not depositors. And they, in violation of their oaths, privately lent to others a large portion of the funds deposited in the bank. But a proceeding of this sort is hardly possible in the case of a properly constituted deposit bank, like that established in Hamburgh. For in the latter the managers are appointed for short periods by the depositors, who, of course, endeavour to select the most trustworthy persons. And though it be necessary that the strictest secrecy should be kept in regard to the accounts of individuals in the bank, its affairs are otherwise transacted with sufficient publicity, while the deposits in its coffers may be withdrawn at any moment.

Notice of banking.

The trade or business of a banker has probably existed in all civilised countries in all ages. The bankers of Greece (τραπεζῖται) and Rome (*argentarii, mensarii, nummularii*) exercised nearly the same functions as those of the present day, except that they do not appear to have issued notes. They received money on deposit, to be repaid on demands made by cheques or orders, or at some stipulated period, sometimes paying interest for it, and sometimes not. Their profits arose from their lending the balance at their disposal, at higher rates of interest than they allowed the depositors. They were also extensively employed in valuing and exchanging foreign monies for those of Athens, Corinth, Rome, &c., and in negociating bills of exchange. In general they were highly esteemed, and great confidence was placed in their integrity. The rate of interest charged by the bankers

Money.

was sometimes very high, but that was not a consequence, as has been alleged, of their rapacity, but of the defective state of the law, which, as it gave every facility to debtors disposed to evade payment of their debts, obliged the bankers to guarantee themselves by charging a proportionally high rate of interest.[1] In modern times the business of banking and exchange was, for a while, almost entirely engrossed by the Jews and the Lombards of Italy.

Sect. III.—*Bank of England, Account of.*

Establishment and History of the Bank of England.

The Bank of England, which has long been the principal bank of deposit and circulation, in this country and in Europe, was founded in 1694. Its principal projector, Mr William Paterson, an enterprising and intelligent Scotch gentleman, was afterwards engaged in the ill-fated colony at Darien. Government being at the time much distressed for want of money, partly from the defects and abuses in the system of taxation, and partly from the difficulty of borrowing, because of the supposed instability of the revolutionary establishment, the bank grew out of a loan of £1,200,000 for the public service. The subscribers, besides receiving eight per cent. on the sum advanced as interest, and £4000 a year as the expense of management, in all £100,000 a year, were incorporated into a society denominated the Governor and Company of the Bank of England. The charter is dated the 27th of July 1694. It declares, amongst other things, that they shall "be capable, in law, to purchase, enjoy, and retain to them and their successors, any monies, lands, rents, tenements, and possessions whatsoever; and to purchase and acquire all sorts of goods and chattels whatsoever, wherein they are not restrained by Act of Parliament; and also to grant, demise, and dispose of the same.

"That the management and government of the corporation be committed to the governor and twenty-four directors, who shall be elected between the 25th of March and the 25th day of April each year, from among the members of the company duly qualified.

"That no dividend shall at any time be made by the said governor and company, save only out of the interest, profit, or produce arising by or out of the said capital stock or fund, or by such dealing as is allowed by Act of Parliament.

"They must be natural-born subjects of England, or naturalised subjects; they shall have in their own name, and for their own use, severally, viz. the governor at least £4000, the deputy-governor £3000, and each director £2000, of the capital stock of the said corporation.

"That thirteen or more of the said governors and directors (of which the governor or deputy-governor must be always one) shall constitute a court of directors, for the management of the affairs of the company, and for the appointment of all agents and servants which may be necessary, paying them such salaries as they may consider reasonable.

"Every elector must have, in his own name and for his own use, £500 or more capital stock, and can only give one vote. He must, if required by any member present, take the oath of stock, or the declaration of stock in case he may be one of the people called Quakers.

"Four general courts to be held in every year, in the months of September, December, April, and July. A general court may be summoned at any time, upon the requisition of nine proprietors duly qualified as electors.

"The majority of electors in general courts have the power to make and constitute by-laws and ordinances for the government of the corporation, provided that such by-laws and ordinances be not repugnant to the laws of the kingdom, and be confirmed and approved, according to the statutes in such case made and provided."

The corporation is prohibited from engaging in any sort of commercial undertaking other than dealing in bills of exchange, and in gold and silver. It is authorised to advance money upon the security of goods or merchandise pledged to it; and to sell by public auction such goods as are not redeemed within a specified time.

It was also enacted, in the same year in which the bank was established, by statute 6 William and Mary, c. 20, that the bank "shall not deal in any goods, wares, or merchandise (except bullion), or purchase any lands or revenues belonging to the crown, or advance or lend to their majesties, their heirs or successors, any sum or sums of money, by way of loan or anticipation, or any part or parts, branch or branches, fund or funds of the revenue, now granted or belonging, or hereafter to be granted, to their majesties, their heirs and successors, other than such fund or funds, part or parts, branch or branches of the said revenue only, on which a credit of loan is or shall be granted by Parliament." And in 1697 it was enacted, that the "common capital or principal stock, and also the real fund, of the governor and company, or any profit or produce to be made thereof, or arising thereby, shall be exempted from any rates, taxes, assessments, or impositions whatsoever, during the continuance of the bank; that all the profit, benefit, and advantage from time to time arising out of the management of the said corporation, shall be applied to the uses of all the members of the said association of the governor and company of the Bank of England, rateably and in proportion to each member's part, share, and interest in the common capital and principal stock of the said governor and company hereby established."

In 1696, during the great recoinage, the bank was involved in great difficulties, and was even compelled to suspend payment of her notes, which were at a heavy discount. Owing, however, to the judicious conduct of the directors, and the assistance of the government, the bank got over the crisis. But it was at the same time judged expedient, in order to place her in a situation the better to withstand any adverse circumstances that might afterwards occur, to increase her capital from £1,200,000 to £2,201,171. In 1708, the directors undertook to pay off and cancel one million and a half of exchequer bills they had circulating two years before, at four and a half per cent., with the interest upon them, amounting in all to £1,775,028, which increased the permanent debt due by the public to the bank, including £400,000 then advanced in consideration of the renewal of the charter, to £3,375,028, for which they were allowed six per cent. The bank capital was then also doubled, or increased to £4,402,343. But the year 1708 is chiefly memorable in the history of the bank, for the Act previously alluded to, which declared, that during the continuance of the corporation of the Bank of England, "it should not be lawful for any body politic, erected or to be erected, other than the said governor and company of the Bank of England, or of any other persons whatsoever, united or to be united in covenants or partnership, exceeding the number of six persons, in that part of Great Britain called England, to borrow, owe, or take up any sum or sums of money on their bills or notes payable on demand, or in

[1] Boeckh's *Political Economy of Athens*, i. 168, &c.; *Voyage d'Anacharse*, cap. 55, *passim*; Smith's *Dictionary of Greek and Roman Antiquities*, voce Argentarii, &c.

Money.

any less time than six months from the borrowing thereof." This proviso, which had a powerful operation on banking in England, is said to have been elicited by the Mine-Adventure Company having commenced banking business, and begun to issue notes.

The charter of the Bank of England, when first granted, was to continue for eleven years certain, or till a year's notice after the 1st of August 1705. The charter was further prolonged in 1697. In 1708, the bank having advanced £400,000 for the public service, without interest, the exclusive privileges of the corporation were prolonged till 1733. And in consequence of various advances made at different times, the exclusive privileges of the bank have been continued by successive renewals, till the first of August 1855, with the proviso that they may be cancelled on a year's notice to that effect being given after the said 1st of August 1855.

We subjoin an account of the successive renewals of the charter, of the conditions under which these renewals were made, and of the variations in the amount and interest of the permanent debt due by government to the bank, exclusive of the dead weight.—(*See following page.*)

Capital of the Bank.

The capital of the bank on which dividends are paid has never exactly coincided with, though it has seldom differed very materially from, the permanent advance by the bank to the public. We have already seen that it amounted in 1708 to £4,402,243. Between that year and 1727 it had increased to near £9,000,000. In 1746 it amounted to £10,780,000. From this period it underwent no change till 1782, when it was increased eight per cent., or to £11,642,400. It continued stationary at this sum down to 1816, when it was raised to £14,553,000, by an addition of twenty-five per cent. from the profits of the bank, under the provisions of the Act 56 Geo. III. c. 96. The Act for the renewal of the charter 3 and 4 Will. IV. c. 98, directed that the sum of £3,671,700, being the fourth part of the debt due by the public to the bank, should be paid to the latter, allowing her, if she chose, to deduct it from her capital. But that has not been done; and after sundry changes, the capital of the bank amounts, as formerly, to £14,553,000.

Crisis of 1745.

The Bank of England has been frequently affected by panics amongst the holders of her notes. In 1745 the alarm occasioned by the advance of the Highlanders, under the Pretender, as far as Derby, led to a run upon the bank; and in order to gain time to effect measures for averting the run, the directors adopted the device of paying in shillings and sixpences! But they derived a more effectual relief from the retreat of the Highlanders, and from a resolution agreed to at a meeting of the principal merchants and traders of the city, and very numerously signed, declaring the willingness of the subscribers to receive bank-notes in payment of any sum that might be due to them, and pledging themselves to use their utmost endeavours to make all their payments in the same medium.

Crisis of 1780.

During the tremendous riots in June 1780, the bank incurred considerable danger. Had the mob attacked the establishment at the commencement of the riots, the consequences might have proved fatal. But they delayed their attack till time had been afforded for providing a force sufficient to insure its safety. Since that period a considerable military force is nightly placed in the interior of the bank, as a protection in any emergency that may occur.

Crisis of 1797.

The year 1797 is the most important epoch in the recent history of the bank. Owing partly to events connected with the war in which we were then engaged; to loans to the Emperor of Germany; to bills drawn on the treasury at home by the British agents abroad; and partly, and chiefly, perhaps, to the advances most unwillingly made by the bank to government, which prevented the directors from having a sufficient control over their issues, the exchanges became unfavourable in 1795, and in that and the following year large sums of specie were drawn from the bank. In the latter end of 1796 and beginning of 1797, considerable apprehensions were entertained of invasion, and rumours were propagated of descents having been actually made on the coast. In consequence of the fears that were thus excited, runs were made on the provincial banks in different parts of the country; and some of them having failed, the panic became general, and extended itself to London. Demands for cash poured in upon the bank from all quarters; and, on Saturday the 25th of February 1797, she had only £1,272,000 of cash and bullion in her coffers, with every prospect of a violent run taking place on the following Monday. In this emergency, an order in council was issued on Sunday the 26th, prohibiting the directors from paying their notes in cash until the sense of Parliament should be taken on the subject. And after Parliament met, and the measure had been much discussed, it was agreed to continue the restriction till six months after the signature of a definitive treaty of peace.

As soon as the order in council prohibiting payments in cash appeared, a meeting of the principal bankers, merchants, traders, &c. of the metropolis, was held at the Mansion-house, when a resolution was agreed to, and very numerously signed, pledging, as had been done in 1745, those present to accept, and to use every means in their power to make bank-notes be accepted, as cash in all transactions. This resolution tended to allay the apprehensions that the restriction had excited.

Parliament being sitting at the time, a committee was immediately appointed to examine into the affairs of the bank; and their report put to rest whatever doubts might have been entertained with respect to the solvency of the establishment, by showing, that at the moment when the order in council appeared, the bank was possessed of property to the amount of £15,513,690, after all claims upon her had been deducted.

Much difference of opinion has existed with respect to the policy of the restriction in 1797; but, considering the peculiar circumstances under which it took place, its expediency seems abundantly obvious. The run did not originate in any over-issue of bank paper, but grew entirely out of political causes. So long as the alarms of invasion continued, it was clear that no bank paper immediately convertible into gold would remain in circulation. And as the bank, though possessed of ample funds, was without the means of instantly retiring her notes, she might, but for the interference of government, have been obliged to stop payments; an event which, had it occurred, might have produced consequences fatal to the public interests.

The error of the government did not consist in their coming to the assistance of the bank, but in continuing the restriction after the alarm of invasion had ceased, and there was nothing to hinder the bank from safely reverting to specie payments.

Notices of the Bank from 1800 to 1821.

It had been generally supposed, previously to the passing of the Restriction Act, that bank-notes would not circulate unless they were immediately convertible into cash. But the event showed, conformably to the principles already stated, that this was not really the case. Though the notes of the Bank of England were not, at the passing of the Restriction Act, declared by law to be legal tender, they were rendered such in practice, by being received

Date of Renewal.	Conditions under which Renewals were made, and Permanent Debt contracted.	Permanent Debt. £	s.	d.
1694	Charter granted under the act 5 and 6 Will. III. c. 20, redeemable upon the expiration of twelve months' notice after the 1st August 1705, upon payment by the public to the bank, of the demand therein specified.			
	Under this act the bank advanced to the public £1,200,000 in consideration of their receiving an annuity of £100,000 a year, viz. eight per cent interest, and £4000 for management..................................	1,200,000	0	0
1697	Charter continued by 8 and 9 Will. III. c. 20, till twelve months' notice after 1st of August 1710, on payment, &c.			
	Under this act the bank took up and added to their stock £1,001,171 exchequer bills and tallies.			
1708	Charter continued by 7 Anne, c. 7, till twelve months' notice after 1st of August 1732, on payment, &c.			
	Under this act the bank advanced £400,000 to government without interest; and delivered up to be cancelled £1,775,027 17s. 10d. exchequer bills, in consideration of their receiving an annuity of £106,501 : 13s., being at the rate of 6 per cent............	2,175,027	17	10
1713	Charter continued by 12 Anne, stat. 1, cap. 11, till twelve months' notice after the 1st of August 1742, on payment, &c.			
	In 1716, by the 3d Geo. I. c. 8, the bank advanced to government, at five per cent................	2,000,000	0	0
	And by the same act the interest on the exchequer bills cancelled in 1780 was reduced from six to five per cent.			
	In 1721, by 8 Geo. I. c. 21, the South Sea Company were authorized to sell £200,000 government annuities, and corporations purchasing the same at 26 years' purchase were authorised to add the amount to their capital stock. The bank purchased the whole of these annuities at 20 years' purchase................................	4,000,000	0	0
	Five per cent. interest was payable on this sum to midsummer 1727, and thereafter four per cent.	9,375,027	17	10
	At different times between 1727 and 1738, both inclusive, the bank received from the public, on account of permanent debt, £3,275,027 : 17 : 10, and advanced to it, on account of ditto, £3,000,000 : Difference	275,027	17	10
	Debt due by the public in 1738....................................	9,100,000	0	0
1742	Charter continued by 15 Geo. II. c. 13, till twelve months' notice after the 1st of August 1764, on payment, &c.			
	Under this act the bank advanced £1,600,000 without interest, which being added to the original advance of £1,200,000, and the £400,000 advanced in 1710, bearing interest at six per cent., reduced the interest on the whole to three per cent.............	1,600,000	0	0
	In 1745, under authority of 19 Geo. II. c. 6, the Bank delivered up to be cancelled £986,000 of			
	Carry forward.........	10,700,000	0	0
	Brought forward......	10,700,000	0	0
	exchequer bills, in consideration of an annuity of £39,472, being at the rate of three per cent.......	986,000	0	0
	In 1749, the 23d Geo. II. c. 6, reduced the interest on the four per cent. annuities, held by the bank, to three and a half per cent. for seven years from the 25th of December 1750, and thereafter to three per cent.			
1764	Charter continued by 4 Geo. III. c. 25, till twelve months' notice after the 1st of August 1786, on payment, &c.			
	Under this act the Bank paid into the exchequer £110,000, free of all charge.			
1781	Charter continued by 21 Geo. III. c. 60, till twelve months' notice after the 1st of August 1812, on payment, &c.			
	Under this act the Bank advanced £30,000,000 for the public service for three years, at three per cent.			
1800	Charter continued by 40 Geo. III., c. 28, till twelve months' notice after the 1st of August 1833, on payment, &c.			
	Under this act the Bank advanced to government £3,000,000 for six years without interest; but in pursuance of the recommendation of the committee of 1807, the advance was continued, without interest, till six months after the signature of a definitive treaty of peace.			
	In 1816, the Bank, under authority of the act 56 Geo. III. c. 96, advanced at three per cent., to be repaid on or before the 1st of August 1833........	3,000,000	0	0
1833	Charter continued by 3 and 4 Will. IV. c. 98, till twelve months' notice after the 1st of August 1855, with a proviso that it may be dissolved on twelve months' notice after the 1st of August 1855, on payment, &c.	14,686,000	0	0
	This act directs that in future the Bank shall deduct £120,000 a year from their charge on account of the management of the public debt; and that a fourth part of the debt due by the public to the Bank, or £3,671,700, be paid off.............	3,671,000	0	0
	Permanent advance by the bank to the public, bearing interest at three per cent., independent of the advances on account of dead weight, or other public securities held by her......	11,015,100	0	0
1844	Charter continued by 7 and 8 Vict. c. 32, till twelve months after the 1st of August 1855, on payment, &c.			
	This act exempts the notes of the bank from all charge on account of stamp-duty, and directs that in future the bank shall deduct a farther sum of £180,000 a-year from the charge on account of the management of the public debt. It also allows notes of the value of £14,000,000 to be issued on securities; separates the banking from the issuing department of the establishment, and effects other important changes.			

as cash in all payments on account of government, and by the vast majority of individuals. For the first three years of the restriction, their issues were so moderate, that they not only kept on a par with gold, but actually bore a small premium. But in 1801, 1802, and 1803, they were so much increased that they fell to a discount of from 8 to 10 per cent. In 1804 they again recovered their value; and from that year to 1808, both inclusive, they were at a discount of 2½ per cent. In 1809 and 1810, however, the directors appear to have embarked on a new course, and to have entirely lost sight of the principles by which their issues had previously been governed; for the average amount of bank-notes in circulation, which had not exceeded 17½ millions, nor fallen short of 16½ millions, in any one year, from 1802 to 1808, both inclusive, was in 1809 raised to £18,927,833, and in 1810 to £22,541,523. The issues of country bank paper were increased in a still greater proportion; and, as there was no corresponding increase of the business of the country, the discount on bank-notes rose from 2½, in 1808, to from 13 to 16 per cent. in 1809 and 1810.

This depreciation in the value of bank paper being accompanied by a corresponding fall in the exchange, attracted the attention of the public and the legislature. In consequence, the House of Commons appointed, in 1810, a committee to inquire into the subject; and having examined several witnesses, the committee in their report, which is both an able and a celebrated paper, justly ascribed the fall in the value of bank paper, as compared with gold, to its over-issue; and recommended, in the view of correcting the existing evil and of preventing its recurrence, that within two years the bank should be obliged to resume specie payments. But this recommendation not being adopted, the over issue of paper went on increasing. In 1812 it was at an average discount, as compared with bullion, of 20¾ per cent.; in 1813, of 23 per cent.; and in 1814, when the maximum of depreciation was attained, it was 25 per cent.

At the period when the restriction on cash payments took place in 1797, it is supposed that there were about 280 country banks in existence; but so rapidly were these establishments multiplied, that they amounted to above 900 in 1813. The price of corn, influenced partly by the depreciation of the currency, and the facility with which discounts were obtained, but more by deficient harvests and the unprecedented difficulties which the war threw in the way of importation, rose to an extraordinary height during the five years ending with 1813. But the harvest of that year being unusually productive, and the intercourse with the continent being then also renewed, prices, influenced by both circumstances, sustained a very heavy fall in the latter part of 1813, and the beginning of 1814. And this fall having ruined a considerable number of farmers, and produced a general want of confidence, such a destruction of provincial paper took place as has rarely been paralleled. In 1814, 1815, and 1816, no fewer than 240 country banks stopped payment; and *eighty-nine* commissions of bankruptcy were issued against these establishments, being at the rate of *one* commission against every *ten and a half* of the total number of banks existing in 1813.

The great reduction that was thus suddenly and violently brought about in the quantity of country bank paper, by extending the field for the circulation of Bank of England paper, raised its value in 1817 nearly to a par with gold. The return to cash payments being thus facilitated, it was fixed, in 1819, by the Act 59 Geo. III., c. 78, commonly called Sir Robert Peel's Act, that they should take place in 1823. But to prevent any future over-issue, and at the same time to render the resumption as little burdensome as possible, it was enacted, in pursuance of a plan suggested by Mr. Ricardo, that the bank should be obliged, during the interval from the passing of the Act till the return to specie payments, to pay her notes, if required, in bars of standard bullion of not less than sixty ounces weight. This plan was not, however, acted upon during the period allowed by law; for, a large amount of gold having been accumulated at the bank, the directors preferred recommencing specie payments on the 1st of May 1821.

The fluctuations, referred to above, in the value of paper were exceedingly injurious. From 1809 to 1815, the creditors of every antecedent contract, land-holders whose estates had been let on lease, stockholders and annuitants of every description—all, in short, who could not raise the nominal amount of their claims or incomes proportionally to the fall in the value of money, were to that extent losers. The injustice that would have been done to the creditors of the state and of individuals, who had made their loans in gold, or paper equivalent to gold, by raising the denomination of the coin twenty-five per cent., however gross and palpable, would not have been greater than was actually done them in 1814, by compelling them to receive payment of their just debts in paper depreciated to that extent.

It is true, that after a currency has been for a considerable period depreciated, as much injustice is done by raising, as was previously done by depressing, its value. But there is good reason to doubt whether the depreciation from 1809 to 1815 (for the depreciation of 2½ per cent. during the six preceding years is too inconsiderable to be taken into account) extended over a sufficiently lengthened period to warrant the legislature in departing from the old standard. It is needless, however, to offer any opinion on this rather difficult point, for we have seen that the value of paper was raised in 1816 and 1817 almost to par by accidental circumstances without any interference on the part of government or of the bank. Sir Robert Peel's Act, to which this rise has been ascribed, not being past till 1819, could have nothing to do with what occurred two or three years previously. Its object was twofold, to redeem the pledge given by Parliament to restore the old standard on the return of peace, and to shut the door against any fresh depreciation of paper.

It has sometimes, indeed, been alleged, that the rise in the value of the currency, by reverting to specie payments in 1821, was in reality much greater than was indicated by the previous difference between the values of paper and gold: for, it is maintained that the value of gold was itself raised by that measure. But we doubt whether this opinion have any good foundation. The supply of gold in the commercial world is too vast to allow of its value being sensibly affected by the drain occasioned by the resumption of cash payments in this country. It was probably, in fact, more than compensated by the cessation of hostilities, and the greater use of bills and other substitutes for coin, after the restoration of tranquillity. We are not aware that there is any article that fell in price after the peace of 1815, of which the fall has not been, or may not be, satisfactorily accounted for by changes in the channels of its supply, or in the cost of production, or both. And the rise that has of late years taken place in the price of some articles, is mostly, we believe, to be accounted for in the same way. The decline in the value of gold, in consequence of the increased

Money. supplies furnished by California and Australia, has hitherto been very trifling indeed. (See Article PRECIOUS METALS.)

SECT. IV.—*Private and Joint-Stock Banks.*

Notices of the issues of private and joint-stock banks. After the statements already made in regard to the constitution and purposes of these banks, it is unnecessary to enter into further details with respect to them, unless as respects their history and proceedings as issuers of money.

Except during the suspension of cash payments, the issues of the Bank of England have generally been, as they always ought to be, determined by the state of the exchange. But though the greatest, the Bank of England has not been the only issuer of paper in this country. Large amounts have been issued by the provincial banks, and their issues have been but little influenced by the influx or efflux of bullion, but have almost wholly depended on the state of credit and prices in the districts in which they happened to be situated. If their managers supposed that these were good or improving, they rarely hesitated, previously to the new system introduced in 1844, about making additional issues. Hence, when the state of the exchange, and the demand on the Bank of England for bullion, showed that the currency was redundant and ought to be contracted, the efforts of the bank to effect its diminution have been often impeded, and met by a contrary action on the part of the country banks. This was not owing to the ignorance of the latter. Under the supposed circumstances, the country bankers saw, speaking generally, that they ought also to contract; but being a very numerous body, comprising several hundred establishments scattered over all parts of the country, each was impressed with the well-founded conviction, that all that he could do in the way of contraction, would be next to imperceptible; and few thought of attempting anything of the sort, so long as they felt satisfied of the stability of those with whom they dealt. On the contrary, most bankers knew, that had they withdrawn a portion of their notes, some of their competitors would have been eager to embrace the opportunity of filling up the vacuum; and that they would only have lost a portion of their business, without in any degree lessening the amount of paper afloat. Hence, in nineteen out of twenty instances, the country banks went on increasing their issues long after the exchange had been notoriously against the country, and the Bank of England had been striving to pull up.

And not only did they almost universally increase their issues when they ought to have been diminished, but the moment they were compelled to set about their reduction, they ran headlong into the opposite extreme, and unreasonable suspicion took the place of blind unthinking confidence. It is seldom, indeed, that a recoil takes place without its destroying more or fewer of the provincial banks; and provided the others succeed in securing themselves, little attention is usually paid to the interests of those they may have taught to look to them for help. In exemplification of these statements, we shall shortly notice some of the circumstances connected with the destruction of country bank paper in 1792-93, 1813-15, 1825-26, and in 1836-39.

1. Previously to 1759, the Bank of England did not issue any notes for less than £20; but having then commenced the issue of £10 notes, her paper was gradually introduced into a wider circle, and the public became more habituated to its employment in their ordinary transactions. The country banks had not, however, been so very scrupulous in regard to the magnitude of their notes, which they endeavoured to get into circulation by making them for very small sums. But this being a practice productive of much abuse, was checked in 1775, by Parliament enacting that notes should not be issued for less than £1. In 1777, this minimum limit was further raised to £5, at which point it continued till 1797, when an issue of £1 notes was again authorised.

Crisis of 1792-93. The distress and embarrassment that grew out of the American war proved exceedingly unfavourable to the formation of country banks, or of any establishments requiring unusual credit or confidence. No sooner, however, had peace been concluded, than everything assumed a new face. Agriculture, commerce, and still more, manufactures, into which Watt and Arkwright's inventions had been lately introduced, immediately began to advance with a rapidity unknown at any former period. In consequence, that confidence which had either been destroyed, or very much weakened by the disastrous events of the war, was fully re-established. The extended transactions of the country required fresh facilities for carrying them on, and these were supplied in the utmost profusion. The number of banks, which in 1784 was certainly under 150, increased so rapidly, that in 1792 they amounted to about 350! In consequence, a banking office was opened in every market-town and in most considerable villages. And such being the case, it is needless, perhaps, to add, that the prudence, capital, and connections of those who set up these establishments were but little attended to. The great object of a large class of traders was to obtain discounts; and the bankers of an inferior description were equally anxious to accommodate them. All sorts of paper were thus forced into circulation, and enjoyed nearly the same degree of esteem. The bankers, and those with whom they dealt, had the fullest confidence in each other. No one seemed to suspect that there was anything hollow or unsound in the system. Credit of every kind was strained to the utmost; and the available funds at the disposal of the bankers were reduced far below the level which the magnitude of their transactions required to render them secure.

The catastrophe which followed, was such as might easily have been foreseen. The currency having become redundant, the exchanges took an unfavourable turn in the early part of 1792. A difficulty of obtaining pecuniary accommodation in London was not long after experienced; and notwithstanding the efforts of the Bank of England to mitigate the pressure, a violent revulsion took place in the latter part of 1792 and the beginning of 1793. The failure of one or two great houses excited a panic which proved fatal to many more. Out of the three hundred and fifty country banks in England and Wales, when this revulsion began, about a hundred were compelled to stop payments, and upwards of fifty were totally destroyed, producing by their fall an extent of misery and bankruptcy till then unknown in the country.

"In the general distress and dismay, every one looked upon his neighbour with caution, if not with suspicion. It was impossible to raise money upon the security of machinery, or shares of canals; for the value of such property seemed to be annihilated in the gloomy apprehension of the sinking state of the country, its commerce and manufactures; and those who had any money, not knowing where they could place it with safety, kept it unemployed and locked up in their coffers. Amid the general calamity, the country banks, which had multiplied greatly beyond the demand of the country for circulating paper currency, and whose *eagerness to push their notes into circulation* had laid the foundation of their own misfortunes, were among the greatest sufferers, and, con-

Money.

sequently, among the greatest spreaders of ruin and distress among those connected with them; and they were also the chief cause of the drain of cash from the Bank of England, exceeding any demand of the kind for about ten years back. Of these banks above a hundred failed, whereof there were twelve in Yorkshire, seven in Northumberland, seven in Lincolnshire, six in Sussex, five in Lancashire, four in Northamptonshire, four in Somersetshire, &c."[1]

Attempts have sometimes been made to show that this crisis was not occasioned by an excess of paper-money having been forced into circulation, but by the agitation caused by the war then on the eve of breaking out. But there do not seem to be any good grounds for this opinion. The unerring symptoms of an overflow of paper—a fall of the exchange, and an efflux of bullion—took place early in 1792, or about twelve months before the breaking out of hostilities. Mr Chalmers states that none of the great houses that failed during this crisis had sustained any damage from the war. The efforts of the country bankers to force their paper into circulation occasioned the redundancy of the currency, and it was on them, and on the country dealers and farmers dependent on them, that the storm principally fell.[2] It has been already seen, and it is of importance to remark, that the Bank of England had no notes for less than £10, and the country banks for less than £5 in circulation when the crisis of 1792-93 took place.

Crisis of 1814, 1815, and 1816.

2. During the period from 1800 to 1813, the number of country banks increased from about 400 to 922; and in consequence partly of this rapid increase, and partly of the suspension of cash payments at the Bank of England in 1797, and the issue of one-pound notes by that establishment and the country banks, the amount of paper afloat was vastly increased, particularly after 1808, when it sunk to a heavy discount as compared with bullion. Mr Wakefield, whose extensive employment in the management of estates in all parts of the country gave him the most favourable opportunities for acquiring correct information, stated to the agricultural committee of 1821, that "down to the year 1813, there were banks in almost all parts of England, forcing their paper into circulation at an enormous expense to themselves, and in most instances to their own ruin. There were bankers who gave commission, and who sent persons to the markets to take up the notes of other banks; these people were called money-changers, and commission was paid them." (Report, p. 213). And among the various answers to the queries sent by the Board of Agriculture in 1816, to the most intelligent persons in different parts of the country, there is hardly one in which the excessive issue of country-bank paper is not particularly specified as one of the main causes of the unprecedented rise of rents and prices previously to 1814.

We have already seen what was the result of this conduct, and that the extensive destruction of country bank paper at the end of the war, by raising the value of the currency nearly to par, paved the way for the resumption of cash payments at the old standard in 1821.

Crisis of 1825-26.

But notwithstanding the ample experience that had been supplied by the occurrences of 1792-93 and 1814-16, of the mischievous consequences of the issue of paper by the country banks, and of their want of solidity, nothing whatever was done, when provision was made for returning to specie payments, to restrain their issues, or to place them on a better footing. The consequences of such improvidence were not long in manifesting themselves. The prices of corn and other agricultural products, which had been greatly depressed in consequence of abundant harvests, in 1820, 1821, and 1822, rallied in 1823; and the country bankers, true to their invariable practice on similar occasions, immediately began to enlarge their issues. It is unnecessary to inquire into the circumstances which conspired, along with the rise of prices, to promote the extraordinary rage for speculation exhibited in 1824 and 1825. It is sufficient to observe, that in consequence of their operation, confidence was very soon carried to the greatest height. It did not seem to be supposed that any scheme could be hazardous, much less wild or extravagant. The infatuation was such, that even the most considerate persons did not scruple to embark in visionary and absurd projects; while the extreme facility with which discounts were procured upon bills at very long dates, afforded the means of carrying on every sort of undertaking. The most worthless paper was readily negociated. Many of the country bankers seemed, indeed, to have no object other than to get themselves indebted to the public. And such was the vigour and success of their efforts to force their paper into circulation, that the amount of it afloat in 1825 is estimated to have been nearly fifty per cent. greater than in 1823.

The consequences of this extravagant and unprincipled conduct are well known. The currency having become redundant, the exchanges began to decline in the summer of 1824. The directors of the Bank of England having unwarily entered, in the early part of that year, into an engagement with the government to pay off such holders of four per cent. stock as might dissent from its conversion into a three and a half per cent. stock, were obliged to advance a considerable sum on this account after the depression of the exchange. But despite this circumstance, they might and ought to have taken measures in the latter part of 1824 and the earlier part of 1825, by lessening their issues, to stop the efflux of bullion. But not being sufficiently alive to the urgency of the crisis, the London currency was not materially diminished till September 1825. The recoil, which would have been less severe had the efforts of the bank to prevent the exhaustion of her coffers taken place at an earlier period, was most apalling. The country banks began to give way the moment they experienced a considerably increased difficulty of obtaining accommodation in London, and confidence and credit were immediately at an end. Suspicion having awakened from her trance, distrust had no limits. All classes of depositors made haste to call up the sums they had entrusted to the care of the banks. There was, also, a run upon them for payment of their notes, not in the view of sending the gold as a mercantile adventure to the Continent, but to escape the loss which it became obvious the holders of country paper would have to sustain. *Sauve qui peut* was the universal cry; and the destruction was so sudden and extensive, that in less than six weeks, above seventy banking establishments were swept off, and a vacuum was created in the currency which absorbed from eight to ten millions of additional issues by the Bank of England; at the same time that myriads of those private bills that had previously swelled the amount of the currency, and added to the machinery of speculation, were wholly destroyed.

Crisis of 1825 not occasioned by bank lending too much capital.

3. It may be worth while, perhaps, to observe that it has been alleged, in opposition to what is now stated, that the difficulties of the bank in 1825 were not caused by any excess either of her issues or of those of the country banks, but by the too great amount of the capital she had lent; and in proof of this allegation, we are referred to the increase of nearly eight millions in the amount of

[1] Macpherson's *Annals of Commerce*, vol. iv. p. 266.

[2] *Comparative Estimate*, p. 226, ed. 1812.

securities which the bank held in August 1825 over their amount in August 1822, and to the simultaneous decrease of nearly six and a half millions in the amount of bullion in her coffers.[1] But a little consideration will suffice to show the futility of this statement. It is impossible, indeed, that any mere advance of capital, however great, whether by the bank or any other great association, should affect the state of the currency or the exchanges. It was not the magnitude of the advances, but the mode in which they were made, that brought on the crisis. The bank took no steps, or none of sufficient energy, to reduce the amount of her notes in circulation till long after the exchange had become unfavourable, and bullion was demanded of her for exportation. The accumulation of securities was the necessary result of this radical error. Had the bank made her advances in the shape of produce—in corn, cotton, cloth, or iron—they might have been ten times as great without having the smallest influence over the exchange. But the currency having become redundant in 1824, the notes of the bank were returned upon her for gold, so that her securities were augmented at the same time that her means of dealing with the unfavourable exchange were impaired. It is to be remembered, that the efflux of bullion showed conclusively that, however issued, and whether greater or less than at former periods, the paper afloat was in excess, and that its contraction had become indispensable. And such being the case, it was the bounden duty of the bank, as soon as she felt the drain for gold setting steadily against her, to adopt every means in her power, by raising the rate of interest, selling securities, and otherwise, to reduce her issues, and restore the exchange to par. And had she done this at a sufficiently early period, it is all but certain she would not have lost more than two or three millions of bullion; whereas, by following a different line of conduct, and deferring the adoption of vigorous repressive measures till too late a period, she was drained of about seven millions of bullion, and her safety seriously compromised before she could stop the drain.

It is, therefore, the merest delusion to ascribe the crisis of 1825, or any similar crisis, to the bank advancing too much capital. She did no such thing. What she did was to issue and keep out an excess of notes in the teeth of an unfavourable exchange. It was this that drained her of her bullion; and it would have had precisely the same result had the bank capital been ten times greater than it actually was.[2]

Measures for establishing joint-stock banks in 1826. Inadequacy of these measures.

4. Notwithstanding nations are proverbially slow and reluctant learners, the events of 1825-26, taken in connection with those of the same sort that had previously occurred, produced a conviction of the necessity of taking some steps to improve the system of country banking in England. But we regret to have to add, that the measures adopted in this view were very far indeed from being effectual to their object. The law of 1708, limiting the number of partners in banking establishments to six, was repealed; and it was enacted, that banks with any number of partners, might be established for the issue of notes anywhere beyond sixty-five miles from London; and that banks not issuing notes might be established in London itself with any number of partners. The circulation of notes for less than five pounds in England and Wales was at the same time forbidden.

Much benefit was expected, but without much reason, to result from these measures. The suppression of £1 notes was in so far advantageous, that it shut up one of the principal channels by which the inferior class of country bankers got their paper into circulation, and tended, consequently, to secure the labouring classes against loss in the event of their bankruptcy. But the other measure, or that for the establishment of joint-stock banks, proved to be a complete failure. And we have seen in the previous inquiry into the constitution of such banks, that nothing but mischief could be expected to arise from giving them power to issue notes.

Progress of the joint-stock system.

Those who supposed that joint-stock banks would be immediately set on foot in all parts of England, were a good deal disappointed with the slowness with which they spread for some years after the Act permitting their establishment was passed. The heavy losses occasioned by the downfall of most of the joint-stock projects set on foot in 1824 and 1825, made all projects of the same kind be looked upon for a considerable period with suspicion, and deterred most persons from embarking in them. But this caution gradually wore off; and the increasing prosperity of the country, and the difficulty of vesting money so as to obtain from it a reasonable return, generated of new a disposition to adventure in hazardous projects. A mania for embarking in speculative schemes acquired considerable strength in 1834, and during 1835 and part of 1836, it raged with a violence but little inferior to that of 1825. It was at first principally directed to railroad projects; but it soon began to embrace all sorts of schemes, and, among others, joint-stock banks, of which an unprecedented number were projected in the course of 1835. The progress of the system was as follows:—

	Banks.		Banks.
In 1826 there were registered	6	In 1832 there were registered	10
In 1827	1	In 1833	13
In 1828	5	In 1834	8
In 1829	4	In 1835	45
In 1830	3	In 1836	11
In 1831	8		
		Total	114

In point of fact, however, the number of banks created in 1835 and 1836 was vastly greater than appears from this statement. We believe that, at an average, each of the fifty-six banks established in those years, like those previously established, had from four to five branches; and as these branches transacted all sorts of banking business, and enjoyed the same credit as the parent establishment, from which they were frequently at a great distance, they were, to all intents and purposes, so many new banks; so that, instead of fifty-six, it may safely be affirmed that from about 220 to 280 new joint-stock banks were opened in England and Wales in 1835 and 1836, but mostly in the former!

In January, February, and March 1836, when the rage

[1]

Securities of all sorts, 31st August 1822,	£17,290,510
——— 31st August 1825,	25,106,030
Excess of Securities, 31st August 1825, over those held on 31st August 1822,	£7,815,520
Bullion in Bank, 31st August 1822,	£10,097,960
Do. 31st August 1825,	3,634,320
Diminution of bullion,	£6,463,640

On the 28th February 1826, the bullion in the bank amounted to only £2,459,510.

[2] Perhaps we may be allowed to observe, that we endeavoured to point out, in an article in the *Scotsman*, published in 1825, what would be the inevitable result of the bank allowing the drain of bullion to run its course, viz., that she would be drained of her last sovereign, and obliged to stop payments; and that she could not avert this result otherwise than by narrowing her issues, and raising the value of the currency. She did this at last, but she ought to have done it nearly twelve months sooner.

Over-issue by the joint-stock banks in 1836-37.

for establishing joint-stock banks was at its height, the exchange was either at par, or slightly in our favour, showing that the currency was already up to its level, and that if any considerable additions were made to it, the exchange would be depressed, and a drain for bullion be experienced. But these circumstances, if ever they occurred to the managers of the joint-stock banks, do not seem to have had, and could not in truth be expected to have, any material influence over their proceedings. Their issues, which amounted on the 26th of December 1835 to £2,799,551, amounted on the 25th of June next to £3,588,064, exclusive of the vast mass of additional bills, cheques, and other substitutes for money they had put into circulation. The consequences were such as every man of sense might have foreseen. In April 1836 the exchange became unfavourable, and bullion began to be demanded from the Bank of England. The latter, that she might the better meet the drain, raised the rate of interest in June from four to four and a-half per cent., and this not being enough sufficiently to lessen the pressure on her for discounts, she raised it in August from four and a-half to five per cent. But during the whole of this period the country banks went on increasing their issues. We have seen that, on the 25th of June 1836, their issues were £788,513 greater than they had been on the preceding 26th of December; and notwithstanding the continued drain for bullion, and the increased rate of interest charged by the Bank of England, and the reduction of her issues, the issues of the joint-stock banks increased from £3,588,064 in June, to no less than £4,258,197 on the 31st of December, being an increase of nearly twenty per cent. after the exchange was notoriously against the country; and the most serious consequences were apprehended from the continued drain for bullion.

It may perhaps be supposed that the increased issue of the joint-stock banks would be balanced by a corresponding diminution of the issues of the private banks, and that on the whole the amount of their joint issues might not be increased. This, however, was not the case. Some private banks were abandoned in 1836, and others incorporated with joint-stock banks; and it is farther true, that those which went on managed their affairs with more discretion than their associated competitors. But, from the 26th of September 1835 to the 31st of December 1836, the issues of the private banks were diminished only £159,087, whilst those of the joint stocks were increased during the same period £1,750,160, or more than *ten times* the falling off in the others!

There should be only *one* issuer of paper-money.

These statements show the inexpediency of having more than one issuer of paper. Its issue ought in all cases to be governed by the state of the exchange, or rather, as already stated, by the influx and efflux of bullion. But previously to 1844, the provincial banks might go on over-issuing for a lengthened period without being affected by a demand for bullion, or even for Bank of England paper.

In the end, no doubt, an efflux of the former was sure, by rendering money and all sorts of pecuniary accommodation scarce in the metropolis, to affect the country banks as well as the Bank of England; and then the injury to industry, occasioned by the withdrawal of their accustomed accommodations from a great number of individuals, was severe in proportion to the too great liberality with which they had previously been supplied. This was especially the case in 1836, when the Bank of England, by bolstering up the Northern and Central Bank, averted, though but for a while, the bankruptcy of that establishment, which had no fewer than *forty* branches; and, by doing so, is said to have prevented the occurrence of a panic that might have proved fatal to many other joint-stock and private banks. Still, however, the shock given to industrial undertakings, by the revulsion in the latter part of that year, and in 1837, although unaccompanied by any panic, was very severe. All sorts of commercial speculations were for a while completely paralysed, and there were but few districts in which great numbers of individuals were not thrown out of employment. In Paisley, Birmingham, and most other towns, the distress occasioned by the revulsion was very general and long-continued. And owing to the Bank of England having delayed, in 1838 and the earlier part of 1839, to take efficient measures for the reduction of her issues, despite the unmistakeable evidence of their being redundant, the bullion in her coffers was reduced in September 1839 to £2,406,000; and, but for the efficient assistance obtained from the Bank of France, her stoppage could hardly have been averted.

SECT. V.—*Act of* 1844. *Objections to and Defence of that Act. Suspensions of in* 1847 *and* 1857.

Act of 1844.

This perilous experience having again forcibly attracted the public attention to the state of the banking system, Sir Robert Peel was induced to attempt its improvement. The clause in the Act 3 and 4 Will. IV. c. 98, which renewed the Bank Charter in 1833, gave Parliament power to revise or cancel it in 1845, and thus afforded a legitimate opportunity for the introduction of the new system. It was indispensable, in attempting to obviate the defects inherent in our currency, to proceed cautiously, to respect, in as far as possible, existing interests, and to avoid taking any step that might excite the fears or suspicions of the public; the grand difficulty being to reconcile such a course with the adoption of any plan that would obviate in any considerable degree the defects complained of. Happily this difficult problem was satisfactorily solved. The measures which Sir Robert Peel introduced and carried through Parliament in 1844 and 1845, for the improvement of our banking system, were so skilfully contrived as to provoke little opposition, at the same time that they effected most important and highly beneficial changes.

The measures in question consisted of the Act 7 and 8 Vict. c. 32, which refers to the Bank of England, and the English country banks; and the Acts 8 and 9 Vict. c. 38, 37, referring to the banks of Scotland and Ireland. These statutes were intended to obviate the chances of over-issue, and of sudden fluctuations in the quantity and value of money, by limiting the power to issue notes payable on demand, and by making the amount of such notes in circulation vary with the amount of bullion in the possession of the issuers. In dealing with the Bank of England, Sir Robert Peel adopted the proposal previously made by Lord Overstone,[1] for effecting a complete separation between the issuing and banking departments of that establishment, and giving the directors full liberty to manage the latter at discretion, while they should have no power whatever over the other.[2]

[1] In tracts published in 1837 and 1840, and in his evidence before a committee of the House of Commons in the latter year.

[2] It is right to state, that except in so far as he no doubt profited by the suggestion referred to, the measures adopted b Sir Robert Peel in 1844 and 1845 were entirely his own. And they will continue to be enduring monuments of the depth and clearness of his views, and of his administrative ability. This is a point in regard to which the evidence of Lord Overstone is quite decisive; and it is difficult to say, whether that evidence redounds more to his lordship's credit, or to that of the illustrious statesman whose claims to the gratitude of the country as the founder of a sound system of currency, he has so generously and successfully vindicated. "I," said Lord Overstone

Money.

Principle on which Act of 1844 was founded.

The notes of the Bank of England in circulation for some years previously to 1844 rarely amounted to twenty or sunk so low as sixteen millions. And such being the case, Sir Robert Peel was justified in assuming that the circulation of the bank could not, in any ordinary condition of society, or under any mere commercial vicissitudes, be reduced below fourteen millions. And the Act of 1844 allows the bank to issue this amount upon securities, of which the £11,015,100 she has lent to the public is the most important item. Inasmuch, however, as the issues of the provincial banks were at the same time limited in their amount, and confined to certain existing banks, it was further provided, in the event of any of these banks ceasing to issue notes, that the Bank of England might be empowered, by order in council, to issue, upon securities, two-thirds, and no more, of the notes which such banks had been authorised to issue. Under this condition, the total secured issue of the bank has (1857) been increased from £14,000,000 to £14,475,000. *But for every other note which the issue department may at any time issue over and above the maximum amount (£14,475,000) issued on securities, an equal amount of coin or bullion must be paid into its coffers.* And hence, under this system, the notes of the Bank of England are rendered really and truly equivalent to gold, while their immediate conversion into that metal no longer depends, as it previously did, on the good faith, the skill, or the prudence of the directors. And these important results have been attained without imposing any burden of which any one has any right to complain. Our currency rests on the fundamental principle, that all debts above forty shillings shall be paid in gold. But individuals and associations, including the banking or commercial department of the bank, have the option, if they prefer it, to exchange gold for bank notes, and to make use of the latter in their dealings with the public. Hence, if A or B goes to the issuers of paper, and gets 100 or 500 notes from them in exchange for an equivalent amount of gold, it is his own convenience he has exclusively in view. He was at full liberty to use gold, but he preferred exchanging it for notes because he could employ the latter more advantageously. This is the way in which paper is issued under the Act of 1844; and such being the case, it is contradictory to say that it is productive either of hardship or inconvenience.

It has sometimes been proposed to increase the issue upon securities from fourteen to fifteen or sixteen millions. But though a measure of this sort would in nowise affect the amount of the currency, it would in some degree, perhaps, diminish the security for its conversion in periods of difficulty; and the advantage that would result from setting free one or two millions of bullion is too trifling to be gained by exposure to such a contingency.

Proposal to issue inconvertible notes.

We may, perhaps, be allowed, in connection with this part of our subject, shortly to observe, that it was suggested to the late Committee on Banks (1857), that the currency might be improved by issuing some fourteen or twenty millions of inconvertible notes. (*Min. of Evidence*, pp. 441-449). The deserts of this proposal may be easily appreciated; and it would not have been worth notice had it not been one of the few practical measures recommended by the opponents of the Act of 1844. It is plain that inconvertible notes, supposing them to be issued in moderate quantities, or to the extent of fourteen millions or thereby, would not serve all the purposes, nor be of the same value as those that are convertible; and if they circulated, it would only be at a fluctuating rate of discount, as compared with other notes and coins. And while the greatest confusion and disorder would thus unavoidably result from their issue, nothing whatever would be gained by it beyond what is gained by the present system. All notes are now payable in gold on demand; but as it is abundantly certain that fourteen millions of notes will be at all times retained in the pockets of the public, that amount is allowed to be issued on securities. It is obvious, therefore, that while we avoid its endless inconveniences, we should realise nothing by the issue of fourteen millions of inconvertible notes, beyond what is realised under the Act of 1844. These, however, though sufficiently conclusive, are inferior considerations. If once we begin to issue such notes, it is impossible to say where we shall be allowed to stop. The principles, if so we may call the crude and contradictory assertions of the proposers of this notable scheme, would justify an issue not merely of fourteen or twenty, but of forty or fifty millions, or any greater sum. But it is not conceivable that it should meet with any countenance from any portion of the public, much less that it should be adopted. If it were, it requires little prescience to foresee that its results would be alike speedy and disastrous. What has repeatedly happened under the like circumstances would no doubt happen again. Gold would be driven from the country; all contracts would be upset, and we should be fortunate indeed if we escaped a national bankruptcy and revolution. If we take to dealing in assignats, we need not hope to escape its inevitable results.

Act of 1844 does nor shackle the bank in using her credit.

But, dismissing such crotchets, it is alleged that the new system is injurious by shackling the bank in the use of her credit. But it must be clear on the least reflection that it does nothing of the sort. It merely prevents the bank from issuing substitutes for money which do not represent money. It does not absorb or lock up a single sixpence worth of her capital; nor does it interfere in any manner of way with her employment either of it, or of her credit. The gold in the issue-department of the bank was not purchased by her, and does not belong to her. She is its keeper, but not its owner. It belongs to the public, or to the holders of bank notes, who deposited it in the bank in exchange for notes, with and under the express stipulation, that on paying the latter into the bank, they should receive back their gold. Any interference with these deposits would be an interference with property held in pledge for others, that is, it would be an act precisely of the same kind with that which deservedly subjected Strahan, Paul, and Co. to transportation for fourteen years. The authority of Mr. Sheffield Neave, the present governor of the bank, may be quoted in corroboration of this statement:—"The issue department is put out of our hands altogether. We are

"had no connection, political or social, with Sir Robert Peel. I never exchanged one word upon the subject of this Act with Sir Robert Peel in my life, neither directly nor indirectly. I knew nothing whatever of the provisions of this Act until they were laid before the public, and I am happy to state that, because I believe that what little weight may attach to my unbiassed conviction of the high merits of this Act, and the service which it has rendered to the public, may be diminished by the impression that I have something of personal vanity in this matter. I have no feeling whatever of the kind. The Act is entirely, so far as I know, the act of Sir Robert Peel, and the immortal gratitude of the country is due to him for the service rendered to it by the passing of that Act. He has never been properly appreciated, but year by year the character of that statesman upon this subject will be appreciated. By the Act of 1819, Sir Robert Peel placed the monetary system of the country upon an honest foundation, and he was exposed to great obloquy for having so done. By the Act of 1844, he has obtained ample and sufficient security that that honest foundation of our monetary system shall be effectually and permanently maintained. And no description can be written on his statue so honourable as that he restored our money to its just value in 1819, and secured for us the means of maintaining that just value in 1844. Honour be to his name."—(*Min. of Evidence*, p. 178, *Committee of* 1857.)

Money.

mere trustees under the Act of Parliament, to see that those securities are placed there and kept up to that amount; and in no case can any creditor of the bank touch that which is reserved for a note-holder. We are in that respect merely ministrative; we are trustees to hold that amount in the issue-department, and our banking department has a totally separate function, which has no relation whatever to the issue-department."—(*Min. of Evidence*, 1857, p. 99.)

But though she may not lay violent hands on the property of the public, the bank, it is obvious, has at this moment the same absolute command over her entire capital and credit, that she would have were the Act of 1844 non-existent. In her banking capacity she is free from all restraint, and is in precisely the same situation as other banking or mercantile establishments. She may lend or not lend as she pleases, and may lay down such conditions as she pleases in regard to the interest and the terms of her loans and discounts. In short, she may do whatever she likes with her own. But farther she is not permitted to go. She may not substitute shadows for realities. She cannot, whether to assist others, or to relieve herself from embarrassment, issue a single note except upon a deposit of bullion. But this rule does operate on herself only. It applies to all individuals and associations. And to relax it in any degree would be—disguise it as you will—to authorise an issue of fictitious or spurious paper, and consequently to vitiate the currency and to abuse credit in the way that is sure to be in the end the most disastrous.

This statement shows the groundless nature of the charge which is often made against the Act of 1844, that under its operation the bank runs the risk of being brought to a stop, though she may have some five, six, or even eight millions bullion in her coffers. For it is plain that two things are confounded in this charge, which are quite distinct, and have no necessary connection with each other, viz., the proceedings of the bank in her capacity of issuer of notes, and her proceedings in her capacity of a banking company. In her former capacity it is all but impossible that she should be brought to a stop; and if such a thing should happen, there would not then be an ounce of bullion in her coffers. It is not, however, impossible, nor even very improbable, that the bank should be brought, in her mercantile capacity, into difficulties, while there may be a large amount of bullion in the issue-department. But, though such should be the case, is that any reason why she should be permitted to draw on funds that do belong to her, and over which she has no control? Strahan, Paul, and Co. were in difficulties when they sold the bonds and other securities intrusted to their care. And supposing the bank were in difficulties, is she to be allowed to right herself by setting aside the principle of *meum* and *tuum*, and seizing on what belongs to others? Her directors would be the first to repudiate such a doctrine. It may be popular among the founders and managers of the Royal British Bank, and their associates and admirers here and elsewhere, but it will be contemptuously rejected by all men who have any sense of honour, or regard for character.

Act of 1844 has not increased fluctuations of interest.

We have already seen that the facility with which fictitious paper might be issued previously to 1844 was, on many occasions, greatly abused, and that by giving a powerful stimulus to speculation and over-trading, it promoted in no ordinary degree, even when it did not originate, those periods of artificial prosperity that never fail to terminate in bankruptcy and ruin. But though such stimulus can no longer be applied, it is alleged that the Act of 1844 has increased industrial vicissitudes by increasing the number and intensity of fluctuations in the rate of interest. But this charge is no better founded than the others. Previously to the modification of the usury laws in 1839, the bank could not charge more for loans than 5 per cent.; and for some considerable period after the restriction had been removed, the directors, influenced in part at least by their accustomed habit, permitted on several occasions the bank to be involved in difficulties which might have been averted by their sooner raising the rate of discount. But everybody who knows anything of the matter, must know that the measures of the bank do not determine the general rate of interest. She of course fixes the rate at which she will lend; but her rate is one thing, and the market rate another. Generally, she regulates her proceedings by the fluctuations in the latter. If, on the one hand, the rate of interest fixed by the bank were above the market rate, none but fools, or persons in desperate circumstances, would resort to her for discounts; while, on the other, if it were below that rate, the demands upon her would be so very great that her means would be speedily exhausted. Whether, therefore, there have been more or fewer fluctuations in the rate of interest since 1844, than in any previous period of equal duration, it is difficult to say, and the fact, were it ascertained, would be wholly immaterial to this question. Fluctuations in the market rate of interest seldom depend, in any degree, and never to any considerable extent, on the proceedings of those whose paper, like that of the bank, is equivalent to, and may be immediately converted into, gold. They are brought about by widely different means; by fluctuations in the rate of profit depending on the negociation of loans; the greater or less demand for capital caused by the opening of new and the shutting up of old commercial channels; the increased efficiency of industry; the undertaking of new projects; and so forth. Fluctuations originating in such widely different causes, must necessarily be of frequent though uncertain occurrence. There can, however, be no manner of doubt, as has been already seen, that their frequency and violence are uniformly and greatly increased by the revulsions consequent on over-issues of paper. At this very time (November 1857) in the United States, which are sufferers from a recoil of this sort, the rate of discount on first class bills varies from 20 to 30 and 40 per cent., while inferior paper cannot be negociated on any terms. The Act of 1844 has made such ruinous fluctuations, or anything approaching to them, impossible in this country, and on that ground alone, were there none else, it is entitled to the support of all save the merest gamblers.

While, however, the commercial vicissitudes which take place in this country are trifling compared with those that take place in the United States, they are also much less severe than those which occurred prior to the Act of 1844. But no one ever said or supposed that that Act, or that any other possible Act, would free us entirely from such vicissitudes. Its object was to insure at all times the equality of gold and paper, and to redress an adverse exchange. But though these great ends be completely effected, we are still necessarily left to contend with such evils as may result from the revulsions and contingencies inseparable from our enormously extended credit and commercial systems. Speculation, and the miscalculation inseparable therefrom, will continue; credit will be given to those from whom it should be withheld; bad harvests will no doubt recur; American and other extensive importers of our produce, will sometimes fail to make good their engagements; great corporations will sometimes be mismanaged; and mistaken views will sometimes

Money. prevail amongst the public. And the distress occasioned by the occurrence of these and other contingencies, may be severe, long continued, and widely diffused. But while, on the one hand, the bubble of unnatural prosperity is no longer inflated, as was formerly the case to a vast extent, by issues of spurious paper, so, on the other, the suffering and distress caused by the subsequent revulsion, are no longer inflamed and aggravated by their withdrawal or destruction.

The truth is, that no commercial crisis has been, or can be, averted by making issues of fictitious paper. On the contrary, by improperly bolstering up parties not entitled to credit, and by preventing that timely contraction of the currency which is necessary to correct an adverse exchange, they invariably tend to increase the mischief they are meant to alleviate. To tamper with the currency, except under the exigency of internal discredit or of a panic, is a totally inexcusable proceeding. Having adopted gold for the standard of our money, it is our bounden duty to keep such paper as is substituted for gold, on a par with it. Indeed it would be quite as correct to say that a commercial crisis may be mitigated by a change in our measures of length, capacity, or weight, as by a change in our measure of value.

Currency not limited by Act of 1844.

It is further objected to the Act of 1844, that it "limits the currency;" that it makes no provision for the increasing demands of the public; and confines us, in 1857, when the exports will probably exceed 120 millions, to the same amount of money as in 1844, when the exports did not exceed 58½ millions. But though this statement has been made by parties who ought to have known better, the reader can hardly require to be told that it is completely destitute of foundation. The £14,000,000 issued on securities, is the only thing that is limited in the Act; every thing else varies with the varying condition and circumstances of the country, including the means by which the use of money may be economised. In the week ended the 29th of August 1857, the issue department of the bank had issued notes to the amount of £25,323,965, being no fewer than £11,323,965 over and above the amount authorised to be issued on securities. And if the country had really required a larger supply of money, that is, if more coins, or paper equivalent to coins, could have been absorbed into the circulation without rendering the currency redundant, and depressing the exchange, the additional quantity would have been forthwith supplied. For, under such circumstances, merchants, bankers, and money-dealers, would have realised a certain and immediate profit by carrying bullion to the mint or the bank, that they might obtain coins, or notes, or both, with which to increase the currency. It is one of the chief merits of the Act of 1844, that, under its agency, the supply of money is not to any extent or in any degree regulated or influenced by the proceedings of the bank, or the government. They have nothing to do in the matter, unless it be to coin the bullion which individuals or firms carry to the mint for that purpose, and to exchange, when called upon, notes for coins, and coins for notes. The supply of money, like that of all non-monopolised articles, is wholly dependent upon, and is determined by the free action of the public. It would, indeed, be quite as true to say, that the Act of 1844 limits the amount of corn, of cloth, or of iron produced in the country, as that it limits the amount of money. It maintains the value of the notes issued by the bank on a level with the coins for which they are substitutes; but beyond that its effect is *nil*. It has nothing whatever to do with the greater or less amount of the currency. That depends entirely on the estimate formed by the public of its excess or deficiency, an estimate which, when wrong, is sure to be corrected by the exchange. Money.

We may add, that no inference can ever be safely drawn from the number of notes or coins, or both, afloat in a country, as to whether its currency be, or be not, in excess. That is to be learned by the state of the exchange, or by the influx and efflux of bullion. If the imports of bullion exceed the exports, it shows that the currency is in some degree deficient; while, if the exports exceed the imports, it shows that the currency is in excess, and that no additions can be made to it without farther depressing the exchange and increasing the drain of bullion. When the imports and exports of bullion are about equal, then of course the currency is at about its proper level. These are the only criteria by which anything can ever be correctly inferred, in regard to the deficiency or excess of currency. Its absolute amount affords hardly even a basis for conjecture. When there is little speculation or excitement, an issue of 25 or 27 millions bank notes may be in excess; while, at another time, and with a different state of trade and speculation, an issue of 35 or 37 millions of notes may not be enough. Except in periods of internal commotion, or when we are disturbed by alarms of invasion, the state of the exchange is the only, as it is the infallible, test of the sufficiency and insufficiency of the currency.

We may farther state, that those who are in the habit of complaining of the limitation of the currency by the Act of 1844, almost uniformly underrate its amount. We have already seen that, in the week ending the 29th August 1857, the notes issued by the issue department of the bank amounted to £25,323,965, of which £5,999,790 were in the banking department of the bank, leaving a balance of £19,324,175 in the hands of the general public; and this latter sum is, we are told, the real amount of the issues. But this is falling into the rather serious blunder of mistaking a part for the whole. The notes in the banking department of the bank make not only a part, but a most important and active part, of the currency of the country. They constitute the means, along with the bullion in the same department, with which the bank carries on her banking business, and are as evidently a portion of the currency as the notes in the tills of private bankers and the pockets of individuals. The notes in the banking department of the bank must therefore never be omitted in estimating the amount of notes in circulation. The latter, and the notes out of the issue department, are identical; and, in a general point of view, it matters not a straw whether they are in the hands of the banking department of the bank or of individuals.

Notes in the banking department of the bank an important part of the currency.

Mercantile pressure not aggravated by Act of 1844.

We have seen that bills of exchange, about which so much is said, though they serve some of the purposes of money, are not money. But whether the amount of them in circulation be great or small, and whether they be drawn at long or short dates, though highly important in other respects, has no reference to, or bearing upon, this question. When from any cause, whether from an excess in the amount of bills, or notes afloat, the currency becomes redundant, the exchange is depressed, and notes are sent to the issue department of the bank to be exchanged for gold, which is forthwith exported. And it is by the immediate action of the adverse exchange upon notes, and the consequent influence of the contraction of the latter upon bills, that the amount of the currency is lessened, its value raised, and the exchange brought to par. At such periods there is usually more or less of mercantile pressure, and a greater demand for discounts and pecuniary accommodation. This leads to a rise in the rate of interest; but no change in this rate has any

Money.

influence over the currency, except in so far as its rise may diminish, and its fall may increase, the demands upon the bank for loans. A system of this sort effectually prevents any great excess of bills from ever getting into the market; and thus checks, *in limine*, what would otherwise be the most copious source of wild speculation, overtrading and bankruptcy.

The operation of the present system during the late war with Russia, was in all respects eminently satisfactory. It stood in the way of no legitimate transaction, of no fair exercise of the credit, either of the state, or of individuals. But as it was a powerful obstacle to the creation of artificial credit, it was eminently unpopular with those who supposed they would profit by such abuse. It is doubtful, indeed, had the war continued for two or three years longer, whether government might not have been compelled to resort to an inconvertible paper, and consequently to place the property of the public, and of every individual, at the mercy of its issuers!

It is, therefore, wholly untrue to say that the Act of 1844 aggravates the severity of any mercantile pressure that may occur. Its practical effect is to do what other Acts professed but failed to do, that is, to make paper and gold precisely of the same value, and to insure the immediate conversion of the former into the latter. This is what the Act of 1844 really does. And to say that this aggravates either pressure or distress, is equivalent to saying that it would be aggravated by employing a purely metallic currency, or by maintaining a practically invariable measure of value, which is absurd. A gold currency interposes no obstacle to the free transfer of capital from one party to another, and has in truth no influence of any sort over its distribution, its employment, or the rate of profit. How, then, can it either occasion distress, or add to its pressure? It is not difficult to discover, in the stimulus given to emigration and industry by the discovery of the Californian and Australian gold fields, in the destruction of capital occasioned by the late war, in the hoarding now going on in India, China, and other countries, in the improvement of industry and the extension of commerce, and in the various schemes afloat, the causes of the present high rate of interest. But whatever they may be, the equality of gold and paper in England cannot be one of them. Neither can it be said to be occasioned by a scarcity of gold, for we have exported it to all parts of the continent; and interest is more than three times as high in California, and more than twice as high in Australia, in both of which gold is comparatively cheap, as in the United Kingdom.[1]

It is quite true, that if the check on the issue of paper were less cogent than at present (1857), parties might, perhaps, be tempted to lend it at less than 6 or 5, or even 4 per cent. But, down to a very late period, the currency, as shown by the exportation of gold, was really redundant; and hence it is obvious, that the issues now referred to, supposing they had been made, would, by making it still more redundant, have depressed the exchange to a still greater extent, and proportionally increased the drain for gold. Every device of this sort, that is, every attempt to obviate a foreign drain by encroaching on the integrity of the currency, is sure to lead to mischief. It may, like drams administered to a person with a broken-down constitution, have a momentary effect, but the collapse is inevitable, and is sure to be ruinous in proportion to the previous abuse of the stimulant.

Money.

Proposal for vesting the issue of notes in the hands of government commissioners.

It may be said, perhaps—for there is no end of apologies for whatever is vicious—that if the issue of notes were in the hands of government, the entire profit accruing thereon would belong to the public. But supposing such to be the case, the difference between that profit, and that which is or may be realized under the present system, would either be nothing at all, or so inconsiderable as to be wholly unworthy of attention. It will be afterwards seen that at this moment the public receives by far the greater part of the profit made by the bank on the fixed issue of £14,000,000, and if it be deemed expedient, that part may be still further increased, or turned into the lion's share. Assuming, therefore, for a moment, that the power to issue notes is vested in government commissioners, it is not pretended that these notes are to be legal tender. Nothing so monstrous as that could be thought of, or at all events, durst be proposed. The notes issued by the commissioners, like those issued by the bank, must be paid on demand. But to do this, a stock of bullion must be provided; and unless the plan now followed were adopted, and all issues above the amount of £14,000,000, or thereby, were made upon deposits of bullion, the public would not have that perfect security which is given them by the present system, and which is worth more than ten times all the profits arising out of the fixed issue. Even under the old system, or that which existed previously to 1844, the rule of the bank was to keep a stock of bullion on hand equal to a third part of her issues. But this rule was not, and in truth could not, be acted upon. It is plain, however, had it been *bona fide* carried out, that the profits on the issue of notes would not have been materially, if at all different, from what they are at this moment. Nothing, therefore, can be more completely futile than the talk about the large profits that would accrue to the public by vesting the power to issue notes in commissioners appointed by government. With the same security as at present for the conversion of the notes into coin, nothing would be gained by such appointment; and if, as would most likely be the case, it lessened the security referred to, and added to the chances of over-issue and mismanagement, the injury to the public hence resulting might be enormous. We, therefore, are disposed to believe, that of the various proposals in regard to the currency, that which proposes to vest the issue of notes in the hands of government commissioners, is one of the most objectionable. The chances are ten to one that they would act as directed by the government of the day; and this, at all events, would be popularly assumed to be the case. Supposing, however, that they did nothing of the sort, but were perfectly independent, still it is obvious, that whatever they did more or less than is done at present, would be mischievous. And such being the case, it is not easy to see what advantage would be gained by their appointment; while it would have the serious disadvantage of making government directly responsible, in the public estimation, for whatever inconvenience might at any time be supposed to result from the limitation of the currency.

Another class of opponents to the Act of 1844, though

[1] Among the many charges which have been made against the Act of 1844, one of the most extraordinary, if not the most absurd is, that it doubles the intensity of all demands for bullion on the bank, or converts a demand for one million into a demand for two! A million of notes are got, it is said, from the banking reserve of the bank, and these being sent to the issue department, are exchanged for gold, so that the bank has sustained a loss of *two* millions. It is singular that so obvious a fallacy should have been put forward. The gold in the issue department does not belong to the bank, but to the note-holders, so that she sustains neither loss nor injury by its being withdrawn. In this case, and in all cases of the sort, the notes in circulation are reduced a million, and their equivalent in gold is exported.

Proposal to have notes issued by the mint on deposits of gold.

but a small minority, take a different ground from most of those already noticed, and contend not that the Act is too strict, but that it is not strict enough. According to their view of the matter, no notes should be issued on securities. And they propose, conformably to their theory, that the issue of notes should be transferred from the bank to the mint, and that none should be issued except upon the deposit of a corresponding amount of bullion. This project, however, were it adopted, would not be productive of any advantage of any kind whatever, while it would abstract more than fourteen millions of capital from useful purposes. There is not, as already seen, the smallest chance that, under ordinary circumstances, or in the absence of internal commotion or panic, the issue of bank-notes will ever be reduced so low as £14,000,000; and it is therefore quite enough for every purpose of security, that the notes above that limit should be issued on deposits of bullion. How invaluable soever, it would be absurd to make greater sacrifices in favour of security than what are sufficient to obtain it in its most perfect state; and these are fully realized by the Act as it now stands.

It is argued, indeed, by those who have brought forward this scheme, that it would greatly improve the conduct of the bank, and that there would henceforth be fewer fluctuations in the rate of interest, and so forth. But every one must see that those who make such statements confound the proceedings of the bank as issuer of notes, with her proceedings as a great banking association. In truth and reality, however, the former have no connection with the latter; and are conducted precisely as they would be were the suggestion now under consideration to be adopted. In her proceedings as a great banking company, the bank is necessarily affected by all those circumstances which affect the trade and industry of the empire and the world, the state of the exchange, the demand for discounts and loans, and so forth. She must act accordingly, and adapt her measures to the varying wants and exigencies of society. But it is indifferent to the banking department of the bank, whether the notes which are used by it are obtained by carrying an equivalent amount of gold to the issue department, or to any other place. And such being the case, it is clear that the proposed plan, were it adopted, would obviate none of the inconveniences, if such there be, that attach to the present system, while it would introduce others which at present have no existence. For it would occasion a waste of the national resources by unnecessarily locking up fourteen millions of gold; and it would place the issue of paper, where it never ought to be placed, in the hands of government officers. But it is needless to enlarge further on a scheme which is sure to be repudiated by all parties.

Act of 1844 restrains country issues.

The objections to the Act of 1844 are so various and so opposite that they are not easily recollected. Sometimes we are told that it is inconsistent with itself and incomplete, and that it deals stringently with the Bank of England, while it hardly interferes with the country banks. But this is an unfair representation. In dealing with the country banks the Act may not have gone quite so far as it was desirable it should have gone, or as Sir Robert Peel wished it to go; but it notwithstanding effected, even in that respect, a very great improvement, and really left but little to be wished for.

To prevent future over-issues of country paper, it was enacted, that from and after the passing of the Act, no new bank for the issue of notes should be established in any part of the United Kingdom. And it was farther enacted, that the *maximum* issue of notes by the existing country banks should, in future, be limited to the average amount which they had respectively in circulation during the twelve weeks preceding the 27th April 1844;[1] and various penalties are imposed on those whose issues exceed that fixed amount. It was then, also, ordered that the names of the partners, in joint-stock and other banks, should be periodically published.

These are most important regulations. No doubt it would have been better had provincial issues been entirely suppressed, and Bank of England notes been made the only legal substitute for coins. But in matters of legislation what is practicable is of quite as much importance as what is absolutely just and proper. Sir Robert Peel knew what he could carry through Parliament. Had he attempted more he would not only have failed of his object, but would, most likely, have endangered the success of the other and far more important portion of his measure which related to the Bank of England.

Under the operation of the Act of 1844 the extinction of the country issues is being gradually effected, partly by some of the issuing banks finding it to be for their advantage to use notes of the Bank of England instead of their own, and partly by the winding up of some concerns and the bankruptcy of others. But, owing to the limitation of the issues, comparatively little inconvenience has resulted to the public from the latter circumstance.

On the whole, therefore, there does not appear to be much ground on which to object to the existing arrangements in regard to the country banks. Though not theoretically perfect, their practical deficiences are unimportant. To attempt to obviate them might imperil other and more important arrangements. And we incline to think that the notion that such would be the case has had not a little to do in making them be pressed on the attention of the public.

Suspensions of 1847 and 1857.

But it is said, "that even the best system cannot always be carried to an extreme. The Act of 1844 has had to be suspended in 1847, and again in 1857; and machinery for its relaxation in periods of difficulty should be introduced into it!"

We beg, however, to express our dissent from this doctrine. It would be easy to show that the embarrassment of the banking department of the bank in 1847 was mainly a consequence of the injudicious proceedings of the directors; and it is to be hoped that the experience they acquired on that occasion may not be forgotten. But in whatever way the crisis may have originated, there can be no question that the suspension of the Act in 1847 was a measure of doubtful policy. The exchanges had already become favourable, and it was the prevalent opinion in very well-informed quarters, that the panic which had begun to show itself would speedily have disappeared without the intervention of government. It should never be forgotten that, apart from internal panics, the time when the Act is said to be working harshly and oppressively, is the very time when it is most for the public advantage that it should be honestly carried out.

That such is the case is admitted by the highest authorities, and among others by Mr Hubbard, late governor of the bank. "As limitation of credit paper is," says he, "of the very essence of the Act of 1844, and as limitation operates sensibly only under circumstances of pressure, it is obvious that to evade its stringency because a pressure is felt, is simply to stultify the Act; while again, to admit a provision for extending the

[1] This condition applies only to banks in England and Wales. The issues of those in Scotland and Ireland are limited to the average amount of those in circulation during the twelve months ending the 1st of May 1845. See *post*.

credit issue in the event of difficulties arising from any possible or prospective contingency, would be to encourage overtrading, and foster in the banking community an unwarrantable dependence upon the Bank of England, while they make immoderate engagements, and neglect to maintain an adequate reserve for their own protection."[1]

In regard to the late suspension of the Act, we are, perhaps, too near the occurrence to be able to judge dispassionately of its policy. Owing, in no inconsiderable degree, to the prudence with which the business of the bank has been conducted of late years, there has not been, until very recently, any material amount of mercantile distress. Credit, indeed, is apt at all times to be incautiously and improperly given, and there is uniformly a good deal of overtrading and unwarranted expenditure. But except when a revulsion, or something else occurs to deprive parties who are overtrading of their accustomed accommodations, a system that is rotten at the heart may wear an imposing appearance, and seem to be possessed of that solidity of which it is wholly destitute. When, however, the hollowness of such a state of things is laid bare, it would be a gross abuse to attempt by forced measures to bolster up a parcel of mismanaged, bankrupt or ricketty concerns. Such a proceeding is unjust to all those parties who have conducted their businesses soberly and cautiously; and it tempts others to engage in reckless courses, from believing that government will, in the event of their speculations breaking down and being on a sufficiently large scale, volunteer to keep them on their legs.

This last is a most important consideration. In business matters, as in every thing else, individuals should be taught to rely exclusively on themselves. Those who rely on others are necessarily less industrious, cautious, and provident, than if they had no such dependence. They believe that, when the evil days come, they will be helped out of their difficulties; and they therefore make no provision against them, or none that is adequate. It is not easy to estimate the pernicious influence of the statements that are so frequently put forth, of this, that, and the other house, being in difficulties, and of their having obtained large advances from the bank, or other great associations. In nine cases out of ten these difficulties might have been avoided; and had the parties not been pretty well assured that assistance would be granted, they would not have needed it. They would have confined their engagements, and still more their expenditure, within reasonable limits; and their solvency or bankruptcy would not have depended on the judgment or caprice of any set of men. All applications for relief should be rigorously scrutinised; and those best qualified to form a just opinion on such subjects, are of opinion, that there are but few cases in which it is for the public advantage that they should be complied with. "An avowed system," said the most distinguished merchant of his day, "of leaving things to take their own course, and of not listening to the interested solicitations of one class or another for relief, whenever the imprudence of speculation has occasioned losses, will, sooner than any artificial remedy, reproduce that equilibrium of demand and supply which the ardour of gain will frequently derange, but which the same cause will, when let alone, as infallibly restore."[2]

But, however important, even these principles are not to be carried out at all hazards. The *salus publica* is the first consideration, and to it all others must give way. And if, at any time, it can be shown that that grand principle would be compromised by abiding by the Act of 1844, or by any other Act, then undoubtedly it ought to be suspended. But the necessity for interference must be clearly made out.

> Nec deus intersit, nisi dignus vindice nodus
> Inciderit.

The late revulsion, which grew out of the stoppage of the American banks, is said to be an instance of the kind now referred to. The real value of the exports from this country to the United States amounted in 1856 to £21,476,000, of which a large portion was unpaid when the banks stopped payments; and a further and very large sum was due to us on account of dividends on state, railway and canal stocks, and so forth, held by parties in England. The sudden cessation of so large an amount of payments could not fail to occasion a good deal of distress among the merchants and others dealing with America. And it was among this class, or those intimately connected with it, that the greatest overtrading and abuse of credit had taken place. Some firms in Glasgow, which had been notoriously overtrading for a number of years, were the first to give way. And their failure being on a very large scale, the banks[3] by which they had been principally supported became the objects of suspicion. And from suspicion to distrust there is but a step. Notwithstanding the numbers and wealth of the shareholders responsible for the banks in question, they were subjected to a run on the part of the inferior class of note-holders and depositors, and their resources being either anticipated or locked up, they were obliged to suspend payments. And had they only failed, none could have regretted the result. On the contrary, it would have been nothing more than they deserved, for they had for a lengthened period grossly abused the ample resources at their command, and resorted to the most questionable means to bolster up the speculators with whom they had become identified. But the mischief is, that the disastrous effects of such proceedings cannot be confined to the guilty parties. A fire originating in a pig-stye may destroy a palace. The suspension of the offending banks, by generating uneasy feelings and suspicions in the public mind, led to a run on some of the other banks. And to provide for their own safety these establishments immediately began to sell securities, and to adopt other means, by which to obtain supplies of gold. Large amounts of it were in consequence carried to Scotland. And, in addition to the demand for gold, that for discounts, notwithstanding the high rate of ten per cent. charged by the bank, continued undiminished, so that the reserve in her possession was reduced on the 11th of November to £1,462,153; and it was the general belief, that this inadequate reserve would be forthwith either much reduced or wholly swallowed up. To avert the possibility of such an event occurring, the directors were authorised, on the 12th of November, to issue notes without being bound by the conditions of the Act of 1844.[4]

This, though a brief, is, we believe, a sufficiently

[1] Letter of Mr. Hubbard to the governor of the bank, October 1856.

[2] Tract by the late Alexander Baring, Esq. (afterwards Lord Ashburton), on the Orders in Council, 1808.

[3] The Western Bank, and the City of Glasgow Bank, but especially the former.

[4] We subjoin a letter by the governor and deputy-governor of the bank, illustrative of the circumstances referred to:—

"*Bank of England, December* 2, 1857.

"My Lord and Sir,—We have the honour to acknowledge the receipt of your letter of the 27th inst., requesting 'such an explanation with respect to the course which the directors of the Bank of England have pursued in regulating their issues of notes since the 12th inst. as they may be able to furnish for the information of Her Majesty's Government.'

Money. accurate account of the circumstances that led to the suspension of the Act in 1857. The weight to be attached to them will be differently estimated by different individuals. The suspension is believed by some to have been, at least, premature, and others think that probably it might have been avoided. It is alleged that the panic in Scotland had begun to subside previously to the measure being adopted; and it was all but certain that when it had subsided, a considerable portion of the gold that had been sent to Scotland would speedily find its way back to London, and some considerable risk and inconvenience should have been encountered rather than that measures should have been adopted, the effect of which will be to protect speculators and money dealers without capital, and wanting alike in character and conduct, from the consequences of their unjustifiable proceedings. But, at the same time, we admit that the immediate exposure and punishment of these parties, however desirable, was not to be purchased at the risk of a general revulsion. And as the information laid before ministers made them believe that such a calamity was imminent unless the statute of 1844 was suspended, they were bound to act upon that conviction, and to provide *ne quid detrimenti respublica capiat*.

But whatever may be thought of these conclusions, it is at all events certain that the Act of 1844 had nothing whatever to do with the late revulsion. It did not occasion the American stoppage, and under its operation the foreign drain for gold had been entirely stopped; and though it could not prevent the abuses in banking, and the system of rediscounting and overtrading in which so many banks and firms have been engaged, it contributed in no ordinary degree, by preventing the issue of spurious paper, to confine them within comparatively narrow limits, and to lessen the violence of the crisis.

The Act of 1844 is a rule to be enforced in all but extraordinary and unforseen emergencies, the urgency of which cannot be appreciated beforehand, but must be determined at the moment. But when these occur, it may, like the *Habeas Corpus* Act, be properly suspended. It is mainly calculated to regulate our currency by the exchanges, or through our commercial intercourse with other countries; but it is not applicable, nor is any system of which the convertibility of paper into coin makes a part applicable to a state of internal discredit or panic. Had it existed in 1797, it must have been suspended; and its suspensions in 1847 and 1857 are only to be justified by the state of our domestic affairs making an adherence to principle inexpedient and impracticable. But, whenever the circumstances referred to, that is, when the panic and distrust that occasion the suspension of the Act subside, then it should be revived in its pristine vigour. The *Habeas Corpus* Act is not the less efficient at this moment that it has been repeatedly suspended in periods of danger and difficulty.

Inasmuch, however, as the Act of 1844 has been suspended in cases of emergency, and as there can be no doubt that it will be suspended, if occasion require, in time to come, it may be supposed, perhaps, to be indifferent whether such suspension should be effected as hitherto by the *pro re nata* interference of ministers, or whether a suspensive power should be embodied in the Act. We believe, however, that the present plan is much the best of the two. When government interferes to suspend the Act, the necessity under which they are now placed of applying to Parliament for an indemnity, and the discussions thence arising, are the best securities that can be obtained for the measure not being resorted to rashly, or without a reasonably good cause. But it would be quite another thing did the Act contain a clause authorising suspensions. This would show that

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"In complying with this wish it may be well to allude to the position of the Bank of England accounts anterior to the receipt of the letter of the 12th.

"On the 24th of October the bullion in the issue department was £8,777,000; the reserve £4,079,000; the notes in the hands of the public, £19,766,000; the discount and advances, £10,262,000; and the deposits, £16,126,000; the rate of discount at the bank being eight per cent. for bills having not more than 95 days to run.

"In the following week a great shock of credit and a consequent demand on the Bank of England for discounts arose from the failure of the Liverpool Borough Bank, whose rediscounted bills were largely held by the bill-brokers and others in London. The effects of this and other failures, however, up to this time, had not occasioned any alarming pressure on the resources of the bank, or great disquietude in commercial affairs in London.

"On the 5th of November the reserve was £2,944,000, the bullion in the issue department £7,919,000, and the deposits £17,265,000. The rate of discount was advanced to 9 per cent., and on the 10th of November to 10 per cent.

"The Continental drain for gold had ceased, the American demand had become unimportant, and there was at that time little apprehension that the bank issues would be inadequate to meet the necessities of commerce within the legalized sphere of their circulation.

"Upon this state of things, however, supervened the failure of the Western Bank of Scotland and the City of Glasgow Bank, and a renewed discredit in Ireland, causing an increased action upon the English circulation by the abstraction in four weeks of upwards of two millions of gold to supply the wants of Scotland and Ireland; of which amounts more than one million was sent to Scotland and £280,000 to Ireland between the 5th and 12th of November.

"This drain was in its nature sudden and irresistible, and acted necessarily in diminution of the reserve, which on the 11th had decreased to £1,462,000, and the bullion to £6,666,000.

"The public became alarmed, large deposits accumulated in the Bank of England, money dealers having vast sums lent to them upon call were themselves obliged to resort to the Bank of England for increased supplies, and for some days nearly the whole of the requirements of commerce were thrown on the bank. Thus, on the 12th, it discounted and advanced to the amount of £2,373,000, which still left a reserve at night of £581,000.

"Such was the state of the Bank of England accounts on the 12th, the day of the publication of the letter from the Treasury. The demand for discounts and advances continued to increase till the 21st, when they reached their *maximum* of £21,616,000.

"The public have also required a much larger quantity of notes than usual at this season, the amount in their hands having risen on the 21st to £21,554,000.

"The Bank have, since the 12th, under the authority of the letter from the Treasury, issued £2,000,000 of notes in excess of the limits of the circulation prescribed by the Act of 1844, and have passed securities to the issue department to that amount.

"That, however, is not the measure of the amount actually parted with by the Bank, which has not exceeded £928,000, the remainder of the £2,000,000 having been retained as a reserve of notes in the banking department, which, at the same time, also held £407,020 in coin.

"We subjoin a statement of accounts from the 11th of November to the 28th inclusive, from which it will be apparent that the Bank continued to meet all the demands for discounts and advances, on approved securities, to remedy the commercial discredit and distress mentioned in your letter of the 12th inst., 'as occasioned by the recent failure of certain joint-stock banks in England and Scotland, as well as of certain large mercantile firms chiefly connected with the American trade,' and aggravated by the subsequent embarrassment of large joint-stock banks.

"In discounts and advances the sum supplied to the public between the 12th of November and 1st of December amounted in the aggregate to £12,645,000.

"To the Right Hon. the First Lord of the Treasury and the
"Right Hon. the Chancellor of the Exchequer.

SHEFFIELD NEAVE, *Governor*.
BONAMY DOBREE, *Deputy-Governor*."

Money.

they were expected, and, indeed, almost invited. Under such circumstances, they would soon come to be regarded as matters of course, and to be resorted to whenever a complaint or cry of monetary pressure was got up. And were such the case, it would be idle to suppose, that either the Act or the convertibility of notes should be maintained for any considerable period. The millennium of the paper-mongers would be at hand. When the checks which with difficulty restrain over-issue, depreciation, and fraud, are repealed or rendered inefficient, what are we to expect but that they should extend their baleful influence on all sides?

If we are right in these statements, it follows that the Act of 1844 should be indefinitely continued with little or no alteration. We are well convinced that all the most important interests of the country will be best secured by such a proceeding.[1]

Sect. VI. *Management of the Bank of England.*

Bank-notes made legal tender everywhere except at the bank.

When the charter was renewed in 1833, the notes of the Bank of England were made legal tender everywhere in England except at the bank. Of the wisdom of this regulation no doubt can be entertained. Bank-notes are necessarily always equivalent to bullion; and by making them substitutes for coin at country banks, the demand for the latter during periods of alarm or runs is materially diminished, and the stability of the bank and of the pecuniary system of the country proportionally increased.

Since 1826 the bank has established branches in some of the great commercial towns. The mode and terms of conducting business at which have been described as follows:—

Account of branch banks.

"The branch bank at Swansea (and the same is true of those established in other places) is to be a secure place of deposit for persons having occasion to make use of a bank for that purpose; such persons are said to have *drawing accounts:* to facilitate to the mercantile and trading classes the obtaining discounts of good and unexceptionable bills, founded upon real transactions, two approved names being required upon every bill or note discounted; these are called *discount accounts.* The applications of parties who desire to open discount accounts at the branch are forwarded to the parent establishment for approval, and an answer is generally received in about ten days. When approved, good bills may be discounted at the branch without reference to London. Bills payable at Swansea, London, or any other place where a branch is established, are discounted under this regulation. The dividends on any of the public funds, which are payable at the Bank of England, may be received at the branch, by persons who have opened 'drawing accounts,' after signing powers of attorney for that purpose, which the branch will procure from London. No charge is made in this case, except the expense of the power of attorney and the postages incurred in transmitting it. Purchases and sales of every description of government securities are effected by the branch at a charge corresponding to that made by the local bankers where the branch is situated. A commission, including brokerage in London, and all expenses of postage, is charged on paying at the Bank of England bills accepted by persons having drawing accounts at Swansea, such bills to be advised by the branch; also for granting letters of credit on London, or on the other branches. The branch grants bills on London, payable at seven days' date, without acceptance, for sums of £10 and upwards. Persons having drawing accounts at Swansea may order money to be paid at the bank in London to their credit at Swansea, and *vice versâ*, at a charge of 6d. in lieu of postage. The branch may be called upon to change any notes issued and *dated* at Swansea; but they do not change the notes of the bank in London, nor receive them in payment, unless as a matter of courtesy where the parties are known. Bank post bills, which are accepted and due, are received at the branch from parties having drawing accounts, and taken to account without any charge for postage; but unexcepted bank post bills, which must be sent to London, are subject to the charge of postage, and taken to account when due. No interest is allowed on deposits. No advance is made by the branch upon any description of landed or other property, nor is any account allowed to be overdrawn. The notes are the same as those issued by the parent establishment, except being dated Swansea, and made payable there and in London. No note issued exceeds the sum of £500, and none are for a less amount than £5."

But though it might have been advisable to establish offices in Manchester, Birmingham, and one or two more great towns, for the interchange of bank-notes and gold, we much doubt whether the establishment of the branch banks has been advantageous. Speaking generally, it may be laid down that local affairs are best conducted by local agencies; and this is believed to be especially the case in banking. It is a business which is most likely to flourish when those by whom banks are established in country districts belong to those districts, and are well acquainted with the character and pursuits of those with whom they deal.

Bank of England in connection with the government.

The Bank of England transacts the whole business of government. "She acts not only," says Adam Smith, "as an ordinary bank, but as a great engine of state. She receives and pays the greater part of the annuities which are due to the creditors of the public; she circulates exchequer bills; and she advances to the government the annual amount of the land and malt taxes, which are frequently not paid till some years thereafter."

Assistance rendered by bank to the mercantile interest.

The greater part of the paper of the bank has generally been issued in the way of advances or loans to government, upon security of certain branches of the revenue, and in the purchase of Exchequer bills and bullion; but her issue through the medium of discounts and advances to individuals has also been at all times considerable, while during war, and in periods of distress, it is occasionally very great. Generally, however, the directors do not appear to have thought it advisable to enter into any very keen competition with private bankers in the discounting of mercantile paper. And hence it is that the rate of interest charged by the bank for loans being usually equal to, and sometimes rather above the market rate, comparatively few applications are made to her, in ordinary periods, for discounts. But, at the same time, every one who has any reasonable security to offer, knows where they may always be had; while the rate of interest charged by the

[1] We earnestly recommend those who may have any doubts in regard to this conclusion, to read and study the evidence of Lord Overstone before the Bank Acts Committee of 1857. It cannot fail to carry conviction to every one in the least familiar with such subjects, and is a most masterly and indeed triumphant vindication of the Act of 1844, and of sound monetary principles. It embraces, discusses, and exhausts the fundamental principles of paper money and banking. It were much to be wished that it were published separately.

Of the opponents of the Act of 1844, the writers in the *Economist* are at once the most reasonable, ingenious, and able. Those, however, on whom their lucubrations may have made an impression, will probably be restored to the sound faith if they read over the pamphlet of Mr. Arbuthnot of the Treasury. He has shown the fallacy of many of the statements and conclusions of the writers referred to, as well as of others, and has set the practical working of the Act of 1844 in a clear light.

Money.

bank necessarily forms a *maximum* rate which no other establishment can exceed. When, however, any circumstances occur to occasion a pressure in the money market, or a difficulty of obtaining accommodations in the usual channels, the market rate of interest generally rises to the rate fixed by the bank, how high soever that may be, and on such occasions the private bankers, and the public generally, resort to the bank for aid. She then becomes, as it were, a *bank of support;* and has, as such, on various occasions, rendered good service to public credit, and to the commercial interests of the country.

But, at the same time, it must be admitted that the interference of the bank in assisting the commercial interest is a matter that requires the greatest consideration, and that it can only be safely undertaken in rare instances and under very peculiar circumstances. We repeat again, that however a drain for gold may originate, the fact of its existence shows conclusively that gold is more valuable abroad than here, and consequently that the currency is redundant and ought to be diminished. Under such circumstances, it is the imperative duty of the directors, if they would prevent the total exhaustion of their banking reserve, not to fill up the vacuum caused by the exchange of notes for bullion, by the issue of fresh notes. It is at such periods, no doubt, that the applications for assistance are the most urgent; but it is impossible to yield to them, and at the same time to enforce that systematical and continuous reduction of the issues which is indispensable for the safety of the banking department of the bank. She can no longer assist herself as on former occasions, by making fresh issues of paper. And in truth that resource was of no real advantage to her, but the reverse. It tempted her to disregard those great principles and warnings which never can be neglected with impunity. The great commercial crises that took place in 1793, in 1815-16, in 1825, and in 1836-39, were all increased in violence and destructiveness by the bank declining to narrow her issues immediately on the exchange becoming unfavourable, and deferring her repressive action till too late a period.

Methods by which the bank may reduce her issues.

When the bank sets about reducing her issues, she may effect her object in various ways, viz., by rejecting a portion of the bills sent to her for discount, by raising the rate of interest at which she discounts or makes advances, by shortening the dates or *echéance* of the bills which she negociates, and by selling bullion and securities. Of these means, some may be more or less expedient at one time, and some at another. On the whole, however, the first mode, or the rejection of bills, seems to be, in all respects, the most objectionable. The bank will not, of course, discount any bill in regard to the payment of which there can be any reasonable doubt. And when the solidity of the bills offered for discount cannot be objected to, it becomes an invidious, if not an unjust proceeding, to discount some and reject others. Under such circumstances, the true plan is to raise the rate of interest, for while such rise operates equally and universally, it makes rich parties, or those who can avail themselves of other means of accommodation, withhold their demands, and thus effects its object in the fairest and easiest way, and without sacrificing individuals.

Inasmuch, however, as any sudden rise in the rate of discount, especially if it be considerable, is always productive of more or less inconvenience to the mercantile world, it may be proper, when the exchange becomes unfavourable, to endeavour to restore it to par by shortening the dates of bills, and if circumstances will permit, by selling bullion and securities. But, at all events, the redundancy of the currency must be got rid of, and the exchange redressed; and if the other means at the disposal of the bank be inadequate to effect this object, a rise in the rate of interest should be at once resorted to, and carried to the necessary extent.

Money.

It may be observed, with respect to the sale of securities, that they may be wholly or partly paid by drafts against deposits held by the bank. But, if so, it is clear that, at all events, her debts, or the obligation under which she lies to pay notes or gold to depositors when demanded, will be in so far reduced.

The fact that the applications for discounts at the bank are usually most numerous, when the rate of discount is highest, has made some doubts be entertained in regard to the efficacy of a rise in that rate to raise the value of the currency, and restore an unfavourable exchange to par. But the additional demand for discounts, on the occasions referred to, is most commonly a consequence of the increased difficulty of obtaining them in other quarters; and when the rate of discount becomes unusually high, apprehensions of a revulsion begin to be entertained, and bankers and others carry bills to the bank, not that they may get gold to send abroad, but that they may provide for their own security, by getting a supply of notes or gold, or both, to keep in reserve. And it is further to be observed, that the rise in the rate of interest, whether it be, as it usually is, the result of capital becoming scarcer or more productive, or of a temporary increase in the demand for money, uniformly operates to hinder the exportation of the latter. That such is the case is evinced by what took place in 1825, and in 1836-37. And on the recent occasion, notwithstanding the large sums lent by the bank on bills and advances of one sort or other, the ten per cent. rate of interest charged by her was sufficient to stop the efflux of bullion to the Continent and the United States; and, but for the abuse of credit by some private establishments, the restoration of the exchange to par would have been effected without any internal revulsion.

Mischievous effects of discounting bills at long dates.

The Bank of England rarely discounts bills that have more than two, or at most three, months to run, and it were well were this rule generally observed by other establishments. The discounting of bills at long dates is a powerful stimulus to unsafe speculation. When individuals obtain loans which they are not to be called upon to pay for six, twelve, or, perhaps, eighteen months, they are tempted to adventure in speculations which are not expected to be wound up till some proportionally distant period, and as these not unfrequently fail, the consequence is that, when the bills become due, there is commonly little or no provision made for their payment. In such cases the discounters, to avert an imminent loss, sometimes consent to renew the bills. But, while a proceeding of this sort is rarely productive of ultimate advantage to either party, the fact of its having taken place makes other adventurers reckon that, in the event of their speculations proving to be less successful than they anticipated, their bills will be treated in the same manner, and thus aggravates and extends the evil.

In other respects, too, the discount of bills at long dates, or their renewal, or the making of permanent loans, is altogether inconsistent with sound banking principles, for it prevents the bankers from having that command over their resources which is advantageous at all times, and indispensable in periods of difficulty or distress.

Distinction between real and accommodation bills.

In the discounting of bills, a great deal of stress is usually laid, or pretended to be laid, on the distinction between those that arise out of real transactions and those that are fictitious, or that are intended for accommodation purposes. The former are said to be legitimate, while the latter are stigmatised as illegitimate.

Money.

But Mr Thornton[1] has shown that the difference between these two classes of bills is neither so well marked nor so wide as most persons suppose. A notion seems to be generally entertained that all real bills are drawn against produce of one sort or other, which, or its value, is supposed to form a fund for their payment. Such, however, is not always, nor even most commonly the case. A, for example, sells to B certain produce, for which he draws a bill at sixty days' date. But prices are rising, trade is brisk, or a spirit of speculation is afloat, and in a week or two (sometimes much less), B sells the produce at an advance to C, who thereafter sells it to D, and so on. Hence it may, and in fact frequently does happen, that bills amounting to four, five, or even ten times the value of a quantity of merchandise, have grown out of its successive sales, before the first bill of the series has become due. And not only this, but bills are themselves very frequently rediscounted; and in this case the credit of the last indorser is generally the only thing looked to; and there is not, perhaps, one case in ten in which any inquiries are made in regard to the origin and history of the bills, though they are often of the most questionable description.

On the whole, therefore, it would seem that the real or presumed solidity of the parties signing a bill, and responsible for its payment, is the only safe criterion by which to judge whether it should or should not be discounted. But the fact of a merchant or other trader offering accommodation bills for discount ought unquestionably to excite a suspicion that he is trading beyond his capital. Inquiries of the most searching description should forthwith be instituted; and unless satisfactory explanations are given, his paper should be rejected. On the same principle, the offering of bills for rediscount ought to awaken suspicions of the bankers and others who resort to so questionable a mode of carrying on business. But, except in so far as a feeling of distrust may be thus very properly excited, there does not appear to be anything in an accommodation bill *per se* to hinder it from coming within the pale of negociability. It is a mode of obtaining a loan from a bank; and when the character of the bill is known to the banker, or is openly declared, it does not appear to be an objectionable mode.

Besides bills avowedly intended for accommodation purposes, another and a different variety of such bills is drawn by parties at a distance from each other, often men of straw, and made to appear as if they were bottomed on real transactions. And we are sorry to say, that bills of this sort are always current, and often to a large extent. Of course no person of respectability can be knowingly connected with such bills, which are almost always put in motion either to bolster up some bankrupt concern, or to cheat and defraud the public. But despite the mischief of which they are productive, it appears to be pretty generally supposed that the currency of these bills is an evil which cannot be prevented. There can, however, be no real doubt that it may, at all events, be very greatly diminished; and this desirable result would be effected were it enacted that all bills shall henceforth bear upon their face what they really are. That those that are intended for accommodation purposes shall have at their head the words "*Accommodation Bill;*" and that those only shall bear to be for "value received" that have grown out of *bonâ fide* transfers of property. An enactment of this sort could not be felt as a grievance by any one unless he had a fraudulent purpose in view. And were the impressing of a false character on a bill made a criminal offence punishable by three years' imprisonment, or some such penalty, there is every probability that a formidable check would be given to the issue of spurious bills, and to the manifold abuses to which the practice gives rise.

Money.

Bill-discounters who have got fictitious paper on their hands, and attempt, as has been done, to get rid of it by concealing its character, or representing it in a favourable light, make themselves parties to the fraud. Such conduct is so very flagitious, that when it can be fairly brought home to the parties, it should subject them to the severest penalties.

Rates of discount charged by bank.

The rates of discount charged by the bank, since its establishment in 1694, down to the present time (1857), have been as follows:—

From	Aug. 8, 1694	to Aug. 30, 1694	on Foreign bills . .	6	per cent.
...	Aug. 30, 1694	Jan. 16, 1695	Foreign bills . .	4½	...
...	Oct. 24, 1694	Jan. 16, 1695	Inland bills . .	6	...
...	Jan. 16, 1695	May 19, 1695	Foreign bills . .	6	...
...	Jan. 16, 1695	(to customers of the bank) do.	. .	3	...
...	Jan. 16, 1695	July 26, 1716	Inland bills . .	4½	...
...	May 19, 1695	Feb. 28, 1704	Foreign bills . .	4	...
	Do.	on Foreign bills, not payable at the bank		5	...
...	Feb. 28, 1704	June 22, 1710	Foreign bills . .	5	...
...	June 22, 1710	July 26, 1716	For. & Inland do.	4	...
...	July 26, 1716	April 30, 1719	bills and notes .	5	...
...	April 30, 1719	Oct. 27, 1720	bills	5	...
...	Oct. 27, 1720	Aug. 23, 1722	bills	4	...
...	Aug. 23, 1722	Oct. 18, 1742	Inland bills . .	5	...
...	Do.	do.	Foreign bills . .	4	...
...	Oct. 18, 1742	Dec. 12, 1744	Foreign bills . .	5	...
...	Dec. 12, 1744	May 1, 1746.	do. (15 d. to run)	4	...
...	Do.	do.	Inland bills . .	5	...
...	May 1, 1746	April 5, 1773	Foreign bills . .	5	...
...	May 1, 1746	June 20, 1822	Bills and notes . (95 days to run) .	5	...
...	June 20, 1822	Dec. 13, 1825	do. .	5	...
...	Dec. 13, 1825	July 5, 1827	do. .	5	...
...	July 5, 1827	July 21, 1836	do. .	4	...
...	July 21, 1836	Sept. 1, 1836	do. .	4½	...
...	Sept. 1, 1836	July 15, 1838	do. .	5	...
...	Feb. 13, 1838	May 16, 1839	do. .	4	...
...	May 16, 1839	June 20, 1839	do. .	5	...
...	June 20, 1839	Aug. 1, 1839	do. .	5½	...
...	Aug. 1, 1839	Jan. 23, 1840	do. .	6	...
...	Jan. 23, 1840	Oct. 15, 1840	65 day bills . .	5	...
...	Oct 15, 1840	June 3, 1841	95 day bills . .	5	...
...	June 3, 1841	April 7, 1842	do. .	5	...
...	April 7, 1842	Sept. 5, 1844	do. .	4	...
...	Sept. 5, 1844	Mar. 13, 1845	bills	2½	...
...	Do.	do.	notes	3	...
...	Mar. 13, 1845	Oct. 16, 1845	minimum rate .	2½	...
...	Oct. 16, 1845	Nov. 6, 1845	do. .	3	...
...	Nov. 6, 1845	Aug. 17, 1846	do. .	3½	...
...	Aug. 17, 1846	Jan. 14, 1847	do. .	3	...
...	Jan. 14, 1847	Jan. 21, 1847	do. .	3½	...
...	Jan. 21, 1847	April 8, 1847	do. .	4	...
...	April 8, 1847	Aug. 5, 1847	do. .	5	...
...	Aug. 5, 1847	Sept. 23, 1847	do. .	5½	...
...	Sept. 23, 1847	Oct. 25, 1847	do. .	6	...
...	Oct. 25, 1847	Nov. 22, 1847	do. .	8	...
...	Nov. 22, 1847	Dec. 2, 1847	do. .	7	...
...	Dec. 2, 1847	Dec. 23, 1847	do. .	6	...
...	Dec. 23, 1847	Jan. 27, 1848	do. .	5	...
...	Jan. 27, 1848	June 16, 1848	do. .	4	...
...	June 15, 1848	Nov. 2, 1848	do. .	3½	...
...	Nov. 2, 1848	Nov. 22, 1849	do. .	3	...
...	Nov. 22, 1849	Dec. 26, 1850	do. .	2½	...
...	Dec. 26, 1850	Jan. 2, 1852	do. .	3	...
...	Jan. 1, 1852	April 22, 1852	do. .	2½	...
...	April 22, 1852	Jan. 6, 1853	do. .	2	...
...	Jan. 6, 1853	Jan. 20, 1853	do. .	2½	...
...	Jan. 20, 1853	June 2, 1853	do. .	3	...
...	June 2, 1853	Sept. 1, 1853	do. .	3½	...
...	Sept. 1, 1853	Sept. 16, 1853	do. .	4	...
...	Sept. 15, 1853	Sept. 29, 1553	do. .	4½	...
...	Sept. 29, 1853	May 11, 1854	do. .	5	...
...	May 11, 1854	Aug. 3, 1855	do. .	5½	...
...	Aug. 3, 1854	April 5, 1855	do. .	5	...
...	April 5, 1855	May 3, 1855	do. .	4½	...
...	May 3, 1855	June 14, 1855	do. .	4	...
...	June 14, 1855	Sept. 6, 1855	do. .	3½	...
...	Sept. 6, 1855	Sept. 13, 1855	do. .	4	...
...	Sept. 13, 1855	Sept. 27, 1855	do. .	4½	...
...	Sept. 27, 1855	Oct. 4, 1855	do. .	5	...
...	Oct. 4, 1855	Oct. 18, 1855	do. .	5½	...
...	Oct. 18, 1855	May 8, 1856	65 day bills . .	6	...
...	Oct. 18, 1855	May 22, 1856	95 day bills . .	7	...
...	May 22, 1856	May 29, 1856	Minimum rate .	6	...

[1] On the Paper Credit of Great Britain, cap. 2.

Money.

From May 29, 1856	to June 26, 1856	on Minimum rate	5	per cent.
... June 26, 1856	Oct. 1, 1856	do.	4½	...
... Oct. 1, 1856	Oct. 6, 1856	do.	5	...
... Oct. 6, 1856	Nov. 13, 1856	do.	6 and 7	...
... Nov. 13, 1856	Dec. 4, 1856	do.	7	...
... Dec. 4, 1856	Dec. 18, 1856	do.	6½	...
... Dec. 18, 1856	April 2, 1857	do.	6	...
... April 2, 1857	June 18, 1857	do.	6½	...
... June 18, 1857	July 16, 1857	do.	6	...
... July 16, 1857	Oct. 8, 1857	do.	5½	...
... Oct. 8, 1857	Oct. 12, 1857	do.	6	..
... Oct. 12, 1857	Oct. 19, 1857	do.	7	...
... Oct. 19, 1857	Nov. 5, 1857	do.	9	...
... Nov. 5, 1857		do.	10	...

Dividends on bank stock.

The dividends on bank stock, from the establishment of the company to the present time, have been as follows :—

Years.	Dividend.	Years.	Dividend.
1694	8 per cent.	1764	5 per cent.
1697	9 "	1767	5½ "
1708 }	Varied from 9 to	1781	6 "
1729 }	5½ per cent.	1788	7 "
1730	6 "	1807	10 "
1730	5½ "	1823	8 "
1721	6 "	1839	7 "
1728	5½ "	1852	7½ "
1747	5 "	1853	8 "
1753	4½ "	1856	9½ "

Bank does not allow interest on deposits.

The Bank of England does not allow, either at the head office in London, or at her branches, any interest on deposits; and in doing so she acts wisely. Notwithstanding the non-payment of interest, she has often very large amounts of deposits on her hands, and were she to pay interest, the probability is that they would be very greatly increased, and might, in periods of difficulty, seriously compromise her safety. At present the bank may either retain deposits or invest them in those securities from which they may be most easily withdrawn. But if she allowed interest, the case would be different, and she would be obliged to look quite as much or more to the profits to be made by investments as to the facility of repossessing herself of funds. We beg, in corroboration of what has now been stated, to draw the reader's attention to the following extract from the evidence of Mr Weguelin, late governor of the bank, before the Committee of 1857 :—

"We," said he, "at the Bank of England, have always considered that the proper functions of a banker were to keep the spare cash of his customer, such cash as his customer required for his daily expenditure, for the sudden demands of his business, and any accidental accumulation which might happen before the customer had occasion to invest it. That is contrasted with the system pursued by the joint-stock banks. The joint-stock bank invites a large deposit by offering a certain rate of interest for the deposit; in point of fact, the joint-stock bank becomes the investor of the money instead of the customer. The customer of a joint-stock bank does not himself invest his own money, but he employs the joint-stock bank to do it, taking the guarantee of the joint-stock bank, and taking, possibly, a lower rate of interest. Now that system, if applied to the Bank of England, would be, I think, very prejudicial to the public interests. It would, in the first place, force upon the Bank of England to invest its reserves much more closely than it does now. If it had to pay interest upon its deposits, it could only do so by investing them in some securities that would pay a higher rate of interest than that which it pays. Its deposits also are of that particular character which would render it still more inexpedient that they should be closely invested. They consist, in the first place, of government deposits, which rise from a low rate at one period of a quarter up to five or six millions higher at another period of a quarter, and again collapse to a very low rate at another period. Again, the private deposits consist, to a certain extent, of the deposits of the bankers and the joint-stock banks of London. Those deposits are the amounts which those bankers require to work their own business. Consequently, they are not deposits which should be very closely invested by the Bank of England. In times when there is a great accumulation of deposits in the Bank of England, it is because the public are not able at those times to find investments to their mind to employ those deposits; and consequently, it is not at all likely that the Bank of England, if that is the case with the public generally, will be able to find investments which the public themselves have not been able to do. All these reasons combined would lead me to think that to force a system upon the Bank of England by which it should be obliged to employ its deposits very closely—much more closely than it does at present—would be not only prejudicial and unsafe as regards the Bank of England, but would be prejudicial to the public interest."—*Quest.* 159.

Money.

The truth is, that the whole subject of deposits is beset with difficulties. The extent to which it has been already carried has deeply endangered the stability of the banking system, and we have seen that it is indispensable it should be subjected to regulation.

Management of national debt.

Previously to 1786, the bank received an allowance for trouble in paying the dividends, superintending the transfer of the stock, &c., of the national debt of £562 : 10s. a million on its amount. In 1786 this allowance was reduced to £450 a million, the bank being, at the same time, entitled to a considerable allowance for her trouble in receiving contributions on loans, lotteries, &c. This, though long regarded as a very improvident arrangement on the part of the public, was acquiesced in till 1808, when the allowance on account of management was reduced to £340 per million on £600,000,000 of the public debt, and to £300 per million on all that it exceeded that sum, exclusive of some separate allowances for annuities, &c. The impression, however, was still entertained that the allowances for management should be further reduced, and this has been effected in the interim.

Profit on fixed issue.

Exclusive of her functions as public banker, and manager of the public debt, the Bank of England is connected with government through the circulation. We have seen that she is entitled to issue upwards of £14,000,000 upon securities, that is, on the credit of the funds she has lent to government. But for these she receives about 3 per cent. interest, and such being the case, the public is clearly entitled to a portion, if not to the whole amount of the profits realised by the bank on the issue of these £14,000,000. It is difficult to say how much this may amount to. The issue department of the bank seldom re-issues notes, but for the most part destroys them as soon as they are returned to it. This practice is said to be necessary to enable the bank to obviate fraud, by keeping a proper account of the numbers of the notes afloat. An opinion is, however, pretty generally entertained that this might be effected by a less expensive process than that which is now resorted to. And, certainly, it seems to be a very wasteful proceeding, that a quantity of newly manufactured notes issued by the bank in the forenoon, and returned to her in the afternoon, should not be reissued, but consigned to the flames. The Scotch banks are justly censurable for keeping their notes too long afloat, but this is running with a vengeance into the opposite extreme.

But, as it is, the cost of maintaining an issue of £14,000,000 is estimated by the bank at about £113,000 a year; and taking the gross profits of the issue at 3 per cent., or £420,000, the nett profits may be estimated at £307,000 a year; and of this sum the bank pays to government £180,000, viz., £60,000 in lieu of the old charge for stamp duty, abolished in 1844, and a further sum of £120,000, leaving the bank £127,000 for her share of the profits. And so long as the cost of the issues remains at about its present amount, we do not know that there

Money. is much to object to in this arrangement. Probably, however, were the allowance to government further increased by some £50,000 or £60,000, the bank might find means, without injury to the public, of re-issuing her notes, or of otherwise reducing the cost of their circulation. During the year ended the 31st March 1856, the payments made to the bank for managing the national debt and annuities amounted to £95,875.

It should be observed that the responsibility and expense incurred by the bank, in managing the public debt, are very great. The temptation to the commission of fraud, in transferring stock from one individual to another, and in the payment of the dividends, is well known; and notwithstanding the skilfully devised system of checks adopted by the bank for its prevention, she has frequently sustained very great losses by forgery and otherwise. In 1803 the bank lost, through a fraud committed by one of her principal cashiers, Mr Astlett, no less than £340,000; and the forgeries of Fauntleroy, the banker, cost her a still larger sum! At an average of the ten years ending with 1831, the bank lost, through forgeries on the public funds, £40,204 a year.—(*Report on Bank Charter, Appen.* p. 165).

Dead weight.

Besides the transactions alluded to, the bank entered, on the 20th of March 1823, into an engagement with government with respect to the public pensions and annuities, or, as they have been more commonly termed, the *dead weight*. At the end of the war, the naval and military pensions, superannuated allowances, &c., amounted to above £5,000,000 a-year. They would, of course, have been gradually lessened, and ultimately extinguished, by the death of the parties. But it was resolved in 1822 to attempt to spread the burden equally over the whole period of *forty-five* years, during which it was calculated the annuities would continue to decrease. To effect this purpose, it was supposed that, upon government offering to pay £2,800,000 a-year, for forty-five years, capitalists would be found who would undertake to pay the entire annuities, according to a graduated scale previously determined upon, making the first year a payment of £4,900,000, and gradually decreasing the payments until the forty-fifth and last year, when they were to amount to only £300,000. This supposition was not, however, realised. No capitalists were found willing to enter into such distant engagements. But in 1823 the bank agreed, on condition of receiving an annuity of £585,740 for *forty-four* years, commencing on the 5th of April 1823, to pay, on account of the pensions, &c., at different specified periods, between the years 1823 and 1828, both inclusive, the sum of £13,089,419.—(4 *Geo.* IV. c. 22).

Mode of transacting banking business at the bank.

Formerly the business transacted at the bank was so much encumbered with forms and conditions, that the generality of merchants and ordinary people rarely thought of employing her to keep their money or make their payments. But in this respect an entire change has been effected. Cheques, the minimum amount of which was formerly £10, may now be drawn of any amount, great or small; and all sorts of banking business is conducted with facility and dispatch, and, we may add, with perfect security.

The bank opens banking accounts, or, as they are called, "drawing accounts," for the safe custody, and the receipt and payment of cash, not only with merchants and traders, but with all persons who choose to keep their money at a banker's, and to draw cheques against it. The bank also takes charge of their customers' bills of exchange, exchequer bills, and other securities, and does all that is needful either in the collection of bills of exchange, the exchange of exchequer bills, or the receipt of dividends, and so forth, free of any charge. Plate-chests, and deed and security boxes, may be deposited, free of expense, by customers, for safe custody. The bank looks to the average balance of cash on each account, to compensate for the trouble and expense of keeping it, and in this respect the requirements of the bank are certainly not greater than those of ordinary bankers. No particular sum is required to be lodged on opening an account; it is only necessary that the party should be known as respectable, and in a condition to require a banking account. But the bank receives and holds sums of money for safe custody for parties who have no current accounts.

The following are the regulations under which accounts are conducted:—

1. All letters should be addressed to the chief cashier.
2. It is desirable that drafts should be drawn upon cheques furnished by the bank.
3. Cheques upon city bankers, eastward of King Street, Cheapside,
   Paid in by 12 o'clock may be drawn for after 1.
   Do. 2 o'clock " " after 3.
4. Cheques paid in after 2, and before 3 o'clock, and cheques upon all other London bankers paid in before 12 o'clock, may be drawn for on the following morning.
5. Cheques paid in after 3 o'clock are sent out at 9 the following morning, and may be drawn for as soon as received.
6. Dividend warrants are received at the drawing office until 4 o'clock in the afternoon for all persons having accounts at the bank.
7. It is requested that notice be given at the drawing office of bills accepted payable at the bank, with the date of their maturity.
8. Persons keeping a drawing account with the bank (although not having a discount account) may tender bills for discount through the drawing office. Application for discounts, or for advances on stock, exchequer bills, &c., must be made before 2 o'clock.
9. Bills of exchange and notes not paid when due, will be noted.
10. The bank will make purchases or sales of British or foreign securities upon an order in writing addressed to the chief cashier; and dividends on stock may be received under powers of attorney granted to the cashiers of the bank.
11. Exchequer bills, bonds, railway debentures, or any other securities may be deposited, and the interest, when payable, will be received and placed to account.
12. Credits paid in to account are received without the bank-book, and are afterwards entered therein without the party claiming them.
13. Notes of country bankers, payable in London, are sent out the same day for payment if paid in before 3 o'clock.
14. The pass-books should be left at the drawing office, at least once a month, to be written up.
15. Where post-bills are required, or a payment is to be made to any office of the bank by cheque on the Bank of England, the cheque must be presented at the office upon which it is drawn, and exchanged for an order on the post-bill office, or on the office at which the payment is to be made.
16. Cash-boxes taken in, contents unknown, for such parties as keep accounts at the Bank.
17. A person having a drawing account may have a discount account; but no person can have the latter without at the same time having the former. When a discount account is opened, the signatures of the parties are entered in a book kept for that purpose, and powers of attorney are granted empowering the persons named in them to act for their principals. Bills of exchange having more than 95 days to run are not eligible for discount.

N.B.—All changes in the residence of persons keeping cash at the bank are requested to be made known at the drawing office; and it is particularly requested not to offer any gratuities to the clerks of the banking offices, such gratuities being strictly forbidden.

There are no holidays at the bank except Christmas and Good Friday.

 Tables.

TABLES exhibiting a View of the Issues, Securities, Bullion, &c., of the Bank of England, and of the Joint-Stock and Private Banks in England and Wales.

No. I.—An ACCOUNT of the Notes, Post Bills, &c., of the Bank of England in Circulation, on the 28th of February and 31st of August in each year, from 1698 to 1792 both included, as near as the same can be made up.

Year.	28th Feb.	31st Aug.	Year.	28th Feb.	31st Aug.	Year.	28th Feb.	31st Aug.	Year.	28th Feb.	31st Aug.
	£	£		£	£		£	£		£	£
1698	1,221,290	1,240,400	1722	2,365,640	3,006,430	1746	3,383,720	3,842,500	1770	5,237,210	5,736,780
1699	743,850	519,150	1723	3,516,110	3,482,210	1747	4,107,420	3,652,310	1771	6,822,780	6,014,110
1700	938,240	781,430	1724	3,232,830	3,857,710	1748	3,894,650	3,789,720	1772	5,962,160	5,987,570
1701	298,860	763,860	1725	3,734,480	3,343,400	1749	3,737,110	4,183,390	1773	6,037,060	6,362,220
1702	920,730	1,030,900	1726	3,076,850	3,152,340	1750	3,964,970	4,318,490	1774	7,550,780	9,886,220
1703	933,760	1,214,040	1727	3,888,180	4,677,640	1751	4,022,160	5,195,310	1775	9,135,930	8,398,310
1704	961,990	946,010	1728	4,574,920	4,513,790	1752	4,444,960	4,750,350	1776	8,699,720	8,551,090
1705	556,610	1,043,150	1729	4,152,590	4,199,910	1753	4,401,580	4,420,290	1777	8,712,230	7,753,590
1706	996,840	805,410	1730	3,998,280	4,416,870	1754	4,062,870	4,081,280	1778	7,440,330	6,758,070
1707	959,820	824,860	1731	4,451,720	5,249,880	1755	3,950,650	4,115,280	1779	9,012,610	7,276,540
1708	648,680	598,940	1732	4,251,660	4,592,400	1756	4,106,790	4,516,360	1780	8,410,790	6,341,600
1709	707,470	691,350	1733	4,385,060	4,543,000	1757	5,319,130	5,149,940	1781	7,092,450	6,309,430
1710	601,580	480,920	1734	4,203,070	4,671,930	1758	5,320,590	4,864,110	1782	8,028,880	6,759,310
1711	477,510	573,230	1735	4,627,990	4,738,550	1759	4,586,840	4,809,790	1783	7,675,090	6,307,270
1712	738,920	2,025,200	1736	4,907,750	5,077,570	1760	4,969,250	4,936,280	1784	6,202,760	5,592,510
1713	1,221,880	800,810	1737	5,215,010	4,414,690	1761	5,632,350	5,246,680	1785	5,923,090	6,570,650
1714	823,640	1,651,780	1738	4,766,280	4,609,420	1762	5,741,090	5,886,980	1786	7,581,960	8,184,330
1715	972,160	978,840	1739	4,347,270	4,152,420	1763	5,999,910	5,314,600	1787	8,329,840	9,685,720
1716	1,460,660	1,579,730	1740	4,550,980	4,444,000	1764	5,501,300	6,210,680	1788	9,561,120	10,002,880
1717	2,053,150	2,188,030	1741	4,841,840	4,084,450	1765	6,316,670	5,356,490	1789	9,807,210	11,121,800
1718	2,782,420	1,806,640	1742	4,471,510	4,911,390	1766	5,617,570	5,246,410	1790	10,040,540	11,433,340
1719	1,807,010	1,939,550	1743	4,654,890	4,250,180	1767	5,510,990	4,883,440	1791	11,439,200	11,672,320
1720	2,466,880	3,032,460	1744	4,253,610	4,270,590	1768	5,778,990	5,415,580	1792	11,307,380	11,006,300
1721	2,244,280	2,206,260	1745	4,279,610	3,465,350	1769	5,707,190	5,411,450			

No. II.—ACCOUNT of the Circulation, Deposits, Securities, Bullion, and Surplus (exclusive of Capital), of the Assets over the Liabilities of the Bank of England at (or as near thereto as the accounts can be made up) the undermentioned Dates in each of the following Years.

Dates.	Circulation.	Deposits.	Securities.	Bullion.	Rest or Surplus of Assets over Liabilities.
1793 February 28 . .	£11,888,910	£5,346,450	£16,005,250	£4,010,680	£2,780,570
August 31 . .	10,865,050	6,442,810	14,809,680	5,322,010	2,823,830
1794 February 28 . .	10,744,020	7,891,810	14,524,550	6,987,110	2,875,830
August 30 . .	10,286,780	5,935,710	12,446,460	6,770,110	2,994,080
1795 February 28 . .	14,017,510	5,973,020	16,811,340	6,127,720	2,948,530
August 31 . .	10,862,200	8,154,980	16,989,920	5,136,350	3,109,090
1796 February 28 . .	10,729,520	5,702,360	17,139,840	2,539,630	3,247,590
August 31 . .	9,246,790	6,656,320	17,025,470	2,122,950	3,245,310
1797 February 28 . .	9,674,780	4,891,530	16,837,750	1,086,170	3,357,610
August 31 . .	11,114,120	7,765,350	18,261,170	4,089,620	3,471,320
1798 February 28 . .	13,095,830	6,148,900	16,799,600	5,828,940	3,383,710
August 31 . .	12,180,610	8,300,720	17,349,640	6,546,100	3,414,410
1799 February 28 . .	12,959,800	8,131,820	17,039,030	7,563,900	3,511,310
August 31 . .	13,389,490	7,642,240	16,930,440	7,000,780	2,899,490
1800 February 28 . .	16,844,470	7,062,680	21,424,050	6,144,250	3,661,150
August 31 . .	15,047,180	8,335,060	22,138,420	5,150,450	3,906,630
1801 February 28 . .	16,213,280	10,745,840	26,424,730	4,640,120	4,105,730
August 31 . .	14,556,110	8,133,830	22,209,570	4,335,260	3,854,890
1802 February 28 . .	15,186,880	6,858,210	21,959,820	4,152,950	4,067,680
August 31 . .	17,097,630	9,739,140	27,113,360	3,891,780	4,169,370
1803 February 28 . .	15,319,930	8,050,240	23,914,900	3,776,750	4,321,480
August 31 . .	15,983,330	9,817,240	26,918,840	3,592,500	4,710,770
1804 February 29 . .	17,077,830	8,676,830	26,998,970	3,372,140	4,616,450
August 31 . .	17,153,890	9,715,530	25,826,680	5,879,190	4,836,450
1805 February 28 . .	17,871,170	12,083,620	28,661,390	5,883,800	4,590,400
August 31 . .	16,388,400	14,048,080	27,772,850	7,624,500	4,960,870
1806 February 28 . .	17,730,120	9,980,790	26,591,070	5,987,190	4,867,350
August 31 . .	21,027,470	9,636,330	29,473,100	6,215,020	5,024,320
1807 February 28 . .	16,950,680	11,829,320	27,408,460	6,142,840	4,771,300
August 31 . .	19,678,360	11,789,200	29,936,950	6,484,350	4,953,740
1808 February 29 . .	18,188,860	11,961,960	27,384,080	7,855,470	5,088,750
August 31 . .	17,111,290	13,012,510	29,244,090	6,015,940	5,136,230
1809 February 28 . .	18,542,860	9,982,950	29,118,200	4,488,700	5,081,090
August 31 . .	19,574,180	12,257,180	33,435,270	3,652,480	5,256,390

Tables.

Dates.	Circulation.	Deposits.	Securities.	Bullion.	Rest or Surplus of Assets over Liabilities.
1810 February 28 . .	£21,019,600	£12,457,310	£33,378,580	£3,501,410	£5,403,080
August 31 . .	24,793,990	13,617,520	40,973,770	3,191,850	5,754,110
1811 February 28 . .	23,360,220	11,445,650	37,122,350	3,350,940	5,667,420
August 31 . .	23,286,850	11,075,660	37,083,280	3,243,300	5,964,070
1812 February 29 . .	23,408,320	11,595,200	38,026,290	2,983,190	6,005,960
August 31 . .	23,026,880	11,848,910	38,176,120	3,099,270	6,399,600
1813 February 27 . .	23,210,930	11,268,180	37,930,950	2,884,500	6,336,340
August 31 . .	24,828,120	11,159,730	40,106,080	2,712,270	6,830,500
1814 February 28 . .	24,801,080	12,455,460	41,989,910	2,204,430	6,937,800
August 31 . .	28,368,290	14,849,940	48,345,960	2,097,680	7,225,410
1815 February 28 . .	27,261,650	11,702,250	44,558,500	2,036,910	7,631,510
August 31 . .	27,248,670	12,696,000	44,854,180	3,409,040	8,318,550
1816 February 29 . .	27,013,620	12,388,890	45,401,310	4,640,880	8,639,680
August 31 . .	26,758,720	11,856,380	37,279,540	7,562,780	6,227,220
1817 February 28 . .	27,397,900	10,825,610	34,278,630	9,080,970	5,736,090
August 30 . .	29,543,780	9,084,590	32,605,630	11,668,260	5,645,520
1818 February 28 . .	27,770,970	7,997,550	30,905,530	10,055,460	5,192,270
August 31 . .	26,202,150	7,927,730	32,370,760	6,363,160	4,604,040
1819 February 27 . .	25,126,700	6,413,370	31,455,000	4,184,620	4,099,550
August 31 . .	25,252,690	6,304,160	31,740,550	3,595,360	3,779,060
1820 February 29 . .	23,484,110	4,093,550	26,187,490	4,911,050	3,520,880
August 31 . .	24,299,340	4,420,910	23,846,120	8,211,080	3,336,950
1821 February 28 . .	23,884,920	5,622,890	20,796,270	11,869,900	3,158,360
August 31 . .	20,295,300	5,818,450	18,475,540	11,233,590	3,595,380
1822 February 28 . .	18,665,350	4,689,940	15,973,080	11,057,150	3,674,940
August 31 . .	17,464,790	6,399,440	17,290,510	10,097,960	3,524,240
1823 February 28 . .	18,392,240	7,181,100	18,319,730	10,384,230	3,130,620
August 30 . .	19,231,240	7,827,350	17,467,370	12,658,240	3,067,020
1824 February 28 . .	19,736,990	10,097,850	18,872,000	13,810,060	2,847,220
August 31 . .	20,132,120	9,679,810	20,904,530	11,787,430	2,880,030
1825 February 28 . .	20,753,760	10,168,780	24,951,330	8,779,100	2,807,890
August 31 . .	19,398,840	6,410,360	25,106,030	3,634,320	2,930,950
1826 February 28 . .	25,467,910	6,935,940	32,918,580	2,459,510	3,974,240
August 31 . .	21,563,560	7,199,860	25,083,630	6,754,230	2,074,440
1827 February 28 . .	21,890,610	8,801,660	23,529,530	10,159,020	2,996,280
August 31 . .	22,747,600	8,052,090	23,199,320	10,463,770	2,863,400
1828 February 29 . .	21,980,710	9,198,140	23,581,270	10,347,290	2,749,710
August 30 . .	21,357,510	10,201,280	23,905,530	10,498,880	2,845,620
1829 February 28 . .	19,870,850	9,553,960	25,384,750	6,835,020	2,794,960
August 31 . .	19,547,380	9,085,070	24,661,810	6,795,530	2,874,890
1830 February 27 . .	20,050,730	10,763,150	24,204,390	9,171,000	2,561,510
August 30 . .	21,464,700	11,620,840	24,565,690	11,150,480	2,630,630
1831 February 28 . .	19,600,140	11,213,530	25,208,980	8,217,050	2,612,360
August 31 . .	18,538,630	9,069,310	23,905,030	6,439,760	2,736,850
1832 February 29 . .	18,051,710	8,937,170	24,333,490	5,293,150	2,637,760
August 28 . .	18,320,000	10,278,000	23,420,000	7,514,000	2,336,000
1833 February 26 . .	19,372,000	12,455,000	23,850,000	10,205,000	2,228,000
August 27 . .	19,925,000	11,927,000	23,245,000	10,871,000	2,264,000
1834 February 25 . .	19,050,000	13,087,000	25,212,000	9,225,000	2,300,000
August 26 . .	19,195,000	13,300,000	27,732,000	7,303,000	2,540,000
1835 February 24 . .	18,510,000	10,071,000	24,895,000	6,289,000	2,603,000
August 25 . .	18,085,000	13,725,000	28,173,000	6,255,000	2,618,000
1836 February 23 . .	18,181,000	14,044,000	27,368,000	7,787,000	2,930,000
August 30 . .	18,018,000	12,040,000	27,697,000	5,250,000	2,889,000
1837 February 28 . .	18,165,000	10,007,000	27,297,000	4,077,000	3,202,000
August 29 . .	18,887,000	10,040,000	25,357,000	6,548,000	2,978,000
1838 February 27 . .	18,975,000	10,825,000	21,958,000	10,471,000	2,629,000
August 28 . .	19,488,000	8,922,000	21,611,000	9,540,000	2,741,000
1839 February 26 . .	18,098,000	7,739,000	21,741,000	6,773,000	2,677,000
August 27 . .	17,982,000	6,488,000	25,141,000	2,420,000	3,091,000
1840 February 25 . .	16,504,000	6,556,000	21,611,000	4,311,000	2,862,000
August 25 . .	17,170,000	6,254,000	22,075,000	4,299,000	2,950,000
1841 February 23 . .	16,399,000	6,407,000	21,344,000	4,335,000	2,873,000
August 31 . .	17,370,000	6,975,000	22,602,000	4,822,000	3,079,000
1842 February 22 . .	16,920,000	8,239,000	22,124,000	6,119,000	3,084,000
August 27 . .	20,332,000	8,690,000	22,159,000	9,729,000	2,866,000
1843 February 28 . .	20,284,370	11,262,560	23,134,370	11,149,790	2,737,230
August 31 . .	19,339,790	11,307,060	21,631,650	12,295,000	3,279,800
1844 February 29 . .	21,148,370	12,529,160	20,648,450	16,213,950	3,184,870
August 31 . .	21,485,260	12,137,590	21,872,100	15,314,540	3,563,790
1845 February 28 . .	21,201,720	15,722,960	24,730,610	15,767,590	3,573,520
August 30 . .	22,100,220	14,401,560	24,507,380	15,592,290	3,588,890
1846 February 28 . .	20,968,240	24,943,600	35,825,480	13,775,790	3,689,430
August 31 . .	21,390,420	16,322,310	25,164,380	16,388,100	3,839,750
1847 February 27 . .	20,151,760	15,250,180	27,256,230	12,044,930	3,899,220
August 31 . .	18,828,070	14,416,850	28,006,710	9,163,840	3,925,630

Tables.

No. III.—A RETURN of the Average Aggregate Amount of Promissory-Notes, payable to Bearer on Demand, in Circulation in the United Kingdom, distinguishing those at the undermentioned Dates circulated by the Banks of England and Ireland, and by Private and Joint-Stock Banks in England, Scotland, and Ireland, together with Bullion in the Bank of England, from March 1840 to March 1857.

Years and Months ended	England.				Scotland.	Ireland.		Total, United Kingdom.	Bullion in the Bank of England.
	Bank of England.*	Private Banks.	Joint Stock Banks.	Ag. Mon. Circ. of Count. Is.	Chart. Priv. and Jt. Stock Banks.	Bank of Ireland.	Priv. and Jt. Stock Banks.		
	£	£	£	£	£	£	£	£	£
1840 March	16,224,400	6,190,306	3,895,748	10,148,430	2,764,692	3,132,500	2,663,925	34,933,947	4,360,000
1841 March	16,209,000	6,254,653	3,673,889	10,093,259	2,944,300	3,164,250	2,314,169	34,724,978	4,339,000
1842 Mar. 5	16,894,000	5,299,455	2,990,986	8,290,441	2,811,109	3,188,750	2,407,625	33,591,925	6,125,000
June 25	17,543,000	4,995,594	2,850,532	7,846,126	2,887,088	3,901,525	1,769,184	32,946,873	7,320,000
Sep. 17	19,914,000	5,098,259	2,819,749	7,918,008	2,648,519	2,806,025	1,663,012	34,949,594	9,336,000
Dec. 10	18,841,000	5,085,885	3,001,590	8,087,475	3,091,228	3,138,525	2,104,855	35,263,083	10,330,000
1843 Mar. 4	20,340,000	4,785,724	2,844,077	7,629,801	2,588,370	3,196,125	2,097,225	35,851,521	11,054,000
June 24	18,411,000	4,503,478	2,863,779	7,367,257	2,869,863	3,105,150	1,734,730	33,488,000	11,472,000
Sep. 16	19,132,000	4,288,180	2,763,302	7,051,482	2,659,176	3,975,950	1,699,946	33,518,554	12,018,000
Dec. 10	18,791,000	4,533,048	3,161,033	7,694,081	3,166,920	3,502,475	2,376,676	35,531,152	12,855,000
1844 Mar. 2	21,471,000	4,992,709	3,427,189	8,419,998	2,684,191	3,609,000	2,428,498	38,612,587	15,784,000
June 22	20,634,000	4,743,057	3,665,104	8,408,161	3,117,988	3,488,300	2,080,277	37,728,726	15,900,000
Sep. 14	21,285,000	4,338,569	3,158,290	7,496,859	2,940,456	3,359,150	2,052,262	37,133,727	15,443,000
Dec. 7	20,986,000	4,442,725	3,086,676	7,529,401	3,486,818	3,900,275	2,945,046	38,847,540	14,466,000
1845 Mar. 1	21,080,000	4,411,507	3,089,879	7,501,386	2,986,708	3,991,050	3,130,508	38,689,652	15,263,000
June 21	21,277,000	4,398,833	3,131,109	7,529,942	3,485,531	3,882,600	2,736,432	38,911,505	16,106,000
Sep. 13	21,931,000	4,358,253	3,142,142	7,500,395	3,341,397	3,712,725	2,547,130	39,032,647	15,986,000
Dec. 6	22,015,000	4,569,278	3,221,883	7,791,161	3,804,031	4,404,975	3,311,855	41,327,022	13,742,000
1846 Mar. 28	20,346,000	4,515,407	3,176,935	7,692,342	3,018,771	4,257,200	3,187,760	38,502,073	13,481,000
June 20	20,553,000	4,456,629	3,128,185	7,584,814	3,508,655	4,119,850	2,852,176	38,618,495	14,150,000
Sep. 12	21,192,000	4,407,765	3,111,536	7,519,301	3,446,787	3,923,575	2,664,600	38,746,263	15,937,000
Dec. 5	21,055,000	4,596,549	3,190,417	7,786,966	3,996,861	4,375,025	3,464,505	40,678,357	15,090,000
1847 Mar. 27	20,087,000	4,541,543	3,247,531	7,789,074	3,360,348	3,857,800	2,846,936	37,941,158	12,903,000
June 19	19,078,000	4,385,608	3,088,327	7,473,935	3,647,314	3,327,400	2,137,551	35,664,200	10,032,000
Sep. 11	18,918,000	4,179,178	2,954,347	7,133,525	3,497,525	3,026,550	2,021,760	34,597,360	9,752,000
Dec. 4	20,161,000	3,691,304	2,576,686	6,267,990	3,732,585	3,175,400	2,147,341	35,484,316	9,798,000
1848 Mar. 25	11,640,000	3,601,089	2,572,329	6,173,418	2,951,937	2,990,875	2,116,520	32,872,750	13,762,000
June 17	18,683,000	3,628,563	2,598,625	6,227,188	3,437,587	2,863,800	1,797,546	33,009,121	13,875,000
Sept. 9	19,134,000	3,482,809	2,471,710	5,954,519	3,021,307	2,583,825	1,683,307	32,376,958	13,740,000
Dec. 2	18,702,000	3,703,728	2,727,165	6,430,893	3,570,126	2,851,750	2,117,800	33,672,069	13,886,000
1849 Mar. 24	18,986,000	3,467,078	2,590,875	6,057,953	2,935,120	2,598,650	1,803,100	32,380,823	15,167,000
June 16	19,312,000	3,540,417	2,661,300	6,201,717	3,380,902	2,481,775	1,564,700	32,941,094	14,644,000
Sept. 8	19,520,000	3,327,758	2,457,526	5,785,284	3,053,322	2,308,575	1,502,870	32,170,051	14,789,000
Dec. 1	19,244,000	3,676,728	2,703,093	6,379,821	3,500,186	2,656,225	2,017,906	33,798,138	16,045,000
1850 Mar. 23	19,936,000	3,516,644	2,686,798	6,203,442	2,993,621	2,601,500	1,888,824	33,623,387	17,010,000
June 15	20,401,000	3,552,821	2,745,227	6,298,048	3,471,528	2,530,125	1,711,686	34,412,387	16,796,000
Sept. 7	20,949,000	3,412,011	2,611,505	6,023,516	3,173,784	2,438,700	1,715,279	34,300,279	16,857,000
Dec. 28	19,757,000	3,450,811	2,685,543	6,136,354	3,345,649	2,647,600	2,209,359	34,095,962	15,951,000
1851 Mar. 22	19,908,000	3,386,962	2,685,756	6,072,718	3,033,235	2,574,275	2,046,637	33,634,865	14,509,000
June 14	20,154,000	3,513,765	2,805,280	6,319,045	3,474,171	2,460,900	1,808,018	34,216,134	13,669,000
Sept. 6	21,018,000	3,219,275	2,569,918	5,789,193	3,125,691	2,252,350	1,719,907	33,905,141	14,097,000
Dec. 27	19,899,000	3,370,976	2,678,391	6,049,367	3,356,974	2,470,225	2,256,542	34,082,108	15,915,000
1852 Mar. 20	21,341,000	3,397,432	2,733,688	6,131,120	3,081,769	2,428,700	2,138,794	35,116,353	18,474,000
June 12	22,722,000	3,504,864	2,850,555	6,355,419	3,580,302	2,510,625	2,018,364	37,186,710	20,102,000
Sept. 4	24,157,000	3,406,593	2,764,442	6,171,035	3,334,198	2,505,875	2,002,826	38,170,934	21,838,000
Dec. 25	23,893,000	3,647,713	2,914,201	6,561,914	3,764,064	2,857,675	2,827,766	39,904,419	21,367,000
1853 Mar. 19	23,206,000	3,671,532	2,993,634	6,665,166	3,443,894	2,804,800	2,715,744	38,855,604	19,176,000
June 11	24,270,000	3,758,260	3,041,149	6,799,409	4,026,225	2,771,650	2,594,518	40,461,802	18,561,000
Sept. 3	24,296,000	3,648,294	2,984,629	6,632,923	3,728,890	2,693,250	2,537,137	39,888,200	17,813,000
Dec. 24	22,112,000	3,833,753	3,056,085	6,889,838	4,112,787	3,095,900	3,357,327	39,567,852	15,462,000
1854 Mar. 18	22,376,000	3,811,787	3,076,382	6,888,169	3,844,363	3,217,425	3,493,353	39,819,310	15,922,000
June 10	21,542,000	3,756,975	3,023,221	6,780,196	4,319,098	3,127,750	3,052,538	38,821,582	13,563,000
Sept. 2	21,100,000	3,485,046	2,853,908	6,338,954	3,867,441	2,869,125	2,708,286	36,883,806	13,619,000
Dec. 23	20,298,000	3,848,896	3,072,727	6,921,623	4,316,095	3,260,275	3,462,374	38,258,367	13,619,000
1855 Mar. 17	19,924,000	3,744,604	3,022,000	6,766,604	3,811,583	3,381,375	3,276,196	37,159,758	13,514,000
June 9	20,616,000	3,830,714	3,071,332	6,902,046	4,377,695	3,180,575	2,841,410	37,917,726	17,316,000
Sept. 1	21,227,000	3,605,892	2,900,971	6,506,863	3,963,833	2,936,875	2,657,687	37,292,258	15,719,000
Dec. 22	19,554,000	3,842,755	3,058,159	6,900,914	4,400,763	3,424,625	3,619,254	37,898,956	11,148,000
1856 Mar. 15	19,396,000	3,692,037	2,993,672	6,685,709	3,819,813	3,332,425	3,259,088	36,493,035	10,570,000
June 7	20,278,000	3,815,905	3,066,419	6,882,324	4,472,759	3,250,550	3,113,829	37,997,462	10,858,000
Sep. 27	20,850,000	3,669,837	3,048,232	6,718,069	4,002,666	3,132,475	3,254,236	37,957,446	12,055,000
Dec. 20	19,808,000	3,696,543	3,044,845	6,741,388	4,349,383	3,529,600	3,777,703	38,206,074	10,526,000
1857 Mar. 14	19,366,575	3,635,602	3,043,057	6,678,659	3,828,478	3,561,575	3,611,634	37,046,921	10,339,000

* This column does not (as it ought to have done) include the notes in the banking department of the Bank of England. The latter are given in Table No. IV.

Tables.

No. IV.—ACCOUNT of Bank of England Notes Issued in each Month of each Year from 1850 to 1856 inclusive, showing the Numbers held by the Public and by the Bank, with the Amounts of Bullion, Securities, and Deposits held by the latter; and showing, also, the Discounts and Advances made by the Bank, and the Rate of Interest.

	Bank Notes Issued.		Amount of Bullion.	Government Securities.	Other Securities.	Public Deposits.	Other Deposits.	Minimum Rate of Interest.	Discounts and Advances.
	Held by the Public.	Held in Reserve by the Bank.							
1850,	£	£	£	£	£	£	£	Per Cent.	£
Jan. 5	18,257,000	12,011,000	17,020,000	14,375,681	11,691,026	10,321,413	9,735,268	2½	4,938,000
... 19	19,333,000	10,731,000	16,816,000	14,296,554	9,848,040	5,599,761	11,070,694	"	3,113,000
Feb. 2	19,625,000	10,479,000	16,811,000	14,296,554	9,828,739	5,727,761	10,591,701	"	3,139,000
... 16	19,187,000	11,154,000	17,090,000	14,399,368	9,657,067	7,087,030	9,846,781	"	2,929,000
March 2	19,008,000	11,368,000	17,126,000	14,419,732	10,425,030	7,838,208	9,881,889	"	3,183,000
... 16	19,009,000	11,478,000	17,273,000	14,418,854	11,322,296	8,542,182	10,260,861	"	4,094,000
April 6	19,374,000	10,816,000	16,936,000	14,418,854	11,981,434	9,255,123	10,024,993	"	5,002,000
... 20	20,335,000	9,538,000	16,630,000	14,292,170	9,779,210	4,627,318	10,946,342	"	2,984,000
May 4	20,107,000	9,817,000	16,573,000	14,292,170	9,778,216	4,997,054	10,649,502	"	2,982,000
... 18	19,469,000	10,494,000	16,631,000	14,292,170	9,746,392	6,764,415	9,582,999	"	2,912,000
June 1	19,215,000	10,788,000	16,738,000	14,316,185	9,760,048	7,577,660	9,215,738	"	2,937,000
... 15	19,460,000	10,739,000	16,942,000	14,315,770	11,057,149	8,415,694	9,646,380	"	4,193,000
July 6	19,457,000	10,696,600	16,869,000	14,374,908	11,943,840	9,564,513	9,273,018	"	4,945,000
... 20	20,568,000	9,689,000	16,911,000	14,285,583	10,184,360	4,645,194	11,122,418	"	3,206,000
Aug. 3	20,714,000	9,477,000	16,822,000	14,285,583	10,139,611	5,480,874	9,976,414	"	3,186,000
... 17	19,827,000	10,377,000	16,854,000	14,430,847	10,534,408	7,261,305	9,569,322	"	3,633,000
Sept. 7	19,482,000	10,619,000	16,707,000	14,430,847	11,700,259	8,885,786	9,106,676	"	4,358,000
... 21	18,862,000	11,314,000	16,812,000	14,433,230	12,158,839	10,222,879	8,968,161	"	4,832,000
Oct. 5	19,304,000	10,527,000	16,452,000	14,443,637	13,389,578	10,652,937	8,899,290	"	6,078,000
... 19	20,140,000	9,304,000	16,015,000	14,228,901	10,772,545	6,284,496	9,550,613	"	3,635,000
Nov. 2	19,722,000	9,703,000	16,025,000	14,228,901	11,038,486	6,594,381	9,932,226	"	3,638,000
... 16	19,102,000	10,397,000	16,176,000	14,228,901	11,320,567	8,240,884	9,385,599	"	4,023,000
Dec. 7	18,707,000	10,642,000	15,942,000	14,228,901	12,722,488	9,775,399	9,511,556	"	5,435,000
... 21	18,496,000	10,234,000	15,359,000	14,233,252	13,762,797	10,783,808	9,201,634	"	6,420,000
1851,									
Jan. 4	19,037,000	9,236,000	14,830,000	14,232,319	15,181,698	10,796,555	9,480,319	3	7,860,000
... 18	19,947,000	7,971,000	14,526,000	14,150,256	12,619,768	5,847,019	10,517,783	"	5,337,000
Feb. 1	19,630,000	8,074,000	14,347,000	14,145,696	11,946,360	6,051,128	9,787,615	"	4,835,000
... 15	18,910,000	8,848,000	14,474,000	14,145,696	11,888,361	7,164,484	9,423,679	"	4,801,000
March 1	19,236,000	8,537,000	14,448,000	14,145,696	13,174,857	7,794,344	9,521,505	"	5,674,000
... 15	18,756,000	8,956,000	14,416,000	14,145,250	12,904,218	8,227,989	9,287,826	"	5,412,000
April 5	19,065,000	8,229,000	13,907,000	14,145,250	14,147,070	8,866,091	9,572,840	"	6,669,000
... 19	19,847,000	6,887,000	13,342,000	13,936,798	11,638,650	4,102,458	10,256,573	"	4,659,000
May 3	19,685,000	6,957,000	13,254,000	14,125,102	11,441,155	4,762,496	9,563,751	"	4,535,000
... 17	19,126,000	7,579,000	13,356,000	13,590,988	11,887,695	6,017,417	8,921,477	"	4,982,000
June 7	19,008,000	8,190,000	13,837,000	13,544,329	12,558,110	7,488,615	8,726,683	"	5,786,000
... 21	18,915,000	8,532,000	14,198,000	13,544,281	13,234,757	8,635,559	8,713,685	"	6,443,000
July 5	19,545,000	8,037,000	14,213,000	13,545,235	14,251,192	8,981,362	8,695,802	"	7,387,000
... 19	20,634,000	6,650,000	13,863,000	13,464,021	11,803,076	3,957,006	9,583,816	"	5,186,000
Aug. 2	20,346,000	6,922,000	13,895,000	13,464,021	11,800,143	4,758,458	9,002,461	"	5,207,000
... 16	20,132,000	7,412,000	14,177,000	13,464,216	12,698,000	6,393,552	8,617,141	"	6,105,000
Sept. 6	19,363,000	8,344,000	14,290,000	13,464,216	13,193,878	8,093,413	8,121,431	"	6,227,000
... 20	18,952,000	9,123,000	14,665,000	13,464,216	13,785,274	9,386,100	8,207,807	"	6,809,000
Oct. 4	19,458,000	8,958,000	14,991,000	13,464,216	14,624,018	9,655,588	7,556,950	"	7,551,000
... 18	20,676,000	7,782,000	15,055,000	13,241,768	13,083,883	5,396,169	10,339,401	"	6,109,000
Nov. 1	20,469,000	8,175,000	15,290,000	13,241,768	12,688,022	5,437,553	10,337,251	"	5,647,000
... 15	19,585,000	9,529,000	15,695,000	13,241,768	11,818,439	6,938,290	9,308,899	"	4,836,000
Dec. 6	18,855,000	11,048,000	16,519,000	13,241,768	11,547,043	8,077,344	9,539,188	"	4,570,000
... 20	18,676,000	12,142,000	17,414,000	13,244,220	11,366,148	9,202,522	9,360,449	"	4,384,000
1852,									
Jan. 3	19,285,000	11,707,000	17,558,000	13,290,972	12,214,222	9,447,516	9,371,117	2½	5,138,000
... 17	21,038,000	10,113,000	17,725,000	13,269,098	11,388,726	4,715,153	11,656,776	"	4,191,000
Feb. 7	20,348,000	11,364,000	18,282,000	13,420,923	11,181,921	5,263,972	12,128,638	"	3,997,000
... 21	20,188,000	12,229,000	18,948,000	13,550,532	10,979,880	6,392,181	11,916,013	"	3,744,000
March 6	20,237,000	12,660,000	19,410,000	13,565,323	11,602,383	6,902,929	12,124,056	"	3,588,000
... 20	19,980,000	13,196,000	19,746,000	13,567,593	11,722,150	7,520,393	12,300,704	"	3,493,000
April 3	20,687,000	12,397,000	19,597,000	13,567,593	11,720,843	7,687,708	11,191,626	"	3,464,000
... 17	22,056,000	11,024,000	19,560,000	13,395,779	11,086,331	3,365,285	13,906,918	"	3,272,000
May 1	21,832,000	11,586,000	19,901,000	13,338,023	11,022,332	3,194,817	14,365,920	2	3,261,000
... 15	21,670,000	12,149,000	20,305,000	13,451,657	10,765,581	4,265,675	13,686,289	"	3,166,000
June 5	21,685,000	12,667,000	20,839,000	14,174,572	10,697,573	6,119,961	13,030,750	"	2,976,000
... 19	21,437,000	13,516,000	21,435,000	13,874,526	10,868,650	6,856,819	13,030,979	"	3,160,000
July 3	22,241,000	13,534,000	22,197,000	13,873,545	11,773,967	7,647,476	12,968,501	"	4,032,000
... 17	23,748,000	11,911,000	21,989,000	13,979,616	10,671,902	3,077,870	14,715,088	"	2,991,000
Aug. 7	23,040,000	12,116,000	21,474,000	13,790,720	10,756,634	3,823,713	13,885,973	"	3,064,000

Tables. Tables.

	Bank Notes Issued.		Amount of Bullion.	Government Securities.	Other Securities.	Public Deposits.	Other Deposits.	Minimum Rate of Interest.	Discounts and Advances.
	Held by the Public.	Held in Reserve by the Bank.							
1852,	£	£	£	£	£	£	£	Per Cent.	£
Aug. 21	22,760,000	12,665,000	21,874,000	14,139,338	10,714,100	5,844,525	12,945,084	2	3,002,000
Sept. 4	22,811,000	12,543,000	21,853,000	14,189,182	11,100,487	6,667,129	12,136,546	”	2,901,000
... 18	21,953,000	13,202,000	21,867,000	14,189,182	11,325,130	8,010,476	11,919,586	”	3,166,000
Oct. 2	22,244,000	12,746,000	21,554,000	14,189,182	12,474,729	8,935,158	11,532,546	”	4,344,000
... 16	23,660,000	11,392,000	21,670,000	13,950,375	11,187,061	4,898,568	13,107,431	”	3,220,000
Nov. 6	23,351,000	11,242,000	20,895,000	13,950,375	11,362,535	5,040,143	12,653,673	”	3,298,000
... 20	22,671,000	12,127,000	21,322,000	13,962,688	11,605,603	6,661,061	12,414,448	”	3,531,000
Dec. 4	22,723,000	12,524,000	21,808,000	13,962,688	12,410,821	7,637,710	12,699,303	”	4,263,000
... 18	22,236,000	12,259,000	21,165,000	13,962,688	13,356,036	8,648,726	12,496,270	”	5,155,000
1853,									
Jan. 1	23,054,000	10,960,000	20,528,000	13,961,691	15,875,756	9,266,342	12,993,952	”	7,585,000
... 15	23,662,000	9,004,000	19,149,000	13,870,796	14,157,548	4,939,878	13,284,158	2½	5,679,000
Feb. 5	22,695,000	9,339,000	18,701,000	13,764,651	13,705,812	5,568,205	12,606,230	3	5,349,000
... 19	22,081,000	9,667,000	18,315,000	13,619,393	14,177,702	6,738,059	12,081,941	”	6,016,000
March 5	22,276,000	10,086,000	18,894,000	13,464,538	15,401,220	7,312,751	12,622,301	”	7,156,000
... 19	21,465,000	11,132,000	19,163,000	13,464,538	15,447,272	8,203,555	12,874,698	”	7,208,000
April 2	22,387,000	10,183,000	19,007,000	13,464,538	16,385,120	8,234,115	12,690,203	”	8,050,000
... 16	23,613,000	8,907,000	18,793,000	13,221,382	14,085,037	3,780,216	13,622,968	”	6,006,000
May 7	23,470,000	8,274,000	18,225,000	13,221,382	13,608,166	4,265,469	12,201,614	”	5,607,000
... 21	22,639,000	8,734,000	17,951,000	13,124,653	14,368,263	5,815,477	11,953,498	”	6,317,000
June 4	23,423,000	8,367,000	18,254,000	13,124,653	14,632,359	4,635,454	12,902,839	3½	6,909,000
... 18	22,696,000	9,420,000	18,636,090	13,123,910	13,700,971	4,615,831	13,174,519	”	5,985,000
July 2	22,848,000	9,204,000	18,554,000	13,116,997	14,372,331	5,615,362	12,504,620	”	6,737,000
... 16	23,888,000	7,662,000	18,023,000	13,757,333	13,064,310	2,332,814	13,422,004	”	5,345,000
Aug. 6	23,523,000	7,529,000	17,435,000	13,027,333	13,226,701	2,218,227	12,475,528	”	5,528,000
... 20	23,003,000	7,645,000	17,172,000	13,027,582	13,876,950	4,063,046	11,623,583	”	6,180,000
Sept. 3	22,466,000	7,697,000	16,500,000	12,773,176	14,546,194	4,701,598	11,017,313	4	6,384,000
... 17	22,422,000	6,977,000	15,862,000	12,527,893	16,740,682	6,007,833	11,053,973	4½	8,481,000
Oct. 1	22,773,000	6,259,000	15,613,000	12,339,083	19,124,799	6,738,755	11,885,565	5	10,881,000
... 15	23,667,000	5,013,000	15,271,000	12,455,161	17,425,089	3,700,859	12,664,226	”	9,435,000
Nov. 5	22,627,000	6,420,000	15,680,000	11,498,152	16,749,699	4,077,159	12,171,032	”	8,787,000
... 19	21,591,000	7,560,000	15,819,000	12,477,425	15,989,650	6,034,154	11,632,208	”	8,090,000
Dec. 3	21,206,000	7,201,000	15,093,000	13,622,039	16,586,818	7,659,924	11,480,162	”	8,687,000
... 17	20,606,000	8,124,000	15,443,000	15,043,730	16,237,015	10,492,686	10,699,684	”	8,308,000
1854,									
Jan. 7	21,348,000	7,801,000	15,831,000	14,833,299	16,736,409	8,291,993	12,744,634	”	8,830,000
... 21	22,272,000	7,135,000	16,096,000	13,537,638	14,297,849	2,646,783	13,894,599	”	6,438,000
Feb. 4	22,557,000	6,967,000	16,227,000	12,537,716	13,570,465	2,121,718	12,008,926	”	5,670,000
... 18	21,655,000	7,858,000	16,253,000	11,757,704	13,346,376	2,440,107	12,177,209	”	5,396,000
March 4	21,558,000	7,600,000	15,909,000	11,751,555	13,241,821	2,741,851	11,244,639	”	4,875,000
... 18	20,784,000	7,279,000	14,823,000	11,844,700	14,512,895	3,678,817	11,305,383	”	6,181,000
April 1	21,684,000	5,998,000	14,450,000	11,607,616	16,522,726	4,445,788	11,037,153	”	8,194,000
... 15	22,490,000	4,278,000	13,511,000	13,686,596	14,763,256	1,765,364	12,795,201	”	6,775,000
May 6	21,974,000	3,900,000	12,608,000	12,566,607	14,749,460	2,338,822	10,688,531	5	6,866,000
... 20	20,679,000	5,100,000	12,514,000	10,406,309	15,425,281	2,671,551	10,146,428	5½	7,530,000
June 3	20,540,000	5,467,000	12,750,000	9,856,309	15,494,525	2,557,654	10,212,244	”	7,672,000
... 17	19,700,000	6,673,000	13,109,000	9,720,499	15,374,237	3,212,382	10,513,491	”	7,585,000
July 1	20,099,000	7,385,000	14,216,000	10,332,795	16,750,401	5,315,198	11,119,344	”	9,064,000
... 15	20,683,000	6,403,000	13,824,000	12,470,237	14,234,926	3,207,955	11,655,973	”	6,615,000
Aug. 5	20,302,000	6,291,000	13,300,000	11,360,383	13,638,937	2,347,590	10,609,668	5	5,973,000
... 19	20,123,000	6,880,000	13,701,000	11,030,873	14,740,797	3,891,195	10,380,618	”	7,019,000
Sept. 2	19,852,000	6,836,000	13,368,000	10,980,029	15,178,013	3,996,427	10,402,859	”	6,910,000
... 16	19,583,000	7,049,000	13,279,000	10,996,955	15,353,432	4,985,233	9,780,712	”	6,965,000
Oct. 7	19,959,000	6,391,000	12,972,000	11,015,466	16,677,317	5,766,065	9,598,807	”	8,321,000
... 21	20,871,000	5,947,000	13,406,000	11,113,273	14,742,463	1,893,487	11,702,867	”	6,522,000
Nov. 4	20,604,000	6,366,000	13,525,000	11,524,492	14,155,089	2,858,100	10,932,023	”	6,025,000
... 18	19,828,000	7,024,000	13,495,000	11,429,871	13,850,566	4,465,918	9,685,004	”	5,802,000
Dec. 2	19,617,000	7,627,000	13,870,000	11,517,738	13,710,468	4,994,893	9,759,246	”	5,561,000
... 16	19,039,000	8,331,000	14,029,000	11,565,237	13,869,287	6,035,675	9,710,512	”	5,724,000
1855,									
Jan. 6	19,682,000	7,307,000	13,667,000	11,611,800	15,481,228	6,891,361	9,981,364	”	7,297,000
... 20	20,046,000	5,463,000	12,162,000	11,637,721	14,196,909	2,257,127	10,842,228	”	5,882,000
Feb. 3	19,826,000	6,266,000	12,800,000	11,538,652	14,590,176	3,740,512	10,583,727	”	6,325,000
... 17	19,246,000	7,067,000	12,981,000	11,538,227	14,584,340	4,898,602	10,174,871	”	6,351,000
March 3	19,098,000	7,415,000	13,190,000	11,626,463	15,012,782	5,033,184	10,607,057	”	6,354,000
... 17	18,984,000	8,496,000	14,201,000	11,583,885	14,521,596	5,077,843	11,155,862	”	5,887,000
April 7	19,812,000	8,580,000	15,079,000	13,026,749	13,655,995	6,008,895	11,396,875	4½	5,217,000
... 21	20,283,000	8,089,000	15,056,000	14,274,373	13,032,442	4,450,664	13,019,567	”	4,706,000
May 5	20,168,000	8,743,000	15,619,000	13,591,373	12,721,050	4,337,590	12,645,651	4	4,393,000

Tables. Tables.

	Bank Notes Issued.		Amount of Bullion.	Government Securities.	Other Securities.	Public Deposits.	Other Deposits.	Minimum Rate of Interest.	Discount and Advances.
	Held by the Public.	Held in Reserve by the Bank.							
1855,	£	£	£	£	£	£	£	Per Cent.	£
May 19	19,622,000	10,281,000	16,648,000	10,823,132	12,455,155	3,358,272	12,230,771	4	4,183,000
June 2	19,740,000	11,343,000	17,789,000	12,677,816	12,419,158	5,211,168	13,282,876	"	4,006,000
... 16	19,536,000	11,814,000	18,061,000	12,681,068	12,399,704	5,586,754	13,307,714	3½	3,849,000
July 7	20,483,000	10,412,000	17,584,000	13,757,224	13,328,806	6,852,350	12,586,891	"	4,856,000
... 21	20,773,000	9,208,000	16,644,000	13,071,978	12,706,108	3,178,033	13,604,199	"	4,002,000
Aug. 4	20,709,000	8,892,000	16,232,000	12,851,030	13,592,925	5,152,221	11,857,328	"	4,796,000
... 18	20,277,000	9,230,000	16,117,000	12,810,164	14,943,006	6,407,739	12,250,406	"	6,110,000
Sept. 1	20,105,000	8,263,000	14,939,000	13,031,088	15,661,985	7,267,969	11,098,018	"	6,464,000
... 15	19,713,000	7,397,000	13,698,000	12,799,368	17,388,784	7,838,531	11,146,762	4½	8,338,000
Oct. 6	20,292,000	5,473,000	12,279,000	11,413,143	19,791,293	7,106,524	10,837,643	5½	10,706,000
... 20	20,372,000	4,310,000	11,230,000	10,635,359	18,789,512	3,825,021	11,764,080	60 days and under, 6 per cent; above 60 and under 95 days, 7 per cent.	9,865,000
Nov. 3	20,097,000	4,644,000	11,300,000	10,201,276	18,355,548	3,369,984	11,694,200		9,409,000
... 17	19,422,000	5,240,000	11,263,000	10,124,848	17,787,150	4,110,130	10,886,746		8,974,000
Dec. 1	19,075,000	5,505,000	11,227,000	10,275,480	18,868,757	4,439,589	12,234,788		10,072,000
... 15	18,581,000	6,557,000	11,306,000	9,789,376	18,360,761	4,428,440	12,322,462		9,644,000
1856,									
Jan. 5	18,901,000	5,520,000	10,537,000	10,827,515	19,871,874	5,514,535	12,607,840		11,295,000
... 19	19,371,000	4,913,000	10,425,000	13,728,246	16,857,056	3,858,237	13,512,245		8,410,000
Feb. 2	19,122,000	5,412,000	10,706,000	12,092,361	18,216,497	3,782,879	13,807,258		9,929,000
... 16	18,724,000	5,644,000	10,532,000	11,931,006	17,743,632	4,164,823	12,964,125		9,500,000
March 1	18,935,000	5,493,000	10,600,000	11,451,006	19,490,762	4,083,033	13,918,279		10,830,000
... 15	18,493,000	5,885,000	10,554,000	11,451,006	19,285,028	5,506,124	12,650,535		10,659,000
April 5	19,445,000	4,470,000	10,057,000	11,871,778	19,711,720	6,010,439	11,510,329		11,108,000
... 19	20,015,000	3,669,000	9,876,000	13,117,833	15,929,363	2,958,753	11,907,623		7,699,000
May 3	20,226,000	3,431,000	9,807,000	13,755,083	15,446,266	3,871,799	10,806,090		7,268,000
... 17	19,537,000	4,137,000	9,802,000	12,479,416	16,710,812	2,991,956	12,351,097		8,568,000
June 7	19,579,000	5,953,000	11,688,000	11,682,126	14,333,806	3,297,127	10,734,513	5	6,197,000
... 21	19,323,000	6,915,000	12,418,000	11,276,155	14,411,854	4,132,110	10,602,674	"	6,271,000
July 5	19,947,000	6,552,000	12,611,000	11,308,515	15,527,912	4,817,074	10,470,957	4½	7,111,000
... 19	20,863,000	5,321,000	12,331,000	14,798,464	13,153,664	3,242,869	11,902,473	"	4,760,000
Aug. 2	20,476,000	5,795,000	12,433,000	12,483,045	14,186,000	3,677,416	10,581,413	"	5,790,000
... 16	20,079,000	6,201,000	12,456,000	12,010,078	15,270,195	4,668,218	10,560,407	"	6,872,000
Sept. 6	19,980,000	6,022,000	12,179,000	12,114,078	16,126,951	6,087,068	9,624,407	"	7,262,000
... 20	19,789,000	6,226,000	12,133,000	11,964,953	18,291,557	7,909,724	9,958,972	"	9,433,000
Oct. 4	20,926,000	3,776,000	10,784,000	11,464,278	21,582,464	7,759,499	10,323,552	5	12,746,000
... 18	21,155,000	2,551,000	9,760,000	11,103,896	19,054,088	4,040,590	10,481,220	"	10,336,000
Nov. 1	20,536,000	2,944,000	9,596,000	10,737,841	19,053,446	4,713,654	9,912,776	"	10,341,000
... 15	19,929,000	3,607,000	9,684,000	10,457,869	19,054,017	4,924,785	10,113,368	7	10,412,000
Dec. 6	19,195,000	5,151,000	10,486,000	10,640,867	17,389,715	5,870,709	9,297,193	6½	8,791,000
... 20	18,513,000	5,864,000	10,514,000	10,870,431	17,654,460	6,891,949	9,493,093	6	9,063,000

No. V.—ACCOUNT of the Joint-Stock Banks of England and Wales, with their Partners, Branches, Capital, and the Fixed Issues of such as issue Notes, &c.—(Abridged from the *Bankers' Almanac* for 1858).

Banks.	Date of Establishment.	Partners.	Paid-up Capital.	Branches.	Fixed Issues.
Ashton, Stalybridge, Hyde, and Glossop Bank	1836	152	£25,000	...	...
Bolton Bank	1836	115	64,940	...	...
London Bank	1855	400	300,000	1	...
Stockport Bank	1836	155	60,000	...	...
Westmoreland Bank	1833	121	21,400	...	£12,225
Whitehaven Bank	1837	125	50,000	1	32,681
Liverpool Bank	1831	395	625,000	...	...
Manchester Bank	1828	88	106,068	...	...
Barnsley Banking Company	1832	88	34,200	...	9,563
Bilston District Bank	1836	95	30,375	...	9,418
Birmingham Town and District Banking Company	1836	206	75,000	...	...
Birmingham Banking Company	1829	495	200,000	2	...
Birmingham and Midland Bank	1836	101	150,000	1	...
Bradford Commercial Bank	1833	140	47,550	...	20,084
Bradford Banking Company	1827	140	154,000	...	49,292
Bucks and Oxon Union Bank	1853	9	55,000	7	...
Burton, Uttoxeter, and Ashbourne Union Bank	1839	198	97,312	2	60,701
Bury Banking Company	1836	90	53,820	...	...
Carlisle City and District Bank	1837	237	58,000	1	19,972
Carlisle and Cumberland Banking Company	1836	221	51,925	2	25,610
Chesterfield and North Derbyshire Banking Company	1834	92	25,000	...	10,421
City Bank	1855	268	225,000	...	...

Banks.	Date of Establishment.	Partners.	Paid-up Capital.	Branches.	Fixed Issues.
Commercial Bank of London	1840	346	300,000	...	...
County of Gloucester Bank	1836	265	181,000	10	144,352
Coventry Banking Company	1836	114	56,000	1	16,251
„ and Warwickshire Banking Company	1835	126	76,000	...	28,734
Cumberland Banking Company	1829	153	60,000	5	35,395
Darlington District Banking Company	1831	220	...	5	26,134
Derby and Derbyshire Banking Company	1833	145	62,500	1	20,093
Devon and Cornwall Banking Company	1832	223	100,000	12	...
Dudley and West Bromwich Banking Company	1833	142	91,400	1	37,696
East of England Bank	1835	170	100,000	11	25,025
Glamorganshire Banking Company	1836	132	125,000	2	...
Gloucestershire Banking Company	1831	438	200,000	9	155,920
Halifax Commercial Banking Company	1836	102	61,700	...	13,733
„ Joint-Stock Banking Company	1829	135	75,000	...	18,534
„ and Huddersfield Union Banking Company	1836	260	170,000	1	44,137
Hampshire Banking Company	1834	156	100,000	6	...
Helston Banking Company	1836	10	...	...	1,503
Herefordshire Banking Company	1836	88	45,257	4	25,047
Huddersfield Banking Company	1827	229	140,000	2	37,354
Hull Banking Company	1833	220	Unknown.	3	29,333
Kingsbridge Joint-Stock Bank	1841	...	Unknown.	...	3,952
Knaresborough and Claro Banking Company	1831	104	Unknown.	7	28,059
Lancaster Banking Company	1826	221	125,000	3	64,311
Leamington Priors and Warwickshire Bank	1835	44	Unknown.	3	13,875
Leeds Banking Company	1832	231	110,100	...	23,076
Leicestershire Banking Company	1829	162	142,500	6	86,060
Lincoln and Lindsey Bank	1833	190	77,000	10	51,620
Liverpool Borough Bank*	1836	329	1,000,000	...	...
„ Commercial Banking Company	1832	237	326,400	...	...
„ Royal Bank	1836	200	650,000	...	...
„ Union Bank	1835	208	375,000	...	...
London and County Joint-Stock Banking Company	1836	850	500,000	64	...
„ Joint-Stock Bank	1836	...	600,000	1	...
„ and Westminster Bank	1834	...	1,000,000	6	...
Ludlow and Tenbury Banking Company	1840	11	Unknown.	...	10,215
Manchester and Salford Bank	1836	151	285,000	...	...
„ and Liverpool District Banking Company	1829	683	750,000	14	...
Nottinghamshire Banking Company	1836	182	82,224	...	35,813
National Provincial Bank of England	1833	1,067	600,000	78	442,371
Northamptonshire Banking Company	1836	267	60,000	3	26,401
„ Union Bank	1836	629	192,500	3	84,356
Northumberland and Durham District Bank	1836	408	652,891	8	...
North and South Wales Bank	1836	215	161,587	17	63,951
North Wilts Banking Company	1835	173	40,000	10	63,939
Nottingham and Nottinghamshire Banking Company	1834	245	203,500	5	29,477
Pares' Leicestershire Bank	1836	157	168,750	4	59,300
South Hants Banking Company	1839	60	Unknown.	1	...
Preston Banking Company	1844	3	100,000	3	...
Saddleworth Banking Company	1833	101	Unknown.	2	8,122
Sheffield Union Banking Company	1843	88	81,600	1	...
„ and Rotherham Banking Company	1836	215	121,231	3	52,496
„ Banking Company	1831	181	146,400	1	35,843
„ and Hallamshire Bank	1836	282	158,650	...	23,524
Shropshire Banking Company	1836	250	45,000	3	47,951
Stamford, Spalding, and Boston Bank	1832	About 70	Unknown.	7	55,721
Stourbridge and Kidderminster Bank	1834	136	100,000	3	56,830
Stuckey's Banking Company	1826	75	...	23	356,976
Swaledale and Wensleydale Banking Company	1836	204	53,400	3	54,372
Unity Joint-Stock Banking Association	1855	549	150,000	62	...
Union Bank of London	1839	930	600,000	3	...
„ of Manchester	1836	135	192,000	1	...
West Riding Union Bank	1832	460	Unknown.	2	34,029
Whitchurch and Ellesmere Banking Company	1840	32	Unknown.	1	7,475
Wakefield and Barnsley Union Bank	1832	92	40,000	1	14,604
Warwick and Leamington Banking Company	1834	44	32,800	4	37,124
West of England and South Wales District Bank	1834	732	498,925	15	83,535
Western Bank of London	1856	398	200,000	...	...
Whitehaven Bank	1829	220	42,375	1	31,916
Wilts and Dorset Banking Company	1835	251	100,000	23	76,162
Worcester City and County Bank	1840	60	30,000	1	6,848
Wolverhampton and Staffordshire Banking Company	1832	195	100,000	...	35,378
Yorkshire Banking Company	1843	260	144,964	13	122,532
York City and County Bank	1830	...	100,000	8	94,695
„ Union Banking Company	1833	166	99,000	4	71,240
Total Fixed Issues	...	...	...	...	£3,303,357

* This bank has stopped payments.

Tables.

No. VI.—AN ACCOUNT of the Average Amount of Bank Notes, of the Several Private Banks of Issue in England and Wales, in Circulation during the Weeks ending 8th of November 1856, and the 7th November 1857, with the Fixed Issues of said Banks.—(*From the London Gazette*).

Banks.	Average Amount, Nov. 8, 1856.	Average Amount, Nov. 7, 1857.	Authorised, or Fixed Issue.
	£	£	£
Andover Bank	13,627	10,931	17,751
Ashford Bank	13,277	10,733	11,849
Aylesbury Old Bank	32,829	27,533	48,461
Baldock and Biggleswade Bank	33,631	29,473	37,223
Barnstaple Bank	10,514	10,187	17,182
Basingstoke and Oldham Bank	21,443	22,038	24,730
Bedford Bank	32,511	32,205	34,218
Bewdley Bank	11,546	12,636	18,597
Bicester and Oxfordshire Bank	14,983	16,070	27,090
Birmingham Bank	22,943	23,450	23,695
Birmingham and Warwick Bank	9,998	9,354	18,132
Blandford Bank	6,094	6,401	9,723
Boston Bank	68,657	69,011	75,069
Boston Bank	14,892	15,263	15,161
Bridgewater Bank	7,546	7,244	10,028
Bristol Bank	33,823	33,619	48,277
Brosely and Bridegnorth Bank	19,628	19,584	26,717
Buckingham Bank	23,033	25,880	29,657
Bury, Suffolk, Sudbury, and Stowmarket Bk.	73,254	64,327	82,362
Banbury Bank	36,235	35,017	43,457
Banbury Old Bank	28,226	32,537	55,153
Bedfordshire Buzzard Bk.	36,194	34,308	36,829
Birmingham Bank	29,799	27,351	38,816
Bradford Old Bank	12,123	11,556	12,676
Brecon Old Bank	63,011	64,145	68,271
Brighton Union Bank	20,097	16,968	33,794
Burlington and Driffield Bank	12,594	12,474	12,745
Bury Saint Edmunds Bk.	...	2,393	3,201
Cambridge Bank	14,948	13,475	25,744
Cambridge and Cambridgeshire Bank	49,772	47,299	49,916
Canterbury Bank	28,604	32,051	33,671
Carmarthen Bank	23,859	24,606	23,597
Chertsey Bank	2,545	2,745	3,436
Colchester Bank	17,905	17,197	25,082
Colchester and Essex Bk.	36,410	38,596	48,704
Cornish Bank, Truro	47,146	45,490	49,869
Coventry Bank	7,618	6,634	12,045
City Bank, Exeter	21,342	19,880	21,527
Craven Bank	75,253	73,524	77,154
Chepstow Old Bank	9,383	8,519	9,387
Derby Bank	10,002	10,331	13,332
Derby Bank	40,828	37,315	41,304
Derby Old Bank	27,201	25,872	27,237
Devizes and Wiltshire Bk.	9,735	8,840	20,674
Diss Bank	10,330	10,385	10,657
Doncasterand Retford Bk.	73,087	69,664	77,400
Darlington Bank	84,999	82,698	86,218
Devonport Bank	9,315	9,276	10,664
Dorchester Old Bank	47,966	47,642	48,807
East Cornwall Bank	94,863	96,036	112,280
East Riding Bank	54,090	52,717	53,392
Essex and Stortford Bk.	46,156	41,794	69,637
Exeter Bank	27,552	25,312	37,894
Farringdon Bank	7,637	7,147	8,977
Farnham Bank	12,479	11,160	14,202
Faversham Bank	5,805	5,923	6,681
Godalming Bank	4,603	4,977	6,322
Guildford Bank	13,260	12,619	14,524
Grantham Bank	29,743	26,774	30,372
Hastings Old Bank	30,919	...	...
Carry forward	1,687,865	1,597,186	1,951,570

Banks.	Average Amount, Nov. 8, 1856.	Average Amount, Nov. 7, 1857.	Authorised, or Fixed Issue.
	£	£	£
Brought forward	1,687,865	1,597,186	1,951,570
Hereford City and County Bank	18,841	22,063	23,535
Huntingdon Town and County Bank	53,842	48,537	56,591
Harwich Bank	5,252	4,705	5,778
Hertfordshire, Hitchin Bk.	31,885	29,958	38,764
Hereford and Ross Bank	24,384	23,398	27,625
Ipswich Bank	21,497	20,996	21,901
Ipswich and Needham Bank, Suffolk and Hadleigh Bank	67,041	65,329	80,699
Kentish Bank	17,559	15,900	19,895
Kingston-upon-Hull Bk.	20,131	20,633	19,979
Kington and Radnor Bk.	25,956	25,927	26,050
Knaresborough Old Bank	21,459	21,472	21,825
Kendal Bank	45,366	44,251	44,663
Kettering Bank	8,839	...	...
Longton Staffordshire Bk.	5,259	5,140	5,624
Leeds Bank	52,435	52,358	53,357
Leeds Union Bank	36,694	36,921	37,459
Leicester Bank	31,028	30,030	32,322
Lewes Old Bank	28,988	19,776	44,836
Lincoln Bank	93,223	90,882	100,342
Llandovery Bank	31,739	29,805	32,945
Loughborough Bank	7,273	6,602	7,359
Lymington Bank	3,599	3,390	5,038
Lynn Regis and Lincoln Bank	40,894	38,860	42,817
Lynn Regis and Norfolk Bank	13,330	11,670	13,917
Macclesfield Bank	14,924	14,321	15,769
Manningtree Bank	2.995	1,545	7,690
Merionethshire Bank	9,710	10,632	10,902
Miners' Bank	17,764	17,874	18,688
Monmouth Agric. and Commercial Bank	28,112	29,028	29,335
Monmouth Old Bank	16,929	15,871	16,385
Newark Bank	27,398	22,693	28,788
Newark and Sleaford Bk.	51,293	50,670	51,615
Newbury Bank	19,404	19,277	36,787
Newmarket Bank	22,227	22,130	23,098
Norwich Crown Bank	48,200	48,776	49,671
Norwich and Norfolk Bk.	96,996	95,938	99,655
Nottingham and Notts Bk.	9,953	10,187	10,867
Nuneaton Bank	3,284	3,497	5,898
Naval Bank, Plymouth	19,003	21,548	27,321
New Sarum Bank	9,159	9,614	15,659
Nottingham Bank	32,805	31,487	31,047
Oswestry Bank	11,419	11,841	18,471
Oxford Old Bank	32,680	33,905	34,391
Old Bank, Tonbridge	11,916	7,755	13,183
Oxfordshire Witney Bank	11,360	9,615	11,852
Pease's Old Bank	47,879	46,056	48,807
Penzance Bank	10,836	10,599	11,405
Peterborough Bank	10,580	10,557	12,545
Pembrokeshire Bank	12,399	12,565	12,910
Reading Bank	32,190	27,951	37,519
Reading Bank	29,662	28,933	43,271
Richmond Bank	6,595	6,357	6,889
Rochdale Bank	4,403	4,471	5,590
Rochester and Strood Bk.	7,961	7,141	10,480
Royston Bank	14,490	11,790	16,393
Rugby Bank	8,313	9,446	17,250
Rye Bank	15,868	13,836	29,864
Ross Old Bank, Herefordshire	3,259	3,926	4,420
Saffron Walden Bank	29,073	29,006	47,646
Carry forward	3,114,918	2,976,577	3,610,508

Banks.	Average Amount, Nov. 8, 1856.	Average Amount, Nov. 7, 1857.	Authorised, or Fixed Issue.
	£	£	£
Brought forward	3,114,918	2,976,577	3,610,508
Salop Bank	15,396	14,425	22,338
Scarborough Old Bank	24,677	24,653	24,813
Shrewsbury Old Bank	39,797	40,562	43,191
Sittingbourne and Milton Bank	2,731	3,815	4,789
Southampton Town and County Bank	11,457	11,486	18,589
Southwell Bank	14,272	12,323	14,744
Southampton and Hampshire Bank	3,358	2,973	6,770
Stone Bank	340	...	9,154
Stafford Old Bank	11,912	13,333	14,166
Stamford and Rutland Bk.	31,044	29,932	31,858
Shrewsbury and Welsh Pool Bank	24,459	22,741	25,336
Taunton Bank	27,583	29,328	29,799
Tavistock Bank	10,415	8,910	13,421
Thornbury Bank	8,224	9,808	10,026
Tiverton and Devonshire Bank	10,820	12,863	13,470
Thrapston and Kettering Bank	11,497	11,188	11,559
Tring Bank, and Chesham Bank	12,995	13,274	13,531
Towcester Old Bank	7,544	7,760	10,801
Town and County of Poole Bank	11,413	8,513	11,856
Carry forward	3,394,852	3,254,464	3,940,719

Banks.	Average Amount, Nov. 8, 1856.	Average Amount, Nov. 7, 1857.	Authorised, or Fixed Issue.
	£	£	£
Brought forward	3,394,852	3,254,464	3,940,719
Union Bank, Cornwall	16,825	16,594	17,003
Uxbridge Old Bank	13,454	12,764	25,136
Wallingford Bank	7,753	7,233	17,064
Warwick and Warwickshire Bank	26,554	22,344	30,504
Wellington Somerset Bank	3,918	4,498	6,528
West Riding Bank	45,820	44,353	46,158
Whitby Old Bank	13,424	13,975	14,258
Winchester and Alton Bank	19,436	18,573	25,892
Weymouth Old Bank	15,549	16,161	16,461
Wirksworth and Ashbourne Bank	36,766	36,952	37,602
Wisbeach and Lincoln Bank	59,080	57,326	59,713
Wiveliscombe Bank	7,275	7,226	7,602
Wolverhampton Bank	12,742	10,640	14,180
Worcester Bank	5,624	6,242	15,463
Worcester Old Bank	68,872	74,294	87,448
Worcestershire Bank	7,772	...	...
Wolverhampton Bank	11,344	10,993	11,867
Yarmouth and Suffolk Bank	48,305	44,297	53,060
Yarmouth, Norfolk, and Suffolk Bank	12,747	12,168	13,229
York Bank	43,873	44,575	46,387
Totals	3,871,985	3,715,672	4,486,274

The amount of notes afloat varies from time to time, with the varying condition of the country, the state of credit, and so forth. It may, however, in ordinary years, be estimated as follows, viz.—

Issued by	Bank of England	£28,000,000
,,	Private banks in England	3,700,000
,,	Joint-stock banks in England	3,050,000
,,	Scotch banks	4,000,000
,,	Irish banks	7,000,000
	Total Issues	£45,750,000

Of this sum, from five to six millions is usually in the till of the banking department of the bank.

Sect. VII.—*Banks* (*Scotch*).

The Act of 1708, preventing more than six individuals from entering into a partnership for carrying on the business of banking, did not extend to Scotland. In consequence of this exemption, several banking companies, with numerous bodies of partners, have existed, for a lengthened period, in that part of the empire.

Bank of Scotland.

The Bank of Scotland was projected by Mr. John Holland, merchant, of London, and was established by Act of the Scotch Parliament (Will. III. Parl. 1, § 5) in 1695, by the name of the Governor and Company of the Bank of Scotland. Its original capital was £1,200,000 Scotch, or £100,000 sterling, distributed in shares of £1000 Scotch, or £83 : 6 : 8 sterling, each. The Act exempted the capital of the bank from all public burdens, and gave it the exclusive privilege of banking in Scotland for 21 years. The objects for which the bank was instituted, and its mode of management, were intended to be, and have been, in most respects, similar to those of the Bank of England. The responsibility of the shareholders is limited to the amount of their shares.

The capital of the bank was increased to £200,000 in 1744, and was enlarged by subsequent Acts of Parliament, the last of which (44 Geo. III. c. 23) was passed in 1804, to £1,500,000, its present amount. Of this sum £1,000,000 has been paid up. The last-mentioned Act directed that all sums relating to the affairs of the bank should henceforth be rated in sterling money; that the former mode of dividing bank stock by shares should be discontinued; and that, for the future, it should be transferable in sums or parcels of any amount. On the union of the two kingdoms in 1707, the Bank of Scotland undertook the recoinage, and effected the exchange of the currency in Scotland. It was also the organ of government in the issue of the new silver coinage in 1817.

The Bank of Scotland is the only Scotch bank constituted by Act of Parliament. It began to establish branches in 1696, and issued notes for one pound so early as 1704. The bank also began, at a very early period, to receive deposits on interest, and to grant credit on cash-accounts, a minute of the directors with respect to the mode of keeping the latter being dated so far back as 1729. It is, therefore, entitled to the credit of having introduced and set on foot the distinctive principles of the Scotch banking system, which, whatever may be its defects, is perhaps superior to most other systems hitherto established. Generally speaking, the Bank of Scotland has been cautiously and skilfully conducted; and there can be no doubt that it has been productive, both directly and as an example to other banking establishments, of much public utility and advantage.

It may be worth mentioning, that the Act of Will. III. establishing the Bank of Scotland, declared that all foreigners who became partners in the bank should, by doing so, become, to all intents and purposes, naturalised Scotchmen. After being for a long time forgotten, this clause was taken advantage of in 1818, when several

Money. aliens acquired property in the bank in order to secure the benefit of naturalisation. But after being suspended, the privilege was finally cancelled in 1822.

We subjoin an *official* abstract of the constitution and objects of the Bank of Scotland, printed for the use of the proprietors;—the terms and mode of transacting business are, of course, sometimes altered, according to circumstances.

I. The Bank of Scotland is a public national establishment; erected and regulated by the legislature alone: and expressly as a public bank in this kingdom; for the benefit of the nation, and for the advancement of agriculture, commerce, and manufactures; and for other objects of public policy.—(Will. Parl. 1, § 5; 14 Geo. III. c. 32; 24 Geo. III. c. 8; 32 Geo. III. c. 25; 34 Geo. III. c. 19; 44 Geo. III. c. 23.)

II. The statutory capital is at present £1,500,000 sterling. It is raised by voluntary subscription; and has been subscribed for. £1,000,000 has been called for, and paid in.—(44 Geo. III. c. 23.)

III. Subscribers, if not under obligations to the bank, may, at pleasure, transfer their right. If under obligation to the bank, the obligation must be previously liquidated; or the proceeds of the sale, at a price to the satisfaction of the directors, must be applied towards such liquidation. Transfers are made by a short assignment and acceptance thereof, both in a register appointed for that purpose. The expense, beside the government stamp, is 11s.—(Will. Parl. 1, § 5.)

IV. Bank of Scotland stock may be acquired, in any portions, by any person, community, or other lawful party whatsoever; without selection, exclusion, or limitation of numbers.—(Will. Parl. 1, § 5; 44 Geo. III. c. 23.)

V. Bank of Scotland stock may be conveyed by will, and, if specially mentioned, without expense of confirmation. It cannot be arrested: the holder's right may be adjudged. Dividends may be arrested.—(Will. Parl. 1, § 5.)

VI. The Bank of Scotland is a public corporation by Act of Parliament. The bank's transactions are distinct from those of the stockholders: and theirs from those of the bank.—(Will. Parl. 1, § 5.)

VII. The establishment is expressly debarred from any other business than that of banking.—(Will. Parl. 1, § 5.)

VIII. The management is vested, by statute, in a governor, deputy governor, twelve ordinary, and twelve extraordinary directors. They are chosen annually, on the last Tuesday of March, by the stockholders having £250 of stock or upwards. Those above £250, have a vote for every £250, to £5000, or 20 votes. No person can have more than 20 votes. The governor must hold, at least, £2000 of stock; the deputy governor £1500; and each director £750. They swear to be equal to all persons; and cannot hold any inferior office in the bank.—(Will. Parl. 1, § 5; 14 Geo. III. c. 32; 44 Geo. III. c. 23.)

IX. The executive part is conducted by a treasurer, secretary, and other public officers, all sworn. Those having the official charge of cash find due security.—(Will. Parl. 1, § 5.)

X. The board of directors sits for the general administration of the bank, at the bank's public head office in Edinburgh. The local business of that district is also conducted at that office. For the local business in the other parts of the kingdom, the bank has its regular public offices in the principal towns. At each of these offices there is the bank agent or cashier, who gives due security, and conducts the bank's business for that district in the manner after mentioned.—(Will. Parl. 1, § 5.)

XI. The bank takes in money at all its public offices, on deposit receipts or on current deposit accounts. At the head-office drafts on the branches, and at the branches drafts on the other branches and on the head-office are granted. Both at the head-office and branches drafts are granted on the London, Dublin, and English and Irish provincial correspondents of the bank. All receipts and drafts are on the bank's engraved forms, and bear to be granted "for the Bank of Scotland" or "for the Governor and Company of the Bank of Scotland." At the head office official documents are signed by the treasurer, and at the branches by the agents, and all are countersigned.

Remittances can be made to the principal colonial and continental towns; and bills, payable in the colonies, and in foreign countries, can be negotiated through the bank.—(*Resolution of Court*, 1793, *as since modified.*)

N.B.—The bank has always allowed interest on deposits, at a rate varying according to circumstances. At present (November 1857) it is 4 per cent. Money.

XII. Bills on London, Edinburgh, or any town in the United Kingdom, are discounted at all the bank's public offices. The bank's agents judge, in ordinary cases, of the bills presented; so that parties meet with no delay. The bank does not re-issue the bills which it has discounted.—(*Resolution of Court*, 23d Feb. 1789, *and Subsequent Modifications*).

XIII. Government stock and other public funds may be purchased or sold, and dividends thereon may be received through the Bank.

XIV. The bank gives credit on cash accounts at any of its offices, on bond, with security. The security may be personal co-obligants, or such other security as may be specially agreed on. Applications for cash accounts are given in to the office where the cash account is wanted, and must specify the credit desired, and the security proposed; and the individual partners, where copartneries are proposed. Cash accounts are granted by the directors only; and are not recalled unless by their special authority. It is understood that these credits are not used as dead loans, to produce interest only. In the fair course of business, the advantage of the bank is consulted by an active circulation of its notes, and by frequent repayments to it in a way least affecting that circulation.—(*Resolution of Court*, 6th Nov. 1729, and 23d Feb. 1789).

XV. The Bank's dividend has been for some time 8 per cent. per annum on its paid-up capital of £1,000,000 sterling. The dividends are paid regularly twice a year, without expense. They may be drawn either at the bank's head office, or at any of its other offices, as most agreeable to the stockholder.

The above may suffice as a general outline of the mode in which the business of banking is conducted in Scotland.

The *Royal Bank of Scotland* was established in 1727. Its original capital of £151,000 has been increased to £2,000,000.

The *British Linen Company* was incorporated in 1746, for the purpose, as its name implies, of undertaking the manufacture of linen. But the views in which it originated were speedily abandoned; and it became a banking company only. Its capital amounts to £1,000,000.

None of the other banking companies established in Scotland are chartered associations with limited responsibility, the partners being liable, to the whole extent of their fortunes, for the debts of the firms. Some of them, such as the Edinburgh and Glasgow Bank, the National Bank, the Western Bank, the Commercial Bank, &c., have very numerous bodies of partners. Their affairs are uniformly conducted by a Board of Directors, annually chosen by the shareholders.

The Bank of Scotland began, as already stated, to issue £1 notes so early as 1704; and their issue has since been continued without interruption. "In Scotland," to use the statement given in the Report of the Committee of the House of Commons of 1826, on the Promissory Notes of Scotland and Ireland, "the issue of promissory notes payable to the bearer on demand, for a sum of not less than 20s., has been at all times permitted by law; nor has any act been passed limiting the period for which such issue shall continue legal in that country."

All the Scotch banks receive deposits of so low a value as £10, and sometimes lower, and allow interest upon them. Deposits.

The interest allowed by the banks upon deposits varies, from time to time, according to the variations in the current rate of interest. At present (1857) it amounts to 4 per cent. And it has been estimated, by the best authorities, that the aggregate amount of the sums deposited with the Scotch banks was, previously to the late panic, little, if any thing, under £30,000,000.

Money.

The following TABLE exhibits an account of the different Scotch Banks, their Partners, Branches, Authorised Circulation, Actual Circulation, Coin, &c., in 1856 (from Oliver & Boyd's Almanac).

BANKS.	Instituted.	Partners.	Br.	Paid up Capital.	Authorised Circulation.	Average Circulation, 1855-56.	Coin, 1855-56.
	Years.			£	£	£	£
Bank of Scotland*	1695	645	35	1,000,000	300,485	397.388	177,295
Royal Bank*	1727	958	35	2,000,000	183,000	225,092	88,832
British Linen Co.*	1746	630	48	1,000,000	438,024	480,572	186,570
Commercial Bank*	1810	657	61	600,000	374,880	482,134	183,439
National Bank of Scotland*	1825	1453	49	1,000,000	297,024	336.407	87,628
Union Bank of Scotland	1829	930	73	1,000,000	415,690	530,569	175,262
Edinburgh & Glasgow Bank	1838	1575	23	1,000,000	136,657	163,697	54,138
Aberdeen Town & County Bank	1825	495	20	134,575	70,133	118,969	58,291
North of Scotland Banking Co.	1836	1437	30	200,000	154,319	214,306	89,422
Dundee Banking Co.	1763	79	1	60,000	33,451	41.240	14,587
Eastern Bank of Scotland	1838	400	4	121,140	33,636	41,973	16,295
Western Bank of Scotland†	1832	1280	98	1,500,000	337,938	482,501	265,938
Clydesdale Banking Co.	1838	1381	13	807,380	104,028	158,207	78,082
City of Glasgow Bank†	1839	1306	97	1,000,000	72,921	255,282	208,715
Caledonian Banking Co.	1838	803	10	125,000	53,434	69,450	32,126
Perth Banking Co.	1766	200	10	100,050	38,656	50,369	26,104
Central Bank of Scotland	1834	440	8	78,125	42,933	58,367	26,288

A witness, connected for many years with different banks in Scotland, and who had experience of their concerns at Stirling, Edinburgh, Perth, Aberdeen, and Glasgow, being examined by the Commons' Committee of 1826, stated that more than half the deposits in the banks with which he had been connected were in sums from ten pounds to two hundred pounds. Being asked what class of the community it is that makes the small deposits, he gave the following answer; from which it appears that the mode of conducting this branch of the banking business in Scotland has long given to that country most part of the benefits derivable from the establishment of savings banks.

"*Question.* What class of the community is it that makes the smallest deposits?—

"*Answer.* They are generally the labouring classes in towns like Glasgow: in country places like Perth and Aberdeen, it is from servants and fishermen, and that class of the community who save small sums from their earnings, till they come to be a bank deposit. There is now a facility for their placing money in the Provident Banks, which receive money till the deposit amounts to £10. When it comes to £10 it is equal to the minimum of a bank deposit. The system of banking in Scotland is an extension of the Provident Bank system. Half-yearly or yearly those depositors come to the bank, and add the savings of their labour, with the interest that has accrued upon the deposits from the previous half-year or year, to the principal; and in this way it goes on, without being at all reduced, accumulating (at compound interest) till the depositor is able either to buy or build a house, when it comes to be £100, or £200, or £300, or till he is able to commence business as a master in the line in which he has hitherto been a servant. A great part of the depositors of the bank are of that description, and a great part of the most thriving of our farmers and manufacturers have arisen from such beginnings."

Cash-accounts.

The loans or advances made by the Scotch banks are either in the shape of discounts, or upon cash-credits, or, as they are more commonly termed, *cash-accounts.*

A cash-credit is a credit given to an individual by a banking company for a limited sum, seldom under £100 or £200, upon his own security, and that of two or three individuals approved by the bank, who become sureties for its payment. The individual who has obtained such a credit is enabled to draw the whole sum, or any part of it, when he pleases, replacing it, or portions of it, according as he finds it convenient; interest being charged upon such part only as he draws out. "If a man borrows £5000 from a private hand, besides that it is not always to be found when required, he pays interest for it whether he be using it or not. His bank credit costs him nothing, except during the moment it is of service to him, and this circumstance is of equal advantage as if he had borrowed money at a much lower rate of interest." —(*Hume's Essay on the Balance of Trade.*) This, then, is plainly one of the most commodious forms in which advances can be made. Cash-credits are not, however, intended to be a *dead loan;* a main object of the banks in granting them is to get their notes circulated, and they do not grant them except to persons in business, or to those who are frequently drawing out and paying in money.

The system of cash-credits has been very well described in the Report of the Lords' Committee of 1826 on Scotch and Irish Banking. "There is also," say their Lordships, "one part of their system which is stated by all the witnesses (and, in the opinion of the Committee, very justly stated) to have had the best effects upon the people of *Scotland*, and particularly upon the middling and poorer classes of society, in producing and encouraging habits of frugality and industry. The practice referred to is that of cash-credits. Any person who applies to a bank for a cash-credit is called upon to produce two or more competent sureties, who are jointly bound; and, after a full inquiry into the character of the applicant, the nature of his business, and the sufficiency of his securities, he is allowed to open a credit, and to draw upon the bank for the whole of its amount, or for such part as his daily transactions may require. To the credit of the account he pays in such sums as he may not have occasion to use, and interest is charged or credited upon the daily balance, as the case may be. From the facility which these cash-credits give to all the small transactions of the country, and from the opportunities which they afford to persons who begin business with little or no capital but their character, to employ profitably the

* The capital of the Banks marked with an asterisk is not in shares, but in stock transferable to any amount.
† These banks stopped payments in November 1857. The latter, however, has resumed business.

minutest products of their industry, it cannot be doubted that the most important advantages are derived to the whole community. The advantage to the banks who give these cash-credits arises from the call which they continually produce for the issue of their paper, and from the opportunity which they afford for the profitable employment of part of their deposits. The banks are indeed so sensible that, in order to make this part of their business advantageous and secure, it is necessary that their cash-credits should (as they express it) be frequently operated upon, that they refuse to continue them unless this implied condition be fulfilled. The total amount of their cash-credits is stated by one witness to be £5,000,000, of which the average amount advanced by the banks may be one-third."

The expense of a bond for a cash-credit of £500 is 12*s.* 6*d.* stamp duty, and a charge of from 5*s.* to 10*s.* 6*d.* per cent. for preparing it.

Stability of the Scotch banks.

There have been, until lately, comparatively few failures among the Scotch banks. In 1793 and 1825, when so many of the English banks were swept off, there was not a single establishment in Scotland that gave way. This superior solidity appears to have been owing to various causes, partly to the banks having, for the most part, large bodies of partners, who, being conjointly and individually bound for the debts of the companies to which they belong, go far to render their ultimate security all but unquestionable; and partly to the facility afforded by the law of Scotland, of attaching a debtor's property, whether it consist of land or movables, and making it available for the payment of his debts. This last-mentioned circumstance was referred to as follows, in the report already alluded to.

"A creditor in Scotland is empowered to attach the real and heritable, as well as the personal estate of his debtor, for payment of personal debts, among which may be classed debts due by bills and promissory notes; and recourse may be had, for the purpose of procuring payment, to each description of property at the same time. Execution is not confined to the real property of a debtor merely during his life, but proceeds with equal effect upon that property after his decease.

"The law relating to the establishment of records gives ready means of procuring information with respect to the real and heritable estate of which any person in Scotland may be possessed. No purchase of an estate in that country is secure until the sasine (that is, the instrument certifying that actual delivery has been given) is put on record, nor is any mortgage effectual until the deed is in like manner recorded.

"In the case of conflicting pecuniary claims upon real property, the preference is not regulated by the date of the transaction, but *by the date of its record.* These records are accessible to all persons; and thus the public can with ease ascertain the effective means which a banking company possesses of discharging its obligations; and the partners in that company are enabled to determine, with tolerable accuracy, the degree of risk and responsibility to which the private property of each is exposed."

But, on the whole, we are inclined to think that the long familiarity of the inhabitants with banks and paper money, and the less risk that has attended the business of banking in Scotland, have been the principal causes of the greater stability of the Scotch banks. Latterly, however, owing to the rapid growth of Glasgow, Dundee, and other commercial towns, the risk attending banking in Scotland has materially increased. And while hazard has been augmenting on the one hand, there appears, on the other, to have been a still more rapid decrease of that cautious policy that was supposed to be a characteristic of Scotch bankers. In the recent crisis two of the principal Scotch banks, the head-quarters of which were in Glasgow, were compelled to stop payments. They had very large capitals, the Western Bank £1,500,000, and the City of Glasgow Bank £1,000,000, with a great many branches, large amounts of deposits, and very numerous and wealthy proprietary bodies. Had their management displayed anything like ordinary skill and prudence, they might have gone triumphantly through a far more serious trial. But it was characterised, especially that of the Western Bank,[1] by the most marvellous folly and recklessness. Having advanced immense sums to a few firms that never were entitled to any considerable credit, the Western Bank was so crippled that, for a lengthened period before their stoppage, they were reduced to the miserable expedient of sending up the bills they had discounted in Glasgow to be rediscounted in London; and when this resource failed them, and the other banks declined to come forward to their assistance, they had nothing for it but to shut their doors. On the affairs of the bank being investigated by a committee appointed for the purpose, it was found that they were in a much worse state than any one could have anticipated. Their entire losses are said to amount to the enormous sum of £2,020,584; so that, in addition to the capital and rest of the bank, making together £1,715,892, which have wholly disappeared, a further deficiency of £304,692 will have to be provided for! No such gigantic failure has ever occurred in Scotland; and it is not easy to imagine the misery of which it cannot fail to be productive.

Bankruptcy of the Western Bank.

Eventually, there can be no doubt that the creditors of the Western Bank will be fully paid, for the proprietary comprises some of the most opulent individuals in Scotland. Unhappily, however, it also comprises hundreds belonging to the middle and lower classes, who were tempted, by the dividend of 9 per cent., and the assurance of prosperity, to embark in the concern. And a loss that may be of little or no consequence to the former may send the latter to the workhouse.

The ruin in which the bank has been involved did not come suddenly upon it. On the contrary, it has been accumulating for years. And yet the directors took no steps, or none that were efficient, to arrest the progress of the evil; nor did they apprise their confiding constituents of the perilous condition into which the bank had got. Concealment was practised to the very last moment, till the concern was irretrievably sunk in the abyss of bankruptcy. It is much to be wished that directors who have so acted were really responsible for their conduct. No charge of corruption is brought against them; but their inattention to, and neglect of, the important interests committed to their charge, has been wholly inexcusable. They were bound, on undertaking the office of directors, to bestow unremitting care and diligence upon the performance of the duties which it imposed on them. They might neglect their own business; but they could not, without a flagrant breach of trust, neglect the duties they had undertaken to discharge on account of others. This, however, is precisely what they have done. They appear to have selected the most reckless and incompe-

[1] The management of the City of Glasgow Bank, though in many respects blameworthy, has been, as compared with that of the Western Bank, prudent and skilful. It has recommenced business; and it is to be hoped that its managers will profit by the lesson they have received.

Money. tent managers, and then to have given them *carte blanche*. Whatever such conduct may be in law, it is, morally and politically, in the highest degree culpable. Hundreds have been sent to the antipodes and the treadmill for offences that were comparatively innocuous. No doubt, however, the grand source of mismanagement in banks and other associations is to be found in the apathy of the shareholders, in the blind and often undeserved confidence they place in those who are, no matter how, at the head of their concerns. If those who may be ruined by the proceedings of their own officers and servants will not look after them, it were idle to attempt to throw such a duty upon others.

In a public point of view the stoppage of the Glasgow banks was productive of the very worst results. By creating a panic, and occasioning a heavy internal demand for gold, it may indeed be said to have been the main cause of the suspension of the Act of 1844.

£1 notes should be suppressed. The recent occurrences would seem to show that the time for the suppression of £1 notes in Scotland has arrived. The panic, which has had such mischievous results, principally prevailed among the smallest class of depositors and the holders of £1 notes. Everybody in the least degree familiar with money matters knew that, however the Western Bank might have been perverted and abused, its solvency could admit of no doubt. But such considerations could not be expected to influence the lower classes, who are the principal holders of £1 notes, and to whom large sums are due by the savings and other banks; and hence the run on the Western Bank, the City of Glasgow Bank, and on other banks whose character stood highest. It may be fairly presumed that if £1 notes be permitted to continue in circulation, the like results will take place on future occasions. And with a view to obviate their recurrence, and to strengthen the basis of the currency, sovereigns should be introduced instead of £1 notes. The change would occasion little, if any, immediate loss to the banks, and the increased security of which it would be productive would be as advantageous to them as it would be to the other classes of the community.

We also think that it would be good policy to make Bank of England notes legal tender in Scotland and Ireland as well as in England. This might occasionally be a convenience to all parties, and it would tend to familiarise the public in those parts of the empire to the use of Bank of England notes, which ought eventually to be the only notes in circulation.

Sect. VIII.—*Banking in Ireland.*

Banking in Ireland. "In no country, perhaps," says Sir Henry Parnell, "has the issuing of paper money been carried to such an injurious excess as in Ireland. A national bank was established in 1783, with similar privileges to those of the Bank of England, in respect to the restriction of more than six partners in a bank; and the injury that Ireland has sustained from the repeated failure of banks may be mainly attributed to this defective regulation. Had the trade of banking been left as free in Ireland as in Scotland, the want of paper-money that would have arisen with the progress of trade, would in all probability have been supplied by joint-stock companies, supported with large capitals, and governed by wise and effectual rules.

"In 1797, when the Bank of England suspended its payments, the same privilege was extended to Ireland; and after this period the issues of the Bank of Ireland were rapidly increased. In 1797, the amount of the notes of the Bank of Ireland in circulation was £621,917; in 1810, £2,266,471; and in 1814, £2,986,999.

"These increased issues led to corresponding increased issues by the private banks, of which the number was fifty in 1804. The consequence of this increase of paper was its great depreciation; the price of bullion and guineas arose to ten per cent. above the mint price; and the exchange with London became as high as eighteen per cent., the par being 8⅓. This unfavourable exchange was afterwards corrected, not by any reduction in the issues of the Bank of Ireland, but by the depreciation of the British currency in the year 1810, when the exchange between London and Dublin settled again at about par. (See Art. Exchange.)

"The loss that Ireland has sustained by the failure of banks may be described in a few words. It appears, by the Report of the Committee on Irish Exchanges in 1804, that there were, at that time, in Ireland fifty registered banks. Since that year a great many more have been established, but the whole have failed, one after the other, involving the country from time to time in immense distress, with the following exceptions:—*First*, a few that withdrew from business; *secondly*, four banks in Dublin; *thirdly*, three at Belfast; and, *lastly*, one at Mallow. These eight banks, with the new Provincial Bank and the Bank of Ireland, are the only banks now (1827) existing in Ireland.

"In 1821, in consequence of eleven banks having failed nearly at the same time, in the preceding year, in the south of Ireland, government succeeded in making an arrangement with the Bank of Ireland, by which joint-stock companies were allowed to be established at a distance of fifty miles (Irish) from Dublin, and the bank was permitted to increase its capital from 2½ to 3 millions sterling. The Act 1 and 2 Geo. IV. c. 72, was founded on this agreement. But ministers having omitted to repeal in this Act various restrictions on the trade of banking that had been imposed by 33 Geo. II. c. 14, no new company was formed. In 1824, a party of merchants of Belfast, wishing to establish a joint-stock company, petitioned Parliament for the repeal of this Act of Geo. II.; and an Act was accordingly past in that session, repealing some of its most objectionable restrictions. (5 Geo. IV. c. 73.)

"In consequence of this Act, the Northern Bank of Belfast was converted into a joint-stock company, with a (nominal) capital of £500,000, and commenced business on the 1st of January 1825. But the restrictions of 33 Geo. II., and certain provisions contained in the Acts 1 and 2 Geo. III., and 5 Geo. IV., obstructed its progress, and they found it necessary to apply to government to remove them; and a bill was accordingly introduced, which would have repealed all the obnoxious clauses of the 33 Geo. II., had it not been so altered in the committee as to leave several of them in force. In 1825 the Provincial Bank of Ireland commenced business with a (nominal) capital of £2,000,000; and the Bank of Ireland has of late established branches in all the principal towns."[1]

Since Sir Henry Parnell published the pamphlet from which we have taken the foregoing extract, several joint-stock banking companies have been founded in Ireland. The Provincial Bank, to which Sir Henry alludes, has a paid up capital of £540,000, and has been well and profitably managed. But others have been less fortunate. The Agricultural and Commercial Bank of Ireland, established in 1834, with 2170 partners, a paid-up capi-

[1] *Observations on Paper-Money*, &c., by Sir Henry Parnell, p. 171.

Money.

tal of £352,790, and many branches, stopped payment during the pressure in November 1836, and by doing so involved many persons in great distress. It appears to have been extremely ill-managed. The auditors appointed to examine into its affairs, reported that "Its book-keeping has been found to be so faulty, that we are convinced no accurate balance-sheet could at any time have been constructed." And they significantly added "the personal accounts at the head office require a diligent and searching revision."

The Tipperary Joint-Stock Bank, which was established in 1839, and stopped payments in 1855, appears to have been little, if at all, better than a mere swindling engine. Luckily it did not issue notes; and the sphere of its operations was not very extensive. But, so far as its influence went, nothing could be worse, being ruinous alike to the majority of its partners and the public.

The existing Irish joint-stock banks, amounting to seven, have been all established between 1824 and 1836. We borrow principally from Thom's *Irish Almanac*, the most valuable publication of its class, the following details with respect to the Irish banks in 1856:—

ACCOUNT of the Banks existing in Ireland in 1856, their Branches, Capital, Fixed Issues, &c.

Banks.	Instituted.	Partners.	No. of Branches.	Nominal Capital.	Capital paid up.	Reserved Fund.	Fixed Issues.
Bank of Ireland	1783	...	23	£3,000,000	£3,000,000	£1,040,000	£3,738,428
*Hibernian Joint-Stock Company, Dublin	1824	604	3	1,000,000	250,000	68,000	...
Provincial Bank of Ireland	1825	945	40	2,000,000	540,000	196,787	927,667
Northern Banking Company, Belfast	1825	230	12	500,000	150,000	59,778	243,440
Belfast Banking Company	1827	245	22	500,000	125,000	...	281,611
National Bank	1835	777	47	1,000,000	450,000	66,482	852,269
Ulster Banking Company, Belfast	1836	398	18	1,000,000	187,000	46,222	311,079
*Royal Bank, Dublin	1836	633	...	1,044,250	209,175	67,500	...

* Thus marked do not issue their own notes.

ANNUAL AVERAGE of the Returns of the several Banks of Issue in Ireland under the Provisions of the Act 8 and 9 Vic. c. 37, for the Years 1846 to 1856.

Years.	Certified Issue of all the Banks.	Notes of £5 and upwards.	Notes under £5.	Total Issue of all the Banks.	Gold held.	Silver held.	Total Specie held by all the Banks.
1846	£6,354,494	£3,121,259	£4,144,461	£7,265,721	£2,106,004	£334,258	£2,440,266
1847	6,354,494	2,844,049	2,986,375	5,830,425	1,263,517	491,953	1,755,475
1848	6,354,494	2,439,121	2,389,868	4,823,992	1,083,919	502,975	1,586,898
1849	6,354,494	2,204,474	2,105,802	4,310,283	1,089,476	528,783	1,541,094
1850	6,354,494	2,197,117	2,315,401	4,512,443	1,017,036	375,322	1,315,439
1851	6,354,494	2,113,077	2,349,870	4,462,909	937,408	318,574	1,255,985
1852	6,354,494	2,215,503	2,602,935	4,818,238	994,548	249,028	1,243,576
1853	6,354,494	2,517,570	3,132,883	5,650,455	1,393,867	182,729	1,576,600
1854	6,354,494	2,872,007	3,423,597	6,295,607	1,745,329	213,711	1,959,043
1855	6,354,494	3,046,460	3,315,833	6,362,303	1,777,110	232,078	2,009,496
1856	...	3,338,718	3,968,583	7,307,361	...	...	2,622,687

Sect. IX.—*Banks of Venice, Amsterdam, &c.*

It would far exceed our limits to enter into any detailed statements with respect to the banks and banking systems of foreign countries; we shall therefore confine ourselves to a brief notice of such banks as have been most celebrated, or are at present of the greatest importance.

Bank of Venice.

The Bank of Venice was the most ancient bank in Europe. Historians inform us that the republic being hard pressed for money, was obliged, upon three different occasions, in 1156, 1480, and 1510, to levy forced contributions upon the citizens, giving them in return perpetual[1] annuities at certain rates per cent. The annuities due under the forced loan of 1156, were, however, finally extinguished in the sixteenth century. And the offices for the payment of the annuities due under the other two loans having been consolidated, eventually became the Bank of Venice.[2] This might be effected as follows: The interest on the loan to government being paid punctually, every claim registered in the books of the office would be considered as a productive capital; and these claims, or the right of receiving the annuity accruing thereon, must soon have been transferred, by demise or cession, from one person to another. This practice would naturally suggest to holders of stock the simple and easy method of discharging their mutual debts by transfers on the office books, and as soon as they became sensible of the advantages to be derived from this method of accounting, bank-money was invented.

The Bank of Venice was essentially a deposit bank. Though established without a capital, its bills bore at all times an agio or premium above the current money of the republic. The invasion of the French in 1797 occasioned the ruin of this establishment.

Bank of Amsterdam.

The Bank of Amsterdam was founded in 1609, on strictly commercial principles and views, and not to afford any assistance, or to commix with the finances of the State. Amsterdam was then the great entrepôt of the commerce of the world, and of course the coins of all Europe passed current in it. Many of them, however, were so worn and defaced as to reduce their general average value to about nine per cent. less than their mint value; and, in consequence, the new coins were immediately melted down and exported. The currency of the city was thus exposed to great fluctuations; and it was chiefly to remedy this inconvenience, and to fix the value or par of the current money of the country,

1 The annuities on the forced loan of 1480, were to be suspended during periods of war.

2 Cleirac, Du *Negoce, de la Banque*, &c.—(Bordeaux, 1656), pp. 112-117, a scarce and valuable volume.

Money.

that the merchants of Amsterdam established a "bank," on the model of that of Venice. Its first capital was formed of Spanish ducats or ducatoons, a silver coin which Spain had struck in the war with Holland, and with which the tide of commerce had enriched the country it was formed to overthrow. The bank afterwards accepted the coins of all countries, worn or new, at their intrinsic value, and made its own bank-money payable in standard coin of the country, of full weight, deducting a "brassage" for the expense of coinage, and giving a credit on its books, or "bank-money," for the deposits.

The Bank of Amsterdam professed not to lend out any part of the specie enstrusted to its keeping, but to retain in its coffers all that was inscribed on its books. In 1672, when Louis XIV. penetrated to Utrecht, almost every one who had an account with the bank demanded his deposit, and these were paid off so readily, that no suspicion could exist as to the fidelity of the administration. Many of the coins then brought forth bore marks of the conflagration which happened at the Hôtel de Ville, soon after the establishment of the bank. This good faith was maintained till about the middle of last century, when the managers secretly lent part of their bullion to the East India Company and Government. The usual "oaths of office" were taken by a religious magistracy, or rather by the magistracy of a religious community, that all was safe; and the good people of Holland believed, as an article of their creed, that every florin which circulated as bank-money, had its metallic constituent in the treasury of the bank, sealed up, and secured by oaths, honesty, and good policy. This blind confidence was dissipated in December 1790, by a declaration that the bank would retain ten per cent. of all deposits, and would return none of a less amount than 2500 florins.

Even this was submitted to and forgiven. But, four years afterwards, on the invasion of the French, the bank was obliged to declare that it had advanced to the States of Holland and West Friesland, and the East India Company, more than 10,500,000 florins, which sum they were, of course, unable to make up to their depositors, to whom, however, they assigned their claims on the States and the company. Bank-money, which previously bore an agio of five per cent., immediately fell to sixteen per cent. below current money.

This epoch marked the fall of an institution which had long enjoyed an unlimited credit, and had rendered the greatest services. The amount of treasure in the vaults of the bank, in 1775, was estimated by Mr Hope at 33,000,000 florins.[1]

Bank of Hamburgh.

The Bank of Hamburgh was established in 1619, on the model of that of Amsterdam. It is purely a deposit bank for the transfer of sums from the account of one individual to that of another. It receives no deposits in coin, but only in bullion of a certain degree of fineness. Down to 1845, it charged itself with the bullion at the rate of 442 schillings the mark, and issued it at the rate of 444 schillings, being a charge of four-ninths, or nearly one-half per cent., for its retention; but since that date, it receives and issues bullion at the same rate, charging one per mille for its expenses. It advances money on jewels to three-fourths of their value. The city is answerable for all pledges deposited with the bank: they may be sold by auction if they remain one year and six weeks without any interest being paid. If the value be not claimed within three years, it is forfeited to the poor. This bank is universally admitted to be very well managed.

Sect. X.—*The Bank of France,*

Money.

Bank of France.

Which is second only in magnitude and importance to the Bank of England, was originally founded in 1800, but was not placed on a solid and well defined basis till 1806. Her capital, which was originally fixed at 45,000,000 fr., was raised in the last mentioned year to 90,000,000 fr., divided into 90,000 shares or *actions*, of 1000 fr. each. Of these shares, 67,900 have passed into the hands of the public, the remaining 22,100 having been purchased up by the bank, out of her surplus profits, were subsequently cancelled. Hence her capital amounted, down to 1848, to 67,900,000 fr. (£2,716,000), with a reserve fund, first of 10,000,000 fr., and more recently of 12,980,750 fr. Since 1806 the bank has enjoyed the privilege of being the only institution in Paris entitled to issue notes payable on demand; and, as will be afterwards seen, she is now the only authorised issuer of such paper in France. Her charter and exclusive privileges have been prolonged and varied by laws passed at different periods; according to existing arrangements they are not terminable till 1897.

The bank has established, at different periods, between 1817 and 1856, offices or branches (*succursales*) in different parts of the country. They are managed nearly in the same way as the parent establishment; but their operations have been on a comparatively small scale. These are exclusive of the departmental banks united, as will be immediately seen, to the bank in 1848.

Notwithstanding the skill and caution with which her affairs have generally been conducted, the Revolution of 1848 brought the bank into a situation of extreme danger. She had to make large advances to the provisional government and the city of Paris. And these circumstances, combined with the distrust that was universally prevalent, occasioned so severe a drain upon her for gold, that to prevent the total exhaustion of her coffers, she was authorised, by a decree of the 16th March 1848, to suspend cash payments, her notes being at the same time made legal tender. But to prevent the abuse that might otherwise have taken place under the suspension, the maximum amount of her issues was fixed at 350 millions. She was then also authorised to reduce the value of her notes from 500 fr. to 200 and 100 fr.

Previously to 1848, joint-stock banks, on the model of that of Paris, and issuing notes, had been established in Lyons, Marseilles, Bordeaux, Rouen, and other large cities. And it was then determined that these banks should be incorporated with the Bank of France, and made branches of the latter. This was effected by decrees issued on the 27th April and 2d May 1848, by which the shareholders of the banks referred to (nine in number) were allowed, for every 1000 fr. nominal value of their shares, a share of 1000 fr. nominal value of the stock of the Bank of France. And, in consequence of this measure, 23,351 new shares, representing a capital of 23,351,000 fr., were added to the stock of the Bank of France, making the latter consist of 91,250,000 fr., divided into 91,250 shares. In 1851, the bank resumed, and has since continued specie payments.

The suppression of the local issues of the departmental banks was, no doubt, a judicious measure, and was indispensable, indeed, to secure the equal value of the paper circulating in different parts of the country. This, however, might have been effected by the mere stoppage of the issues of the departmental banks, without consolidating them with the Bank of France. The latter measure is one of which the policy is very questionable; and

[1] Storch, *Cours d'Economie Politique*, tom. iv. p. 102.

there are, as already seen, good grounds for thinking that the banking business of the departments would have been more likely to be well conducted by local associations, than by branches of the Bank of France.

Owing to the peculiar circumstances of the last few years, occasioned partly by the war with Russia, but more by the rage for speculation and the drain for silver to the east, the Bank of France has been exposed to considerable difficulties. And in the view of strengthening her position, and also, it may be presumed, of providing a loan for government, a law has been recently passed (9th June 1857), by which the capital of the bank has been doubled. Previously to this law, her capital amounted, as already seen, to 91,250 shares of 1000 fr. each; whereas it now consists of 182,500 shares of 1000 fr. each. The new shares were assigned to the existing proprietors at the rate of 1100 fr. per share, producing a total sum of 100,370,000 fr., of which 100 millions have been lent to government at 3 per cent. Hence the measure, though it has added to the credit and security of the bank, has not made any addition to the means directly at her disposal.

Down to the passing of this law, the bank could not raise the rate of interest on loans and discounts above six per cent. But this impolitic restriction is now removed, and the bank may charge any rate of interest which she reckons expedient, except upon advances to government, the maximum interest on which is limited to 3 per cent. The bank has been farther authorised to issue notes of the value of 50 fr., to make advances on railway shares, &c., and the charter has been extended to 1897.

The bank is obliged to open a *compte courant* for any one who requires it, and performs services, for those who have such accounts, similar to those performed for their customers by the banks in London. She does not charge any commission on current accounts, so that her only remuneration arises from the use of the money placed in her hands by the individuals whose payments she makes. It is probable, therefore, as has been alleged, that this part of her business is but little profitable. The bank also discounts bills with three signatures, at variable dates; but not having more than three months or ninety days to run. In 1855, the aggregate amount of these discounts in Paris and the departments, amounted to the very large sum of 3,262,000,000 frs., the interest being five per cent. till the 18th of October, and afterwards 6 per cent. Besides discounting bills, the bank makes advances on stocks and pledges of various kinds, and undertakes the care of valuable articles, such as plate, jewels, title-deeds, &c., at a charge of ⅛ per cent. on the value of the deposit, for every period of six months and under. Nothing can show more clearly the petty retail character of the trade of Paris, and generally of France, than the smallness of the value of the bills discounted by the bank. Thus, of 963,000 bills discounted in 1847, the average amount was only £55 : 4s., and of these no fewer than 126,000 were for less than 200 frs. (£8), and 470,000 for less than 1000 frs. (£20), each! (Tooke and Newmarch *On Prices*, vi. 51.)

The administration of the bank is vested in a council of twenty-one members, viz., a governor and two sub-governors, nominated by the Emperor; and fifteen directors and three censors, nominated by the shareholders. The bank has a large surplus capital or rest. In 1855 and 1856 she divided no less than 200 and 272 fr. profits on each share; but these have much exceeded the dividends in any previous year. In 1848 the dividends only amounted to 75 frs. per share. In July 1856, the 1000 fr. share of bank-stock was worth 4075 frs.; in July 1857, it had sunk to 2880 frs. Her intimate connection with the government is decidedly the most objectionable feature in the constitution of the Bank of France.

PARTICULARS in the Condition of the Bank of France, including its Branches and the Departmental Banks, from 1846 to 1856, both inclusive, viz.:—

Years.	Notes in Circulation.	Amount of Discounts.	Bullion in Coffers of Bank. Gold.	Silver.	Total.	Dividend per Share.	Highest Price of Share.
1846 .	262,190,000 fr.	1,618,957,841 fr.	6,800,000 fr.	94,282,000 fr.	101,082,000 fr.	159 fr.	3,505 fr.
1847 .	241,140,000 „	1,808,246,438 „	440,000 „	169,060,000 „	169,500,000 „	177 „	3,600 „
1848 .	409,120,000 „	1,643,728,634 „	4,700,000 „	248,600,000 „	253,300,000 „	75 „	3,230 „
1849 .	431,022,000 „	1,025,666,213 „	4,600,000 „	429,270,000 „	433,370,000 „	106 „	2,500 „
1850 .	481,552,000 „	1,176,423,896 „	11,980,000 „	446,840,000 „	458,820,000 „	101 „	2,425 „
1851 .	583,040,000 „	1,241,412,880 „	82,260,000 „	486,460,000 „	568,720,000 „	105 „	2,650 „
1852 .	689,910,000 „	1,824,469,438 „	68,936,000 „	434,974,000 „	503,910,000 „	118 „	3,108 „
1853 .	644,280,000 „	2,842,930,205 „	103,598,000 „	219,482,000 „	323,080,000 „	154 „	2,950 „
1854 .	636,970,000 „	2,944,643,591 „	193,937,000 „	198,723,000 „	392,660,000 „	194 „	3,000 „
1855 .	612,237,000 „	3,762,000,000 „	99,000,000 „	100,000,000 „	199,000,000 „	200 „	3,300 „
1856 .	612,332,000 „	4,674,000,000 „	81,000,000 „	109,900,000 „	190,000,000 „	272 „	4,075 „ July.

THE NOTES of the Bank of France in Circulation from 1848 to 1856, both inclusive, have been as follows, viz.:—

Years.	Notes of 5000 francs.	Notes of 1000 francs.	Notes of 500 francs.	Notes of 200 francs.	Notes of 100 francs.[1]	Total of Circulation.
1848	1,120,000	210,000,000	72,000,000	55,000,000	71,000,000	409,120,000 francs.
1849	1,145,000	270,050,000	68,330,000	49,075,000	42,422,000	431,022,000 „
1850	530,000	287,868,000	89,174,000	57,318,000	46,632,000	481,552,000 „
1851	120,000	372,051,000	90,198,000	53,890,000	66,781,000	583,040,000 „
1852	490,000	428,012,000	96,053,000	84,663,000	78,167,000	689,910,000 „
1853	290,000	419,232,000	87,003,000	74,767,000	62,988,000	644,280,000 „
1854	90,000	403,649,000	76,707,000	79,221,000	75,303,000	636,970,000 „
1855	120,000	381,991,000	72,744,000	74,747,000	80,416,000	[2]612,237,000 „
1856	50,000	371,505,000	69,954,000	72,704,000	95,927,000	[3]612,332,000 „

[1] Notes for 50 fr. were not issued till this year, 1857. [2] Comprises 2,219,000 fr. old notes. [3] Comprises 2,102,000 fr. old notes.

Money.

Sect. XI.—*Banking in the United States.*

Banking in United States.

It has been the uniform practice of the different States of the Union to allow banks to be established for the issue of notes, payable in specie on demand. In cases where the liability of shareholders in banks was to be limited to the amount of their shares, they had, previously to 1838, to be established by Acts of the local legislatures. But, in general, these were easily obtained; and down to a comparatively late period, it may be said that banking was quite free; and that, practically, all individuals or associations might issue notes, provided they abided by the rules laid down for their guidance, and engaged to pay them when presented.

Under this system, the changes in the amount and value of the paper currency of the United States have been greater than in any other country; and it has produced an unprecedented amount of bankruptcy and ruin.

Between 1811 and 1820, about 195 banks, in different parts of the Union, became bankrupt; and it is said, in a report by the Secretary of the Treasury of the United States, dated 12th May 1820, that these failures, which mostly happened in 1814 and 1819, produced a state of distress so general and severe, that few examples of the like had then occurred.

But bad as this instance was, it was nothing to that which took place subsequently to 1834. The accounts of the aggregate issues of the banks differ a little; but the following statement is believed to be very nearly accurate, viz,—

Years.	Notes.
1830	$66,628,898
1834	94,839,570
1835	103,692,495
1836	140,310,638
1837	149,185,890

Now observe, that this sudden and enormous increase took place under the obligation, which we are told is quite enough to prevent all abuse, of paying notes on demand. The result was, what most men of sense must have anticipated, viz., that a revulsion took place, and that every bank within the Union, without, it is believed, a single exception, stopped payment in 1837.

In 1838 such of the banks as had been best managed, and had the largest capitals, resumed payment in specie. But in 1839 and 1840, a farther crash took place. And the bank-notes afloat, which, as has been seen, amounted to $149,185,890 in 1837, sunk to $83,734,000 in 1842, and to $58,563,000 in 1843. It is supposed that in this latter crash nearly 180 banks, including the Bank of the United States, were totally destroyed. And the loss occasioned, by the depreciation which it caused in the value of stocks of all kinds, and of all sorts of property, was quite enormous. And yet, vast as that loss was, it was really trifling, as a writer in the American Almanack has stated, compared with "the injury resulting to society from the upheaving it occasioned of the elements of social order, and the utter demoralization of men by the irresistible temptation to speculation which it afforded, ending in swindling to retain ill-gotten riches."

The evils of the American system have been aggravated by the lowness of the notes which most banks have issued. This brings them into the hands of retail traders, labourers, and others in the humbler walks of life, who always suffer severely by the failure of a bank.

Money.

Since 1838 and 1842, various measures have been taken in nearly all the States, but principally in New York, to restrain the free action of the banks, and to prevent a repetition of the calamities referred to.

In New York, for example, the banks have been divided into two great classes—the incorporated and the free banks. The former, which are incorporated by a State law, have to conform to certain regulations, and have to contribute a half per cent. annually upon their capital to a security fund, which is devoted to the payment of the notes of defaulting banks. But this is a most objectionable plan; for, in the first place, it does not prevent bankruptcies; and, in the second place, it compels the well-managed banks to contribute to a fund which goes to pay the debts of those that are mismanaged. It has consequently declined in favour, and is now rarely acted upon.

In the other, or free banking system, all individuals or associations who choose to deposit securities (minimum amount $100,000) for their payment, are allowed to issue an equal amount of notes. And this is certainly by far the more efficient as well as the most popular of the two plans. But it is objectionable, because, 1st, A longer or shorter, but always a considerable, period necessarily elapses after a bank stops before its notes can be retired; and, 2d, Because the securities lodged for the notes are necessarily at all times of uncertain and fluctuating value; while, in periods of panic or general distrust, they become all but inconvertible. The Sub-secretary of the Treasury of the United States has animadverted as follows on this plan, in a letter dated 27th Nov. 1854:—

"The policy of many of the State governments has of late years consisted in encouraging the issue of small notes, by sanctioning the establishment of what are popularly called 'free banks,' with deposits of stocks and mortgages for the 'ultimate' security of their issues. This 'ultimate' security is, it may be admitted, better than no security at all The mischief is, that it is least available when most wanted. The very causes which prevent the banks from redeeming their issues promptly, cause a fall in the value of the stocks and mortgages on 'the ultimate security' of which their notes have been issued. The 'ultimate security' may avail something to the broker who buys them at a discount, and can hold them for months or years; but the labouring man who has notes of these 'State security banks' in his possession, finds, when they stop payment, that 'the ultimate security' for their redemption does not prevent his losing twenty-five cents, fifty cents, or even seventy-five cents in the dollar.

"In a circulating medium we want something more than 'ultimate security.' We want also 'immediate' security; we want security that is good to-day, and will be good to-morrow, and the next day, and for ever thereafter. This security is found in gold and silver, and in these only."[1]

It appears from the Report of the Superintendent of Banking for the State of New York for 1856, that the securities he then held in trust amounted to $39,359,071, which were almost wholly lodged by banking associations and individual bankers.

During the year the securities held in trust for the under-mentioned banks that had become insolvent in 1855 were disposed of. But the sums realised by their sale did

[1] The above statements are taken from a paper read by Lord Overstone to the late Committee on Banks.

Money. not in any case suffice to pay the notes at par, while a period, varying from two to four years, would have to elapse before the affairs of the insolvent banks will be finally settled. Money.

Names of Banks that failed.	Notes redeemed.	Rates of Redemption.	Time for Redemption will expire.
Eighth Avenue Bank............................	All........................	94 cents.	May 21, 1861
Farmers' Bank, Onondaga........................	All........................	85 cents.	Nov. 12, 1859
James' Bank....................................	All........................	91 cents.	June 17, 1858
Merchants and Mechanics' Bank, Oswego......	All........................	77 cents.	Sept. 28, 1860
New Rochelle, Bank of..........................	Stock notes.............	Par.......	June 17, 1858
New Rochelle, Bank of..........................	Stock and estate notes	81 cents.	June 17, 1858

This statement sets the defective nature of the security system, as administered in New York, in the clearest point of view. It might, no doubt, be improved by increasing the proportion of securities to notes. But, owing to the variety of securities that are taken (viz., all manner of bonds and mortgages, state, canal, and railway stocks, &c. &c.), and the uncertainty of their value, a great deal of risk is always incurred in accepting them, and they can never form a proper foundation on which to issue notes.

But, however desirable, it would, we fear, be visionary to expect that local issues should be suppressed in America, or that her paper currency should be placed on a really sound foundation. But it may, nevertheless, be easily and greatly improved. And, perhaps, this would be best effected by suppressing low notes, or those for less than twenty dollars, and increasing the proportion of securities to issues. The rules on which so much stress is laid, in most parts of America, for making the issues of banks depend on the magnitude of their capitals, or the amount of specie in their vaults, are really of no use whatever. They may be and have been eluded and defeated in a thousand ways, and serve only to make the public look for protection to what is altogether impotent and worthless for any good purpose.

The following table from Hunt's Commercial Magazine for March 1857, gives an account of the number and condition of the banks of the United States, as officially reported, in certain years from 1834 to 1856.

Table of the Secretary of the Treasury, showing the Number of Banks and Branches, with their Capitals, Discounts, Specie, Circulation, and Deposits, in the Union, in the following years from 1834 to 1856. The last line gives the position of the Banks near January 1, 1856:—

Years.	Banks.	Capital.	Discounts.	Specie.	Circulation.	Deposits.
		Dollars.	Dollars.	Dollars.	Dollars.	Dollars.
1834.........	506	200,005,944	324,119,499	26,641,753	94,839,570	75,666,986
1836.........	713	251,875,292	457,506,080	40,019,594	140,301,038	115,104,440
1837.........	788	270,772,091	525,115,702	37,915,340	149,185,890	127,397,185
1843.........	691	228,861,948	254,544,937	33,515,806	58,563,608	56,168,628
1848	751	204,833,175	344,476,582	46,369,765	128,500,091	103,226,177
1851.........	879	227,807,553	413,756,799	48,671,048	155,165,251	128,957,712
1854.........	1,208	301,376,071	557,397,779	59,410,253	204,689,207	188,188,744
1855.........	1,307	332,177,288	576,144,758	53,944,545	186,952,223	190,400,342
1856.........	1,398	343,874,272	634,183,280	59,314,063	195,747,950	212,705,662

Since writing the above, another crash has taken place, and *all* the banks in the Union, from the Gulph of Mexico to the frontiers of Canada, have again stopped payments!

This new crash affords, had that been necessary, a fresh and striking illustration of the truth of the principles we have endeavoured to establish in the course of this treatise; and it may be expected to awaken, if that be possible, the American people to a proper sense of the enormous abuses connected with their banking system; and the necessity of placing it on an entirely new foundation.

The above account shows that there had been a rapid increase of discounts since 1851, and that increase was especially great in 1856, and went on augmenting down to August last (1857). On the 8th of that month, the discounts and advances by the New York banks, amounted to \$122,077,252, the deposits in their possession being, at the same time, \$94,436,417. This was the maximum of both. On the 24th of August, the Ohio Life and Trust Company, which carried on an extensive banking business in New York, stopped payments; and by so doing gave a severe shock to credit and confidence, which the suspension of two or three more banks turned into a panic. Notes being in a certain degree secured, the run upon the banks was principally for deposits. And to meet it they so reduced their discounts and advances, that on the 17th October, they amounted to only \$97,245,826. This sudden and violent contraction necessarily occasioned the suspension of many of those mercantile houses that had depended on the banks for discounts. And it did this without stopping the drain for deposits, which had sunk on the 17th October to \$52,894,623, being a decrease of \$41,546,784 in about two months. The universal stoppage of the banks was a consequence of these proceedings.

There seems to be no doubt that improvident advances on the part of the banks, and overtrading, were the main causes of the crisis. And it is important to observe that it is stated in the Bankers' Magazine for November 1857 (p. 430), and other works of authority published in New York, that the improvidence referred to was, in part at least, occasioned by the too high interest allowed at New York on deposits on current accounts, or at call. This

made the opulent bankers and capitalists in the Western States keep large balances at New York; and it tempted, and in some degree obliged, the bankers and money-dealers in the latter to make advances on questionable security, for the sake of the high interest payable on them. A system of this sort may be truly said to force capital into the hands of the least deserving, and to be a prolific source of wild speculation and overtrading. And whenever any serious check is given in any quarter of the Union to the process of inflation, the consequences are sure to be in the last degree disastrous: for, the greater number of the banks being very ill supplied with specie, they can resist no serious demand upon them either for payment of notes or deposits; and when one or a few stop, a panic is generated, which involves even the best managed banks in the common ruin.

A tendency to panics is, in fact, one of the peculiarities of the American system. Owing to the liability of the partners in banks being limited, the depositors in them, and the holders of notes not issued upon securities, having nothing to trust to, make all imaginable haste, when their suspicions are awakened, to save themselves by withdrawing their deposits, and cashing their notes. And hence the rapidity with which panics spread throughout the Union: and, we may add, that the slowness with which they are disseminated in this country, arises from the contrary circumstances, from the confidence placed by the public in the unlimited obligation of the partners to make good all demands.

In the city of New York, the action of the foreign exchanges compels the banks to have always on hand a very considerable amount of specie. But the reader will hardly believe with what a small stock of coin the banks in the country parts of that state, and generally throughout the Union, contrive to carry on their business. In illustration of this statement, we may mention, that in June last (1857), the fifty-six banks in the city of New York are reported in the official returns to have had $8,000,000 notes in circulation, with an aggregate amount of no less than $12,000,000 specie in their coffers. But at the same time that the city banks were in this situation, the circulation of the 255 country banks then existing in the state is returned at $24,000,000, and their specie at only $1,200,000, being only $\frac{1}{20}$th part of their notes afloat. And as these returns give only average results, it follows that, while some of the banks would have more, others would have proportionally less specie than this medium rate.

A notion, indeed, would appear to be gaining ground among the banks, in some parts of the States, that when they have given security for their issues, they have done quite enough, and that they may dispense with the troublesome obligation to pay them on demand. It appears, for example, that in the moral and religious state of Massachusetts, there were, on the 7th July 1856, no fewer than 135 banks (excluding those in Boston), which had $6,601,130 of deposits, and notes in circulation amounting to $13,106,068, while their specie on hand amounted to only $1,092,463, or about $\frac{1}{12}$th part of the circulation. And in other parts of the Union the stock of bullion was still more scanty. Thus, in Illinois, on the 6th of July 1857, the State Bank, with notes afloat to the amount of $725,000, had, to meet all demands, $61,000 in specie in her coffers; while the Grayville Bank, with a circulation of $471,556, was provided with a supply of $18,951, in specie, and the Raleigh Bank, with a circulation amounting to $248,000, had a specie fund of no less than $1000! It may be supposed, perhaps, that this would be the minimum amount of specie, but no. For some banks (such as the Bank of the Commonwealth, with notes afloat to the extent of $84,915) were honest enough to admit that they had a considerable circulation without being encumbered with a single dollar!

It is evident that a banking system of this sort has no better foundation than a house of cards. It is sure to fall to pieces at the first touch. The grand object of by far the greater number of the bankers is to get their notes into circulation; and as these are often issued for very small sums, cost nothing, and at the same time yield some 8, 10, or 12 per cent., or more, of interest, we need not wonder at the eagerness with which they pursue this object, or at their success, or the abuses to which it leads. The discount of bills at distant dates, and their renewal, make part of the system.

The security system followed in New York, even were it generally adopted, affords no guarantee against these evils. Instead of preventing, it really tends to encourage over-issue, and it is impotent to insure a proper supply of bullion. All that it contemplates is the ultimate payment of the notes; but it does not prevent the bankruptcy of those by whom they are issued, and we have seen that it does not even accomplish that ultimate payment which it has exclusively in view. The whole system is rotten to the core; and unhappily, too, it is deeply injurious to all those with whom the Americans have any dealings, as well as to themselves.

We are glad to be able to corroborate our views of these matters by the high authority of the President of the United States. Mr. Buchanan, in his message to Congress, delivered on the 8th December 1857, makes the following conclusive statement:—"The first duty which banks owe to the public is to keep in their vaults a sufficient amount of gold and silver to insure the convertibility of their notes into coin at all times and under all circumstances. No bank ought ever to be chartered without such restrictions on its business as to secure this result. All other restrictions are comparatively vain. This is the only true touchstone—the only efficient regulator of a paper currency—the only one which can guard the public against over-issues and bank suspensions. As a collateral and eventual security it is doubtless wise, and in all cases ought to be required, that banks shall hold an amount of United States' or State securities equal to their notes in circulation, and pledged for their redemption. This, however, furnishes no adequate security against over-issues. On the contrary, it may be perverted to inflate the currency; indeed it is possible by this means to convert all the debts of the United States and State governments into bank-notes, without reference to the specie required to redeem them. However valuable these securities may be in themselves, they cannot be converted into gold and silver at the moment of pressure, as our experience teaches, in sufficient time to prevent bank suspensions and the depreciation of bank-notes."

To show the worthlessness of the returns published by the American banks, we may state that they continue, down to the latest advices (December 1857), to represent the capital of the New York banks as quite unimpaired, and as large as it had been twelve months ago! But everybody knows that it is impossible such should be the case. A very large proportion, not less, perhaps, than from a third part to a half or more of the capital of the banks, must have been lost by the late bankruptcies in that city, and by the depreciation of the stocks held by the banks.

It is truly stated by Mr. Buchanan, in the message now referred to, "that it is easy to account for our financial history for the last forty years. It has been a history of

extravagant expansions in the business of the country, followed by ruinous contractions. At successive intervals the best and most enterprising men have been tempted to their ruin by excessive bank loans of mere paper credit, exciting them to extravagant importations of foreign goods, wild speculations, and ruinous and demoralizing stock gambling. When the crisis arrives, as arrive it must, the banks can extend no relief to the people. In a vain struggle to redeem their liabilities in specie, they are compelled to contract their loans and their issues; and at last, in the hour of distress, when their assistance is most needed, they and their debtors together sink into insolvency."

We have already seen that the real value of our exports to the United States in 1856 amounted to £21,476,000. But we have been too much in the habit of estimating our commercial prosperity by the magnitude of the exports, which is a most fallacious criterion. We have heard it stated by well-informed parties, and we believe the statement to be true, that but for the extreme inflation of the banking and credit system of the United States, the imports from England during last year would not have exceeded 15 or 16 millions; and that those from France and other countries would have been reduced in something like the same proportion. And, had such been the case, production here would not have been unnaturally stimulated, and a fair profit would have been obtained from our exports, whereas they will now entail a large and most serious loss.

Besides the bankruptcy and ruin that periodically arise from such a system, it is at all times productive of the greatest inconvenience and trouble. Where there are so many separate and independent banks (about 1400), the sphere of the influence and circulation of each is necessarily circumscribed; and when notes get to any considerable distance from the place where they are issued, especially when they get into a different State, they circulate with difficulty, and generally at a discount. But this is not the only evil by which their circulation is attended. Banks are every now and then suspending payments, or getting into discredit. And lists are regularly published of such defaulting or suspected banks, and of the rates of discount at which their notes are current, without which no traveller can leave his house, and no shopkeeper can venture to transact any business. It is truly astonishing, seeing the extreme inconvenience resulting from such a state of things, that it should be tolerated even for a week. If the general government be not sufficiently strong to suppress local issues, and to substitute in their stead a national paper issued on deposits of bullion, the public may, if they choose, rid themselves of the evil, by refusing to accept payment otherwise than in coin. The banking interest is, however, so very powerful, and embraces so great a number of individuals, that we doubt whether, even with the co-operation of the general government, the time has yet arrived for anything effectual being done for the amendment of the system. But the longer it exists, the more intolerable will it become; and in the end, no doubt, it will be suppressed. It forms, at present, the most gigantic abuse by which an intelligent people ever permitted themselves to be disgraced and oppressed. (J. R. M.)

MONFLANQUIN, a town of France, in the department of Lot-et-Garonne, is situated on a hill near the left bank of the Lède, 25 miles N. of Agen. The town is well built, but the streets are narrow, crooked, steep, and ill paved. Wine and fruits are produced in abundance in the neighbourhood. Pop. 5075.

MONGE, GASPAR, the inventor of descriptive geometry, was born at Beaune in 1746. He received his education at the college of the Oratory in his native town, and at a superior school in Lyons. His talent for mathematics gained for him a place as modeller at the age of nineteen in the school founded at Mézières for the instruction of engineers. From this obscure position, however, he soon raised himself by the discovery of a new and easy method of making the calculations of an operation of deployment or defiling, which had been prescribed him as a task. Bossut, who professed mathematics at Mézières, now appointed Monge his assistant; and he was attached, in the same capacity, to Abbé Nollet, professor of natural philosophy, whom he soon afterwards succeeded in that chair. In this situation he made a number of curious experiments on gas, molecular attraction, and the effects of optics and electricity, as well as refined deductions on meteorology, and on the important discovery of the production of water by the combustion of inflammable air; in which, however, he had been anticipated by Cavendish without being aware of it. About the same time Monge extended and generalized his first mathematical essays, and setting out from the principle which refers to the three rectangular co-ordinates the position of any point whatever taken in space, he made it the foundation of a new and fruitful doctrine, indispensable for all the arts of construction, and to which, when completed by successive developments, he applied the name of Descriptive Geometry. More than twenty years elapsed, however, before he succeeded in obtaining the application of his geometry to the tracings of carpentry.

Through the interest of D'Alembert, Monge was received into the Academy of Sciences in 1780, and was soon after made professor of physics in the Lyceum of Paris.

Like many others, he was at first led away by the promises and hopes of the Revolution; but the terrible events that followed in such rapid succession in some measure dissipated this illusion, which he shared in common with so many others. He was made a member of the Executive Council, but resigned this irksome post in 1793. When the Committee of Public Safety made an appeal to the savans to assist in producing the *matériel* requisite for the defence of the republic, Monge applied himself wholly to these operations, and distinguished himself by his indefatigable activity. It was at this time he composed his *Art de fabriquer les Canons*, and his *Avis aux Ouvriers en Fer, sur la Fabrication de l'Acier*.

At length Monge published his *Géométrie Descriptive*, which he had so long kept secret, and which unquestionably forms his highest title to distinction. Of all the applications of which his geometry was susceptible, he has only treated of five,—viz., carpentry, stone-cutting, deployment, linear and aërial perspective, and the distribution of light and shadow. To him also France was in a great measure indebted for the establishment of the Polytechnic School. After visiting Italy on an artistic mission, Monge accompanied Napoleon to Egypt, where he was indefatigable in his scientific researches, and in his endeavours to provide for the wants of the army after the naval defeat of Aboukir.

On his return, Monge became president of the Egyptian Commission, and was again placed at the head of the Polytechnic School. On the formation of the Senate he was appointed a member of that body, with an ample provision and the title of Count of Pelusium; but on the fall of Napoleon he was deprived of all his honours. He died on the 28th of July 1818.

The separate publications of Monge are:—*Traité Elé-*

mentaire de Statique, Paris, 1786, in 8vo; *Description de l'Art de fabriquer les Canons*, Paris, 1795, in 4to; *Leçons de Géométrie Descriptive*, Paris, 1813, in 8vo; *Application de l'Analyse à la Géométrie des Surfaces du Premier et du Deuxième Degré*, Paris, 1809, in 4to. Monge likewise inserted four memoirs on Pure Analysis in the *Collection des Savants Etrangers de l'Académie des Sciences de Paris* (tomes vii., ix., and x.) His name also figures amongst the contributors to the *Dictionnaire de Physique* of the *Encyclopédie Méthodique*; and the *Annales de Chimie* contain several memoirs written by him. (J. B-E.)

MONGHIR, a British district of Hindustan, in the presidency of Bengal, bounded on the N. and E. by Bhaugulpore, on the S.W. by Ramghur and Behar, on the W. by Behar and Patna, and on the N.W. by Tirhoot. It lies between Lat. 24. 20. and 26. 1. N., and Long. 85. 40. and 86. 50. E. The district has an area of 2558 square miles, and a population estimated at 800,000. It is intersected by numerous rivers, the principal of which are the Ganges, the Sukree, the Kiyul, the Bhagmuttee, and the Gogaree. The district was acquired by the East India Company in 1765 by virtue of the firman of Shah Allum, Emperor of Delhi, granting to them the dewanny of Bengal, Behar, and Orissa. The town of Monghir is situated on the southern bank of the Ganges. It was the residence of Sultan Sujah during his government of the Bengal province, and was strengthened by him during his rebellion against his father, Shah Jehan. The fortifications have been for many years quite neglected, and the only part which remains is a small citadel, containing an arsenal and store-rooms. It is still surrounded by a wall and deep ditch, and is a place of considerable antiquity. It was an object of contention between the kings of Behar and Bengal in the early part of the sixteenth century. In 1762 it was the residence of Cossim Aly Khan, and was taken by the British the following year. The travelling distance from Calcutta is 300 miles.

MONGOLIA, an extensive district in the interior of Asia, forming part of the Chinese empire, and bounded on the N. by Siberia, E. by Mandchooria, S. by China proper, and W. by the Chinese province of Kansoo and the government of Thianshan Peloo. It lies between 38. and 52. N. Lat. and between 87. and 124. E. Long., having a length of about 1500 miles, a breadth in the central part of about 900, and an area estimated at 1,200,000 square miles. This vast territory consists of an elevated plain, bounded on the S. by the mountains of Nanshan, and on the N. by the Altai range. The centre of the plain is occupied by the Great Gobi Desert, which extends across the country from S.E. to N.W., and is estimated to contain an area of 300,000 square miles. It is covered with sand and stones, and the vegetation, except in a few oases, is very stunted and scanty. In the N., however, the surface of Mongolia becomes more mountainous, and rises in some places to a considerable height. The principal ranges in this region are offshoots from the Altais, which extend eastwards, under various names, till they reach the basin of the Amoor. On the S. the Alashan ridge, a continuation of the Nanshan, enters Mongolia, and after stretching northwards for about 400 miles, extends in an easterly direction, under the name of Inshan, for about 600 miles more. The ridge then turns north-eastwards, when it assumes the name of Khing-Khan, and continues in this direction till the Altais or Nertshinsk Mountains are reached about 120. E. Long. Its highest summit, the peak of Petsha, situated in about 43. N. Lat., is said to attain the height of 15,000 feet above the sea-level. The country which lies to the S. of the Inshan Mountains for the most part resembles in its character the Gobi Desert, and is covered with sandy hills, almost entirely destitute of vegetation and water. It is inhabited by a tribe of Mongols called Ortoos, who attend almost exclusively to the rearing of sheep, which find subsistence on the patches or oases of pasture-land that here and there occur. Of a similar nature, but less covered with sand-hills, is Kortshin, a district of Mongolia which lies to the E. of the Khing-Khan range. The country on the N.W. side of the Great Gobi is almost totally unknown. That, however, through which the caravan road to Siberia passes is said to be hilly, with level tracts of meadow land, and, though thinly wooded, is not destitute of water. There are no great rivers in Mongolia, although its table-land gives rise to many large streams which water other lands. The principal of these are the Hoangho in the S., the Kerulun and Toro, tributaries of the Amoor, on the N.E.; and the Selenga and Orchan, affluents of Lake Baikal, on the N.; besides some small streams in the interior, which lose themselves in stagnant lakes, or sink into the sand. Almost the entire extent of Mongolia is elevated more than 3000 feet above the sea, and the climate in consequence is extremely cold in winter. The weather, however, is subject to great and sudden changes, and in summer the heat is often insupportable from the want of any shelter from the rays of the sun. The principal animals of Mongolia are bears, boars, wolves, foxes, hares, wild horses, goats, cranes, quails, swans, &c. The inhabitants of Mongolia belong to that great family of races known by the name of Mongolian. They are middle-sized, strong, and muscular, with a dark-yellow complexion, broad faces, flat noses, and prominent ears. They have very little beard, and shave the hair of the head, with the exception of a single tuft. This race consists of two branches; the Proper or Eastern Mongols, who inhabit the country called Mongolia; and the Kalmucks, or Western Mongols. The former of these nations is divided into three sub-branches;—the Tshakhars, Khalkhas, and Sunnits. The first of these inhabit the country between the Gobi on the N. and the wall of China on the S.; the desert itself is occupied by the Sunnits, who are the least numerous of the three; and the Khalkhas dwell in the N. of Mongolia. They are all nomads, dwelling in tents, and pursuing pastoral occupations. Large herds of camels, horses, and sheep are reared by them, and oxen, asses, and mules by those on the frontiers of China. They are divided into twenty-six tribes, each of which is governed by a hereditary chief; with the exception of the Khalkhas, who form only one tribe, and are governed by four chiefs called *khans*. A sort of feudal system prevails in Mongolia; the princes pay a tribute to the Chinese Emperor, and the people are bound to military service between the ages of eighteen and sixty. The Chinese *Li-fanyuen*, or tribunal of foreign affairs, exercises jurisdiction over the Mongolians; and under it are one civil and two military governments. A considerable trade is carried on through Mongolia, between China and Russia, by means of caravans. The principal imports are furs, woollen stuffs, and leather; while the articles exported to Russia consist of teas, silk and cotton goods, rhubarb, sugar-candy, &c. The seat of this trade is at the towns of Kiakhta in Siberia and Mae-mae-chin in Mongolia, which are situated at a short distance from each other, on each side of the boundary between the two countries. Free intercourse is allowed between the inhabitants of the two towns during the day, but by night the gates are shut, and all communication is cut off. The trade generally continues from October till the end of winter, and is carried on solely by barter, the use of money being forbidden. Previous to the twelfth century of the Christian era, the Mongolians do not seem to have been united under one empire, or known by a common name; but under Gengis Khan, who was born in 1163, these tribes became important and received from him the name of *Kœkœ Monghoël*, or "Celestial People." Gengis Khan, after having raised himself, and the tribe to

which he belonged, to the head of the whole Mongolian race, conquered China, Persia, and the whole of Central Asia, and carried devastation and terror into Europe as far as the boundaries of Poland. He was succeeded by his son Oktai, under whom the empire continued to be enlarged; but it was soon afterwards split into many small tribes, which were again re-united in the fourteenth century by Timur or Tamerlane. After the death of this conqueror in 1405 the Mongol empire gradually became separated into the various tribes of which it had been originally formed. Frequent wars between the Mongolians and the Chinese took place, until the conquest of China by the Mandchoorians in the seventeenth century, when the Tshakkar and Sunnit Mongols voluntarily submitted to the conquerors; and their example was followed in 1688 by the Khalkhas. It is believed that the Mongolians, who are all trained to military service, could bring into the field an army of 500,000 men; and the population of the country has been estimated, from that circumstance, at 2,000,000. (See the article Asia.)

MONK, George, Duke of Albemarle, was a younger son of Sir Thomas Monk, and was born at Potheridge, in Devonshire, on the 6th December 1608. As his family were in decayed circumstances, he was from an early age destined to be a soldier of fortune. But before he had formed any definite plans for his future life, and before he had attained the age of seventeen, he cudgelled an under-sheriff for an affront offered to his father, and was forced to escape from punishment by volunteering into the army. His first campaign was made in that ill-concerted expedition against Cadiz, which returned inglorious at the end of the year. Nothing daunted by this unfortunate beginning, he soon afterwards sailed in the armament against the Isle of Rhé, and served as an ensign till the end of the war in 1628. The peace which followed rendered it necessary for him to earn his livelihood by entering some foreign service. He therefore embarked for the United Provinces, at that time the great seminary for soldiers, and began to devote himself earnestly to all the duties of his profession. After he had been engaged in several battles and sieges, he returned to England about his thirtieth year with the rank of captain, and with a thorough knowledge of the military art. Charles I. was then on the eve of mustering an army against his Scottish subjects. At the recommendation of the Earl of Leicester, Monk was appointed a lieutenant-colonel, and accompanied the King in those two futile expeditions which resulted in 1640 in the treaty of Ripon. The colonelcy of a regiment in Ireland was then conferred upon him by Lord Leicester, and for a year he fought with distinction against the Irish rebels. By this time the King was in the very heat of his struggle with the Parliament, and was in urgent need of the assistance of the troops in Ireland. Monk was therefore ordered to strike a truce with the rebels, and to return to England. But no sooner had he landed with his forces at Bristol in September 1643, than he was apprehended, and deprived of his command, on the charge of being friendly to the Parliament. This suspicion, founded on no other grounds than his connection with Leicester and his studied indifference to either of the contending parties, was speedily disproved, and the rank of major-general of the Irish brigade was conferred upon him as a compensation for the injury done to his character. He set out for his new regiment, then engaged in investing Nantwich, and arrived in time to be surprised and captured by Sir Thomas Fairfax in 1644. For the next two years he lay in the Tower, and his imprisonment would have been aggravated by severe poverty had not Charles I. secretly supplied him with a hundred pounds. Yet, when his royal benefactor had been left by the issues of war a hopeless captive in the hands of his enemies, Monk did not hesitate to abandon his cause. He was induced in November 1646 to purchase his freedom by taking the Solemn League and Covenant. His valour and military experience were immediately recognised by the Parliament; and in 1647 he was sent to quell the rebellion in the north of Ireland. Any other leader in this command would have become hopelessly embarrassed through the scanty supplies from England; but Monk was economical, and by his attention to agriculture, and his judicious division of the booty, managed to provide for his troops. He continued to harass and weaken the daring rebel O'Neill until 1649, when discontent and dissension among his troops forced him to patch up a truce and return to England. His talents, however, had by this time secured the confidence of Cromwell. Accordingly, in the expedition against the Scots in 1650, he was appointed lieutenant-general of the ordnance, and a regiment was raised expressly for him. He did signal service at the battle of Dunbar, was appointed commander-in-chief in Scotland, and was left by Cromwell to complete the subjugation of the kingdom. This he effected with much energy, and at the same time with much cruelty, for he butchered in cold blood the governor of Dundee and 800 of the garrison. Scotland was then formally united to the English commonwealth, and Monk returned to London in 1652. Shortly afterwards the Dutch war broke out; and in 1653 Generals Monk and Dean were sent out into the Channel in command of a fleet to encounter the redoubtable admiral Van Tromp. A fight began on the 2d of June. Dean was almost immediately shot. Monk, however, maintained the contest for two days, until the opportune arrival of a squadron under Admiral Blake gave an impulse to his attack, which in a short time scattered the Dutch ships in irretrievable flight. On the 31st of July he acted an important part in that other sea-fight which resulted in the death of Van Tromp and the humiliation of Holland. About this time an insurrection of the royalists in Scotland rendered it necessary that some able general should assume the command in that country. This post was allotted to Monk; and he repaired to the north in the early part of 1654. After reforming the discipline of the English army, which had relapsed into a state of great laxness during his absence, he followed the rebels into the Highlands. In a short time he pressed upon them so closely, that the Earl of Middleton, their principal leader, was forced to abandon his troops and to flee for his life into Holland. The rest of the insurgents soon submitted; and Monk, returning to the neighbourhood of Edinburgh, took up his abode at Dalkeith House. He now set himself to consolidate the government of the kingdom. As long as he was under the watchful and penetrating eye of Cromwell, he was prudent enough to show himself a thorough supporter of the policy and principles of the Protectorate. He set a price upon the head of all those nobles who had been up in arms for the King. He forbade the gentry to exercise any jurisdiction over their servants, to wear swords, to ride on horses of value, or to settle their own disputes. He discountenanced the Presbyterians, by depriving them of the power of excommunication and of the liberty of meeting in general assemblies. He also transmitted to London all intelligence regarding the machinations of the royalists, and took care never to intermeddle with English politics. But no sooner had Cromwell died, and left the reins of government in the feeble hands of his son Richard, than Monk changed his policy. He fixed a steady eye upon the commotions which then began to trouble the English public. He relaxed the severity of his government in Scotland, and endeavoured to conciliate both the royalists and republicans. At the same time he hoarded up money, ammunition, and arms. In 1659 the resignation of Richard, the restoration of the Long Parliament, and the consequent rupture between the Parliament and the army, opened up for Monk a way to more decisive measures. Uninfluenced by a private letter which he received at this

period from the exiled prince, he resolved to follow that course of action which was likely to be safest, and at the same time most advantageous to himself. He therefore declared for the Parliament, and set out for London at the head of 7000 veterans. It was now apparent to all that the fate of the country was in his power, and the parliamentarians and the republicans, the two great parties into which the people were divided, alike strove to secure his aid. Yet he marched through England, hearing deputies from both, with the same cautious taciturnity, diverting their attention with fruitless negotiations, and all the while silently observing in what direction the tide of public opinion was setting. On his arrival in London he continued to fluctuate for some time between serving the Parliament and conciliating the citizens; but no sooner was he convinced that the general opinion of the nation and of his army was in favour of a freer and fuller representation of the people, than he awed the Parliament into re-admitting those of their number who had been expelled by former governments. One of the first acts of the restored members was to appoint Monk commander-in-chief of the entire forces both by sea and land. He now saw the direction in which the public mind was tending, and he now had the power to take the lead in that direction. His actions accordingly became more definite. He remodelled the army, placed several royalists in high places of command, and laid all the officers under an engagement to be completely subservient to his will. He dissolved the old Parliament and convoked a new. At length, on the 1st May 1660, he introduced Sir John Greenville to the Parliament with proposals from the King; and two days afterwards he received Charles II. on the beach of Dover. Honours and riches were now lavished upon him. He was created Earl of Torrington and Duke of Albemarle, and received several pensions. In 1664 he presided at the Admiralty; and in 1665 he was entrusted with the government of the city during the great plague. Along with Prince Rupert he commanded the fleet against the Dutch in 1666, and displayed all the courage of his youth. Monk died of dropsy on the 3d January 1670, and was buried in Westminster Abbey. (See BRITAIN; also Lives of Monk by Skinner, 1723, and by Guizot, 1849.)

MONKS. See MONACHISM.

MONMOUTH, JAMES, *Duke of*, a natural son of Charles II. and Lucy Walters, was born at Rotterdam in 1619, and was educated in France. His winning manners rendered him popular, but his foolish vanity made him the dupe of designing tacticians, who induced him to head an insurrection against his uncle James II. in June 1685. He was beheaded on the 15th July of the same year. (See BRITAIN.)

MONMOUTH, a parliamentary and municipal borough and market-town of England, capital of Monmouthshire, is situated at the junction of the Monnow with the Wye, 17 miles S. of Hereford, and 129 miles W. of London. The site of the town is a tongue of land formed by the junction of the two rivers aforementioned; and its vicinity is characterized by all the picturesque attractions of the valley of the Wye. The name of the town, however, is derived from the tributary of this stream—it being a corruption of Monnow's Mouth. Monmouth has been successively a British and Roman station, a Saxon fortress, and a Norman walled town. A castle was erected here during the Saxon period to overawe the surrounding district, which originally belonged to the county of Hereford, and after the Norman conquest was handed over to the custody of William Fitz-Badoron. In 1257, John, Lord of Monmouth, replaced the old fortress by one of greater dimensions; but he, having no male heirs, resigned possession in favour of Prince Edward, afterwards Edward I. Eight years later, this fortress suffered so severely from a siege by the Earl of Leicester, that it had to be rebuilt and its defences rendered more complete. It then passed into the hands of John of Gaunt; and during the reign of his son Henry IV. became the birth-place of Henry V., the hero of Agincourt. In 1846 the castle, being held by the royalists, was besieged and taken by the parliamentary forces. Only a few ruins remain of this ancient building. Traces of the old town wall and moat are also apparent, and one of the four city gates is still entire. The town is provided with an excellent market-place, and contains several other objects of note and interest. The assize court buildings, the façade of which is decorated with a statue of Henry V., the castellated county jail, and St Mary's church, are the most prominent buildings. The latter occupies the site of a church belonging to a Benedictine priory once situated here, and is remarkable for the beauty of its spire, which is 200 feet in height. St Thomas's church, on the other side of the Monnow, an old building, partly in the Norman, partly in a later style; a handsome town-hall; and Jones's Free Grammar School, are the only other edifices worthy of mention. The borough was incorporated by Edward VI. in 1550, and also received charters from Queen Mary in 1557, James I. in 1606, and Charles II. in 1666. It is governed by a mayor, 4 aldermen, and 12 councillors; and unites with Newport and Usk in returning a member to Parliament. Monmouth owes most of its prosperity to the periodical influx of persons during the assizes and sessions, and to the large number of tourists attracted by the beauties of the district. Manufactures are few and insignificant; but a considerable trade in timber and metals is carried on; while the Wye fisheries give employment to several persons in the town and vicinity. A market is held on Saturday. Pop. (1851) 5710.

MONMOUTHSHIRE, a maritime county of England, bordering on South Wales, is bounded on the N. and N.E. by Hereford, N.W. by Brecknock, E. by Gloucester, S. by the estuary of the Severn and the Bristol Channel, and W. by Glamorgan. It is 34 miles in length from E. to W., by 28 miles in greatest breadth, and contains an area of 368,399 statute acres. The coast line, which is 20 miles long, extends from the Rumney to the Wye, and includes the two harbours of Chepstow and Newport. These are respectively formed by the mouths of the rivers Wye and Usk, which here debouch into the Bristol Channel. The scenery of Monmouthshire is highly picturesque and varied, uniting the beauty of Devon with the grandeur of Wales. The language spoken is partly Welsh, partly English. The latter is the ordinary language of the districts abutting on Gloucestershire and Herefordshire, and Welsh of the rest; though, owing to the establishment of schools, there are now few persons who do not understand both languages, especially in the towns. The Welsh spoken is the Gwentian, one of three dialects prevalent in Wales.

Monmouthshire has an irregular surface, encircled by a chain of heights, some of which attain the altitude of mountains. This ridge commences near Wentwood Forest on the south-east, and extends to the neighbourhood of Newport on the south-west. The sea-shore, however, is skirted by two extensive levels, called Caldecot and Wenloog levels, protected from the sea by strong embankments, which are kept in repair by the landowners of the district. The geological structure of the county is interesting. Devonian rocks prevail east of a line drawn between Abergavenny and Newport, and is pierced by an under-stratum of Silurian near Usk, in the centre of the county; while the South Wales coal-field occupies the western half of the county, and becomes rich in iron as well as coal in the vale of Crickhowell, on its north-west border. The coal measures are skirted by a narrow strip of carboniferous limestone—useful as a flux with iron ore, as well as for building and manure. A tongue of carboniferous limestone also enters the county at Chepstow from the Dean Forest coal-field, and is bor-

dered on the south by a strip of Permian formation, which forms the Monmouthshire shore of the Severn.

The surface in the southern or maritime district of the county consists of large tracts of moorland, having a rich, loamy soil, which occasionally is highly favourable to the growth of trees. In the east the soil is of a reddish colour, which, when carefully cultivated, is very productive, and this district extends along both sides of the River Usk. The soil of the western and most mountainous parts, on the other hand, is generally thin and peaty, and covers strata of sandstone, under which the coal and iron are found.

Agriculture is comparatively backward in Monmouthshire; the farms are small, ranging from 20 to 100 acres, and are held almost universally from year to year. The farm buildings are likewise inferior, though quite equal to the capabilities of the present class of tenantry. The produce of wheat averages 20 bushels an acre; and, where skill has been applied, as many as 35 bushels have been obtained. The soil resting on the red sandstone, when kept clean and drained, is here admirably adapted for the growth of wheat; but the crop is taken too often. Many farms where barley is raised, being unweeded and undrained, produce no more than 10 to 15 bushels an acre of that cereal, but, with better cultivation, would yield twice the quantity. Nor are the green crops very luxuriant, owing to the general want of drainage—although on some estates 20 tons per acre of Belgian carrots, and 40 tons per acre of mangel-wurzel, have been produced. Efforts are being made by the landlords to stimulate improvement; and the Duke of Beaufort, the owner of a large part of the county, has shown that, by skill and management, good crops may be obtained from the worst land. One of the results of this recent interest taken in agriculture is the adoption by many farmers of the light fences in place of the old-fashioned jungles, which, however much they add to the picturesque, diminish the breadth of land and injure the crops. The county contains many dairy farms, for which cows of the Durham and Gloucester breeds are preferred. Hereford cattle are common; and the Radnor breeds improve wonderfully on the pastures here. Of sheep, the prevalent breeds are Ryelands and Leicesters, and a smaller number of South Downs. The rearing of mules is carried on perhaps to a greater extent than in any other county, and Spanish asses are imported for the purpose. The animals produced are well-formed and capable of bearing great fatigue. They are employed in carrying coal on their backs in the more hilly districts.

Monmouthshire, however, is a mining rather than an agricultural county, and the chief commerce flows from its staple productions—coal and iron. There are twelve beds of the former, which vary in thickness from 3 to 9 feet. The area of the Monmouthshire coal-field is about 90,000 acres; the seams which can be profitably wrought averaging a thickness of 50 feet, and the yield being nearly 73,000 tons an acre. The principal seams lie at a considerable depth below the ground, and they are reached by digging what are called in this country "levels," which are passages driven through the sides of the hills, instead of perpendicular shafts. The quantity of coal exported from Newport in the year 1856 was 681,442 tons; and, in addition, a large quantity was carried into the interior of the country by railway, or found an outlet at the port of Cardiff, in the neighbouring county of Glamorgan. The ironstone of Monmouth occurs both in beds and in large detached masses, and yields from 18 to 55 per cent. of iron. The ore is the common clay-ironstone. The iron-works are situated in the neighbourhood of Pontypool, which is perhaps one of the first places in which iron was fabricated in this kingdom. A family named Grant were the first ironmakers at Pontypool. They were succeeded about the year 1565 by Mr Richard Hanbury, citizen and goldsmith of London, who held a third part of the immense tract of mineral property in the neighbourhood at a rental of 3s. 4d. a year, the whole of it having been let by the owner, the Earl of Abergavenny, for 9s. 4d. only. Mr Hanbury greatly increased the works; and they were extended still more by his grandson, Mr Capel Hanbury, the first great ironmaster of his age. At that time (the reign of Elizabeth) the ore was smelted with charcoal; and to prevent the destruction of timber in making it, a statute was passed prohibiting the erection of iron-works except in certain districts; of these Monmouthshire was one. Yet in 1740, nearly 150 years afterwards, when coal was first successfully employed in iron-smelting, Monmouthshire contained only two iron furnaces, making 900 tons annually; while the invention of the steam-engine in 1788 only led to the erection of a third furnace, by which the "make" was increased to 2100 tons. In 1790, however, three new furnaces were erected at Blaenavon, and others at Blaendare and Ebbw Vale. Five years later the Nantyglo works were commenced, but at first did not succeed, and were suspended for a year. Under the management of the Bailey family, however, they have now come to be ranked among the greatest works of the kind in the United Kingdom. A great impulse was given to the Monmouth iron trade by the success of that of Blaenavon, and a perfect range of furnaces sprung up along the valleys that run towards Merthyr-Tydvil. In 1803, the Beaufort, Ebbw Vale, Clydach, and Varteg works were put in operation; then followed the Tredegar in 1805, the Nantyglo in 1811, the Coalbrook Dale in 1821, the Blaina in 1824, the Pentewan in 1825, the Abersychan in 1827, the Bute in 1828, the Golynos, afterwards united with Pentewan, in 1837, and the Victoria works in 1838. These are all very extensive furnaces; but there are besides many minor works, some of which have been recently opened. The South Wales system of iron-works commence at Clydach, 4 miles from Abergavenny, and extend in an unbroken line to Merthyr, a distance of 20 miles. The Monmouthshire coal and iron trade is greatly facilitated by a succession of valleys, with a gradual inclination towards Newport, whence the produce is exported.

A group of mountains in the north, neighbouring on Abergavenny, called the Blorenge, or Grayridge, possesses great beauty of outline. The northern extremity of the chain is 1720 feet high; while its loftiest peaks, the Sugar-Loaf and Holy Mountain, are respectively 1856 and 1498 feet high.

The chief rivers of the county are the Wye, the Monnow, the Usk, the Rumney, and the Ebbw. The first is universally pronounced one of the most beautiful of the English rivers, meandering, as it does, through a rich as well as picturesque country, its banks overhung with trees, and occasionally darkened by some abrupt and lofty cliff. Rising from the sides of Plynlimmon in Montgomery, the Wye separates Brecknock from Radnor, and enters Hereford, which it traverses in a S.E. direction, till it forms the boundary between that county and Gloucester. It then takes a southerly course, dividing the counties of Monmouth and Gloucester; and after passing the towns of Monmouth and Chepstow, enters the Bristol Channel, after a course of 40 miles through the county. The river is navigable at the town of Monmouth, and is used for the export of timber and bark. The Monnow rises at Hay in Herefordshire, enters Monmouthshire near Langua bridge, and forms the eastern boundary of the county, flowing through a beautiful valley until it joins the Wye at Monmouth. The Usk enters the county from Brecknock near Abergavenny, becomes tidal at Caerleon, and falls into the sea a little below the port of Newport. The Rumney rises in Brecknock, forms the boundary between that county and Monmouth, and after a meandering course southwards, enters the Bristol Channel 2 miles E. of

Cardiff. The Ebbw finds its source at Ebbw Vale, on the N.E. of the county, and after a southerly course enters the estuary of the Usk. There are also some minor streams: the Sirrhwy, a feeder of the Ebbw; the Avon, of the Usk; the Trothy, of the Wye; and the Honday, of the Monnow. Of these streams, the Wye and Usk are the most abundant in salmon; while all the rivers are well stocked with trout and other fish. The fishermen here use boats called *coracles*, said to be of the same character as those in use among the ancient Britons. They are made of thin hoops, covered with strong canvas, thickly coated with pitch, and edged with basket-work. The seat is in the middle of the coracle, which measures about 5 feet in length, and is light enough to enable the fisher to carry it on his shoulders. Great dexterity and caution are required to avoid upsetting, for even the slightest movement in hooking a fish will be sufficient to overturn the craft.

The means of internal communication in Monmouthshire is rendered complete by the number of railways and canals which intersect it. The South Wales line, connecting London and Milford Haven, is carried along the coast of this county, and passes by Chepstow and Newport. The Newport and Abergavenny Railroad, which unites with the Hereford line, connects Monmouthshire with Shrewsbury and the north. A branch from the same also passes through Pontypool to Blaenavon, and a number of short mineral lines bring the various coal and iron stations into ready communication with the sea and the main railroads.

The population of the county has shown a steady increase for the last fifty years, and the only subject for remark is the preponderance of males over females. In 1831 there were 112,686 inhabitants; in 1841, 157,021; and in 1851, 177,130. Of the last sum 92,301 were males, and 84,829 females. The county contained in 1851 only three towns having more than 5000 inhabitants,—viz., Newport, 19,323; Tredegar, 8305; and Monmouth, 5710. Monmouthshire returns three members to Parliament,—two for the county and one for the combined boroughs. It is divided into 6 unions and 161 parishes, which afforded in the half-year ending Lady-Day 1857, poor-relief to the amount of L.19,210, or L.710 less than what was expended in the former half-year. The county is included in the Oxford circuit, and belongs to the diocese of Llandaff, with the exception of three parishes, which pertain to that of Hereford, and three to St David's. In 1851 there were 434 churches in Monmouth, of which number 159 belonged to the Established Church, 126 to the Methodists, 79 to the Baptists, 51 to the Congregationalists, 8 to the Roman Catholics, and 6 to the Mormons. Education was dispensed, at the same date, in 336 day schools, 135 of which were public, attended by 12,632 scholars, and 201 private, attended by 4548 scholars; and also in 330 Sunday schools, attended by 28,882 scholars. The number and character of the literary institutions, with their respective libraries, in 1851, are too insignificant to require notice.

The history of Monmouthshire can be carried back to the time of the Roman conquest. It formed a part of the territory belonging to a native tribe called the Silures, at the time of the second Roman invasion of Britain. Ostorius Scapula, one of the commanders of the Emperor Claudius, attempted to expel them, but the Silures, assisted by the mountainous character of the district, ultimately obliged him to retire. The general died not long afterwards of an illness caused by the fatigues of his campaign. Julius Frontinus was, however, more successful in the reign of Vespasian, and Monmouthshire became a part of *Britannia Secunda*,—a term applied to the conquered territory west of the Severn. After the Romans evacuated Britain A.D. 408, South Wales was divided into a number of petty states, which were either at war with each other or engaged in repelling the attacks of the Scots and Picts. Vortigern, who invited the Saxons over to Britain to expel these ruthless bands, was a king of Gwent, as Monmouthshire was anciently called. For many years after, the Angles and Welsh were at constant war, until the latter were forced to submit. In 1034 the territory of Gwent or Monmouth was invaded by Canute the Dane, and several fortresses were occupied by his forces. It remained in the possession of the English till the Norman conquest, when William, unable to spare sufficient troops to subdue the district thoroughly, incited his barons to make incursions at their own cost. The lands which they conquered became their own, and were held *per baroniam*, with the right of administering justice upon them. The subsequent history of the county exhibits a series of struggles between the possessors of the land and the Welsh. The natives were then little better than barbarians, and hated the English, who held their towns and castles, punished their bards as vagabonds, and excluded them from every public office. Henry II. seized and garrisoned the town and castle of Caerleon in 1174, when on his way to conquer Ireland. Henry III. defeated Llewellyn, the Welsh prince, at Grosmont Castle, and twice seized that fortress, giving it at first to Hubert de Burgh, but afterwards annexed it to the duchy of Lancaster. Henry V., when Prince of Wales, in 1405 drove Owen Glendwr, the last of the Welsh chieftains, out of Grosmont Castle, and defeated him in battle at Usk. During the Parliamentary war Monmouthshire became again a field of contest. Raglan Castle, a favourite residence of Charles I., was held for him in 1646 by Henry, Marquis of Worcester, who, although then eighty-five years of age, kept up the defence for two months, after which he capitulated to Fairfax. Chepstow Castle surrendered to the parliamentary forces two years later, being the last fortress which defied the power of Cromwell. The feudal jurisdiction, which was abolished by Henry VIII. in 1535, was succeeded by an administrative arrangement, which placed Monmouth among the English shires; and it was regularly considered an English county in the reign of Charles II., when it was included in the Oxford circuit. The last vestiges of the baronial system, however, were not got rid of until the reign of William III., when the Lord Marchers' Court, held at Ludlow, Shropshire, was suppressed by act of Parliament on the petition of the Welsh people.

Monmouthshire is rich in antiquarian remains. It contained five Roman stations,—*Venta Silurum*, now Caerwent; *Isca Silurum*, now Caerleon; *Gobannium*, now Abergavenny; *Blestium* and *Burrium*;—the last two are doubtfully fixed at Monmouth and Usk. The remains of walls, aqueducts, subterranean buildings, mounds, and pavements, are remarkable. The county was traversed by two Roman roads,—the Via Julia, leading from the mouth of the Severn to Caerwent, Caerleon, and onward towards Neath; and the Akeman Street, from Caerwent, across the Wye and Severn, to Cirencester. The former can still be traced, and is called in the Gwentian dialect *Sarn-her*, "the long-paved causeway." There are traces of six British and Roman encampments, and remains of no less than twenty-five Norman fortresses: these formed two lines, the first, including Scenfreth, Grosmont, Monmouth, Chepstow, and Caldecot, on the banks of the Monnow, the Wye, and the Severn; and the second, including White Castle, Usk, Langibby, Caerleon, and Newport, stretching in a diagonal line from Grosmont to the banks of the Rumney. At the time of the Reformation there were two hospitals and fifteen other religious houses in the county; but two only remain—Llanthony and Tintern abbeys—both in ruins. The former was once a distinguished priory of Cistercians, and, judging from the remains, never had been a highly-ornamented building. It was erected about 1112, but was soon afterwards abandoned by its inmates. Tintern Abbey, famous

alike for the beauty of its architecture and of the surrounding scenery, was founded in 1131, and dedicated to St Mary. The ruin, which exhibits the purest Gothic style, is roofless, but the walls are almost entire, and some of the piers are still standing. (F. C.)

MONOCHORD, an instrument by which the several proportions of musical sounds and intervals, as well in the natural as in the tempered scales, are tried. Originally it had, as its name implies, only one string; but it is better constructed with two; for, by means of the additional string, an opportunity is afforded of judging of the harmony of two tempered notes in every possible variety of temperament. The monochord is called the harmonical canon. Its invention is ascribed to Pythagoras.

MONOGRAM, an abbreviation of a name by means of a character or cipher, formed by the interweaving of two or more letters with each other. They are of very ancient date, and were employed upon coins, medals, seals, &c., by not a few of the more distinguished families of Greece and Rome. They were not used by the Roman emperors till a later period. The Greek monogram for the name of Christ ☧, consisting of a combination of the first two letters of Χριστος, is found on the coins of Constantine the Great; and was continued by not a few of his successors. Monograms appear frequently on coins, &c., during the middle ages, and they were frequently employed by princes (*e.g.*, the kings of France, A.D. 751–987), and other dignitaries of that period, as a substitute for their signature. This mode of adhibiting their names to their works was frequently adopted in later times by printers, painters, and engravers; and monograms are occasionally to be met with at the present day attached to books and works of art. When all the letters which compose the word are expressed in the monogram, it is called *perfect;* otherwise it is said to be *imperfect.*

Much labour and research have been expended on the deciphering of ancient monograms, and many of them remain still unintelligible. The most valuable works on this branch of the subject are Montfaucon, *Palæographia Græca;* Froelich, *Annal. Reg. Syr.;* Combe, *Museum Hunterianum;* Torremuzza, *Description des Monnaies de Sicile;* Pellerin, *Recueil des Villes, des Peuples, et des Rois;* Mionnet, *Traité de la Numismatique;* Le Blanc, *Traité Historique des Monnaies de France.* Of later monograms various treatises have taken notice; but the ablest works, since the Abbé de Marolles, in 1667, drew attention to the subject, are those of Bartsch, *Peintregraveur;* and especially Brulliot, *Dictionnaire des Monogrammes,* &c., 2 vols. 4to, Munich, 1832–34,—both works of great accuracy and research. (See NUMISMATICS.)

MONOMANIA. See MENTAL DISEASES.

MONOMOISE, or MONOMOEZI, a territory of southern Central Africa, situated on the eastern shore of Lake Taganyka, inclosed by no definite boundaries, but having an estimated length of 570 miles, by a breadth of 420 miles. S. Lat. (of Oha the capital) 6. 34., and E. Long. 29. It is now two centuries and a half since this country was first heard of by Europeans, and at that time it was believed to extend from Abyssinia in the N., to Monomotapa in the S., and from the E. coast far into the interior of Central Africa. From more recent explorations, however, its limits are found to be not nearly so extensive, and its exact position has been now determined by Lake Taganyka instead of Lake Nyassa, on whose shores some later geographers have incorrectly placed it. Monomoise, which may be said to lie between 3. and 7. of S. Lat., occupies an elevated tableland watered by the Luffia and its affluent the Magrassie, and is composed of several tribal districts. These are stated by one authority to amount to six,—viz., Uranga, Ovinza, Ugiyie, Oha, Usooie, and Oocanga; while according to a later account, they are said to number only four. Each tribe is governed by a chieftain, who pays homage to the great chief of the Oha tribe, and thus the entire territory has sometimes been designated the Empire of Monomoise. The prefix *mono* signifies great, or master; hence the full name is equivalent to *the great Moises,* or the chief nation of the Moises; and it is known that this last name is borne by a numerous people, widely scattered over the interior, and divided into various tribes. The Monomoises are a tall race, and those residing on the shores of the lake are said to be as fair as the Abyssinians. In civilization they surpass nearly all the other South African nations, and are described as industrious and ingenious, as well as hospitable to strangers. Their dress consists of cotton, manufactured by themselves, and which they make not only for their own use, but also for transmission to the sea-coast for shipment. Trade, which is largely engaged in, is much furthered by the use of a hardy breed of asses for conveying goods to the sea. The Monomoises, however, are far from a peaceful people; on the contrary, they are said to be at constant war with their neighbours in the interior, though friendly relations are generally preserved with the commercial tribes of the coast. Large caravans proceed annually from Oha to Zanzibar, conveying cotton, copper, ivory, and a sort of red oil, which articles are obtained from the country to the S.W. of the lake. These generally start for the coast in March or April, after the end of the rainy season, and return after an absence of nine or ten months. Lake Taganyka contains large quantities of fish, has numerous islands, and is navigated by long and narrow boats without sails. Its breadth at the town of Oha, situated on its shores, is about 24 miles; its depth is also great, and it is frequently agitated by a considerable swell. The River Luffia, which waters the Monomoise country, flows from Lake Taganyka, and is joined by several tributaries. No estimate has as yet been made of the population, but it is said to be large, especially on the shores of the lake.

MONOMOTAPA, a country in the S.E. of Africa, to the S. of the Zambesi, between 15. and 19. S. Lat., and 30. and 35. E. Long. It is inhabited by a people of the Mucaranga race, and was formerly an important empire, but it is now split up into independent states, of which the most important are Susas and the Katalosas. The name Monomotapa is not now in use.

MONOPHYSITES, a body of heretics who adopted the doctrine of Eutyches the Archimandrite, the opponent of Nestorius. (See EUTYCHES.) The latter, from the two natures of Christ, inferred also two persons,—a human and a divine. Eutyches, on the other hand, from the one person inferred also one nature, viz., the Divine,—the human having been absorbed into it; but in the end his own united with the rival heresy in more points than one. After the condemnation of Eutyches at Chalcedon, his heresy became divided into ten chief sects, whence it has received the name of the "ten-horned." Of these the principal leaders, as enumerated by Anastasius the Sinaite, were Eutyches himself, Dioscorus, Timothy Œlurus, or "the Cat," Gajan, Julian, Severus, Peter "the Fuller," Barsanuphius, Theodosius, and Jacob Baradæus, or "the Ragged." Besides these, are to be enumerated the followers of Peter "the Stammerer," the Acephali, the Aphthartodocetæ, who held that Christ's body was in itself incorruptible, and not subject to passion or suffering; the Theopaschites, from Peter "the Fuller," who held that the Godhead suffered directly; and the Theodosians, from Severus and Theodosius of Alexandria, whose followers soon fell into numberless divisions. The chief of these were the Agnoetæ, whose distinctive tenet it was, that Christ was altogether ignorant of things to come; and the Tritheites, who thought that there were three essences as well as three persons in the Godhead. There were also numberless other sects who differed

from each other on points of more or less consequence, and agreed only in their hatred of the Council of Chalcedon, and the doctrine it laid down.

When all attempts of the imperial power to restore peace to the churches of Egypt and the East had failed, the Emperor Zeno, in the year 482, published his "Henoticon," by which he hoped to put a period to the disturbances which on more than one occasion had terminated in open riot and bloodshed. The "Henoticon" asserted the Creed of the General Council of Nice held in 325, and anathematized Nestorius and Eutyches, but said nothing positively as to Monophysitism in itself,—that is, the doctrine of the nature or natures after the Incarnation. The greater number of eastern bishops readily signed this formula; but Leo the Great, then Pope, separated them in consequence from the communion of the Church of the West; while the more obstinate of the Monophysites seceded from the rule of their bishops, and formed the sect of the Acephali, which existed upwards of three centuries, when its members were received again into the church.

The Monophysites still exist in Egypt and the East, under the title of Jacobites, which they derived from Jacob Baradæus; whilst the orthodox are distinguished by that of Melchites, or Royalists, from their adherence to the edict of the Emperor Marcian, in favour of the Council of Chalcedon, and their adoption of its doctrine. (G. J. D.)

MONOPOLI, a town of South Italy, Naples, province of Bari, and on the shore of the Adriatic, 26 miles S.E. of the town of Bari. It stands on an eminence overlooking the sea, and is protected by a castle. The streets, which are narrow and irregular, are rather gloomy in appearance, from the height of the houses. The town, nevertheless, is the favourite resort of many people of wealth. There are numerous churches; and the cathedral, which is a handsome edifice, contains a painting of "St Sebastian" by Palma Vecchio. There are two suburbs, in which the houses are better built than in the town itself. Manufactures of linen and cotton fabrics are carried on; and there is a considerable trade in wine and oil, as well as in the manufactures of the place. The town has two harbours, which, however, though deep, are not well sheltered. On the coast, about 6 miles S.E. of Monopoli, stand the ruins of the ancient *Gnatia*, known in modern times by the name of Torre d'Egnazia. Monopoli is the seat of a bishop, who is a suffragan of the Holy See. Pop. 15,000.

MONOTHELITES, a heretical offshoot from the sects of the Apollinarians and Monophysites. They distinguished the will from the operation, and said that a multiplicity of wills must of necessity involve a multiplicity of willers. In order, therefore, to preserve the unity of Christ's person and nature after the Incarnation, they held that in Him there was one will or energy only. This will was not human, for that would infer strife and sin; but they admitted Him to be perfectly sinless, and hence they ascribed to Him a divinely human will, which, from a term used by Dionysius the Areopagite, they called *Theandric*. As the Eutychians absorbed the human in the Divine nature, so the Monothelites merged the human will in the Divine. Their opponents met them by the denial of their major premiss, that the will depends on the *person* of the willer, and asserted, on the contrary, that it is the result of the nature; and, therefore, that in Christ each nature had its own manner of operation and will, though in Him these wills were in no degree in sinful opposition.

Monothelitism was first heard of in the seventh century, and was in its vigour from the year A.D. 629 to the sixth general council held A.D. 680. Heraclius, the Greek emperor, was the original cause of its formal enunciation. After he had recovered the provinces rent from the empire by the Persians, he was desirous of strengthening his power by the reunion with the dominant church of those Nestorians who had been driven into Persia. The leaders of the Monophysites acceded to his wish, on the condition of its being ruled, that after the union of the two natures in Christ, there was but one mode of operation and will; Sergius, the Monophysite patriarch of Constantinople, agreed; and Honorius, in consequence, published in the year 630 an edict in favour of that doctrine. On this Cyrus, who had been recently converted to Monothelitism by Sergius, and promoted by Honorius to the patriarchate of Alexandria, held a council in that city A.D. 633, and propounded nine articles of faith, which at first met with great success. He was earnestly opposed, however, by Sophronius, a monk of Palestine, then residing at Alexandria, who, on being made patriarch of Jerusalem, assembled a council there and condemned the Monothelites. Sergius thereupon wrote to Pope Honorius, who in reply expressed his approbation of the doctrine of Sergius as opposed to that of Sophronius, and clearly enunciated Monothelite doctrine. "We confess," he said, "one will in Jesus Christ, because the Godhead took not our sin, but our nature as it was created before the corruption of sin."

More than one of the Romish controversialists have made unsuccessful attempts to defend the reputation of Honorius from the accusation of heresy arising out of his letters to Sergius. The error of his Holiness, like that of the Monothelites, lay in the assumption that two wills could not coexist in our Lord without sinful opposition; and hence he must be ranked with those heretics with whom he was subsequently condemned in the sixth general council.

To put an end to the dispute, Heraclius, in the year 639, issued the edict known by the name of the "Ecthesis," or exposition of the faith, in which he laid down the doctrine of one will, but prohibited all controversy on the question of one or two operations. Many eastern bishops, with Pyrrhus, the successor of Sergius, at their head, received the "Ecthesis;" but John IV. of Rome immediately assembled a council in that city, in which the "Ecthesis" was rejected, and the Monothelites condemned. The most able opponent of Monothelitism at this time was Maximus the monk, who vanquished Pyrrhus, Patriarch of Constantinople, in a public disputation. Theodore of Pharan, in Arabia, was the most prominent of its champions.

In the year 648, Constans the Emperor revoked the "Ecthesis," and published in its place a formula known by the name of the "Type," which was formally condemned by Pope Martin I. in the Lateran Council of 649. Constans, enraged at what he supposed an attack on his authority, caused Martin to be seized and carried to the Isle of Naxos, where he was kept prisoner for a year. Thence he was removed to the town of Chersoneeus in the Crimea, where he soon afterwards died. Maximus was next arrested and brought, with his disciple Anastasius, to Constantinople. On his refusing to adopt Monothelitism in any guise, he was forcibly conveyed to Byrza in Thrace; thence he was carried back to Constantinople, where he was publicly scourged, had his tongue cut out, and his right hand severed at the wrist. After this he was banished to Lazi in Colchis, where he soon died. The West, overawed by these violences, remained for some time quiet; but in the year 677 the schism between the East and West was complete. To put a final termination to these disputes, the sixth Œcumenical Council was assembled at Constantinople in A.D. 680, at which the Emperor was present in person. The result was to establish the doctrine of two wills and operations; and the Monothelites, with Pope Honorius at their head, were again formally condemned. The doctrine of Monothelitism was henceforth confined to the people inhabiting Mounts Libanus and Antilibanus, who are known in history by the name of Maronites. (See MARONITES.) (For more detailed information respecting the Monothelites, consult Neander's *Church History*, vol. v.) (G. J. D.)

MONRO, Alexander, a celebrated physician and anatomist, and founder of the medical school of Edinburgh, was the son of John Monro, a surgeon in Edinburgh, and was born in London in 1697. He showed an early inclination to the study of physic; and his father, after giving him the best education which Edinburgh then afforded, sent him successively to London, Paris, and Leyden, to improve himself further in his profession. On his return to Edinburgh in the autumn of 1719, he was prevailed upon to read some public lectures on anatomy, and to illustrate them by showing the curious anatomical preparations which he had made and sent home when abroad. He at the same time persuaded Dr Alston, then a young man, to give some public lectures on botany. Accordingly, in the beginning of the winter of 1720, these two young professors began to give regular courses of lectures,—the one on the materia medica and botany, the other on anatomy and surgery. These were the first regular courses of lectures on any of the branches of medicine which had ever been read at Edinburgh, and may be looked upon as the opening of that medical school which has since acquired so great reputation all over Europe.

On the foundation of the medical faculty of Edinburgh in 1721, Dr Monro was appointed university professor of anatomy, but was not received into the university till the year 1725, when he was inducted along with Maclaurin, the celebrated mathematician. From this time he regularly gave a course of lectures on anatomy and surgery from October to May, upon a most judicious and comprehensive plan,—a task in which he persevered with the greatest assiduity, and without the least interruption, for nearly forty years; and so great was the reputation he had acquired, that students flocked to him from the most distant corners of his Majesty's dominions. Dr Monro had a principal share in founding the Royal Infirmary of Edinburgh, and was accustomed occasionally to give lectures on the surgical cases which occurred there.

In 1759 he entirely relinquished the business of the anatomical theatre to his son Dr Alexander Monro, who had returned from abroad, and had assisted him in the course of lectures delivered the preceding year. He still endeavoured, however, to render his labours useful, by reading clinical lectures at the hospital for the improvement of the students. Dr Monro died on the 10th of July 1767, in the seventieth year of his age.

Of his works, the first in order is his *Osteology, or Treatise on the Anatomy of the Bones*, which appeared in 1726, and was translated into most of the languages of Europe. In the later edition he added a description of the *Lacteal Sac* and *Thoracic Duct*, and gave an admirable description of the *Anatomy of the Nerves*. The six volumes of *Medical Essays and Observations*, so well known and so much esteemed, were published by a society in Edinburgh, and were mainly owing to his zeal and activity. In the first two volumes of the *Physical and Literary Essays*, published by the Physical Society of Edinburgh, we find several papers written by him, possessing very great merit. His account of the *Success of Inoculation in Scotland* may be considered as his last publication. A collection of his works, properly arranged, corrected and illustrated with copperplates, with a Life of the author prefixed, was published by his son, Dr Alexander Monro, in one 4to volume, Edinburgh, 1781.

MONROE, James, a President of the United States, was descended from a Scottish family, and was born in Westmoreland county, Virginia, in April 1758. After receiving his education at William and Mary College, he entered the revolutionary army in 1776, was engaged in several battles, and rose to be aide-de-camp to Lord Stirling, with the rank of major. Towards the close of the war General Washington conferred upon him the rank of colonel; but as he was unable to raise an army in Virginia, already exhausted by former conscriptions, he devoted himself to the study of law. His sagacity, firmness of purpose, and plodding perseverance soon marked him out as one adapted for civil offices. He was elected a member of the Assembly of his native state in 1782, a member of the old Congress in 1783, a member of the Virginia Convention in 1788, and a senator of the United States in 1790. In 1794 he was appointed minister plenipotentiary to France; but as his measures failed in satisfying the government of his native country, he was recalled in 1796 by President Washington, with an implied censure. Yet this circumstance did not degrade him in the general estimation. In 1799 he was nominated governor of Virginia, an office which he held for three years. He was also appointed minister extraordinary to France, and minister to London in 1803, and envoy to Spain in the following year. In 1806 he was again sent to England to negotiate with the Fox ministry. The important post of secretary of state was bestowed upon him in 1811; and in 1817 he succeeded James Madison as President of the United States. In 1821 he was re-elected by an almost unanimous vote. The government of Monroe was characterized by a vigorous and enlightened patriotism. His attention to the improvement of the army and navy was great, and descended to minute particulars. He made vigorous exertions for the abolition of the slave trade, and encouraged the establishment of the principles of free commerce with all nations. His resolution to defend the independent South American governments against all European interference was bold and at the same time sagacious, and it served its purpose. At the end of his second term Monroe retired from the presidency into private life. He died at New York on the 4th July 1831.

MONROVIA, a seaport-town of West Africa, capital of the Liberian republic, is situated on the Guinea coast, N. Lat. 6. 19., and W. Long. 10. 49. It contains the government-house, the president's residence, and several churches and schools, besides a printing establishment and a head jail. The town was founded in 1821, and now contains about 2000 inhabitants.

MONS (Flem. *Berghen*), a town of Belgium, capital of the province of Hainault, is situated on both sides of the Trouille, which is here crossed by three bridges, 38 miles S.W. of Brussels by railway. It stands partly on a plain and partly on the slope of a hill, is defended by a castle, and is surrounded by fortifications, which are entered by five gates. On the E. of the town are two lakes, by means of which and the river the whole neighbourhood may be laid under water. The streets are in general wide, regular, and well paved, though some are steep and winding; and the houses are handsome and well built. There are eight squares, the most important of which is the Place d'Armes, which contains the government-house and the provincial council-hall. Mons possesses five churches, the principal of which is that of St Wardru, a building in the Gothic style, with one of the finest collections of works of art in Belgium. The chief of the other buildings are the town-hall, a Gothic edifice with a handsome steeple; the castle, court-house, college, theatre, and arsenal. The town has also an academy of music, school of arts, and many other educational institutions; an orphan hospital, a deaf-and-dumb institution, two lunatic asylums, &c. The manufactures of Mons are important and various, consisting of linen, woollen, and cotton stuffs; hardware, fire-arms, musical instruments, soap, oil, candles, earthenware, &c. The chief wealth of the place, however, is derived from the coal-pits in the neighbourhood, in which a large number of men are employed. There are also extensive bleachfields near the town. The trade is considerable in coal, marble, building stone, timber, horses, cattle, corn, and manufactured goods. Mons stands on the railway between Brussels and Valenciennes, and is also connected with Condé on the Scheldt, and by a canal which

forms part of a communication by water between this town and Paris. It is believed to occupy the site of a Roman camp founded by Cæsar, which was defended with great courage and success by Q. Cicero, the brother of the orator, against several Gallic tribes. In the seventh century it became the residence of Alberic, Count of Hainault, and subsequently increased in size and prosperity, till it was made by Charlemagne, in 804, the capital of Hainault. After undergoing several sieges and changes, it fell into the hands of the Duke of Burgundy. The greatest prosperity to which this town attained was during the reign of Charles V., but this was soon after checked by the exactions of the Duke of Alva; and after an unsuccessful attempt at revolt, the town remained quiet, and gradually declined in importance. In 1678 the Prince of Orange was defeated near Mons by Marshal Luxemburg, who afterwards besieged the town; but his operations were cut short by the peace of Nimeguen. In 1691 it was besieged and taken by the French, who retained the town till the peace of Ryswick. In 1709 the battle of Malplaquet was fought in the neighbourhood of Mons, in which Marlborough and Prince Eugene defeated the French; and the town soon afterwards capitulated to the conquerors. In 1792 the French, under Dumouriez, defeated the Austrians at Jemappes, and afterwards obtained possession of Mons, which was in 1794 declared to belong to France, and made the capital of the department of Jemappes. It was restored to Belgium in 1814. Pop. 23,165.

MONSELICE, a town of Austrian Italy, in the government of Venice, and province of Padua, is situated on a lofty rock, 12 miles S.S.W. of Padua. The principal buildings are an ancient castle, which commands the town, and fou. churches. Manufactures of woollen stuffs, silk, and hats are carried on here. It has a considerable trade, which is much assisted by the position of the town on a canal connecting Este and Bacchiglione. Pop. 5400.

MONSOON, a regular or periodical wind, in the Indian seas, blowing constantly in the same direction during six months of the year, and contrariwise during the remaining six. (See METEOROLOGY, sect. 67; and PHYSICAL GEOGRAPHY.)

MONSTER, a birth or production of a living being degenerating from the proper and usual disposition of parts in the species to which it belongs; as, when there are too many members, or too few, or some of them are extravagantly out of proportion, either on the side of excess or defect. The word comes from the Latin *monstrum*, a derivative of *monstrando*, showing; and hence also the box in which relics were anciently kept to be shown was called *monstrum*. Dugdale mentions an inventory of the church of York with this article, "*Item unum monstrum cum ossibus sancti Petri in beryl, et crucifixo in summitate.*" Aristotle defines a monster to be a defect of nature, when, acting towards an end, she cannot attain to it, from some of the principles being corrupted.

Monsters do not propagate their kind, for which reason some rank *mules* amongst the number of monsters, as also *hermaphrodites*. Females which bring forth twins are found most liable to produce monsters. The reason probably is, that although the twins are covered with one common chorion, yet they have each their separate amnios, which by their contiguity may chance to grow together, and so occasion a confusion or blending of the parts.

With respect to structure, monsters are of various kinds. Some have an excess or defect in certain parts, such as those which are called *acephalous*, or want the head; those which have two heads, two arms, two legs, and one body, or which have two bodies and one head, or which have three legs; and those which want the arms or the legs. Others err through an extraordinary and deformed conformation, through an unnatural union of certain parts or viscera, through a great derangement in one or more of their members, and through the extraordinary place which these often occupy in consequence of this derangement or transposition. The monster described by Dr Eller of the Academy of Berlin was of this kind. It was a fœtus of nine months, twenty-eight inches long, with an enormous head and frightful countenance: and in the middle of a broad and vast forehead it had a reddish eye, without either eyebrows or eyelids, and sunk deep into a square hole. Immediately below this eye was an excrescence which strongly resembled a penis, with a glans, a prepuce, and an urethra; the part covered with hair was likewise below the nape of the neck. In other monsters we meet with the unnatural union of some parts which, from their destination and functions, ought always to be separate; and the separation of other parts which, for the same reasons, ought constantly to be united. The reader may see the different ways in which the formation of monsters takes place in four memoirs by M. Leméry, inserted in *L'Histoire de l'Académie des Sciences*, 1738 and 1739.

In the volume published by the Academy of Sciences in the year 1724, mention is made by M. Geoffroy of a monster born in Barrois, 1722. This monstrous production consisted of two children without the inferior extremities, and joined together by a common navel. Each of them had a nurse, sucked, and eat pap; and the one sucked whilst the other slept. The reader may likewise consult the second part of Winslow's *Memoirs on Monsters*, inserted in the volume published by the Academy of Sciences in 1734, where he will find the history of the two very extraordinary twin monsters who exhibited during their lives a great difference in their moral and physical qualities. We are obliged to refer simply to these memoirs, as they are too long for abridgment.

It is observed by Haller, that in some monsters the natural structure has been changed by some shock or passion, whilst in others the structure, independently of any accident, appears to have been originally monstrous; such as when all the members are reversed from left to right, when the person has six fingers, and in many other instances. M. Renou, surgeon at Pommeraye, in Anjou, published an account of some families with six fingers, who were to be found in several parishes of the Lower Anjou, and which had existed there from time immemorial. This deformity was perpetuated in these families even when they intermarried with persons who were free from it. Whether the propagation of these supernumerary organs, which are not only useless, but inconvenient, and even disagreeable, be owing to the father or mother, the children of both sexes are subject to it indiscriminately. A father and mother with six fingers frequently have a part, and sometimes the whole of their children, free from this deformity; but it again makes its appearance, and in a very great degree, in the third generation. From this it appears that such a fault in the conformation is hereditary. (The reader may consult the *Journal de Physique* for November 1774, p. 372.) This variety of *sexdigitary* hands and feet is not comprehended in the *Recherches sur quelques Conformations Monstrueuses des Doigts dans l'Homme*, which is inserted in the Memoirs of the Academy of Sciences for 1771. In the *Journal de Physique* for August 1776, we find a description of a double uterus and vagina observed in a woman who died in childbed, by Dr Purcell of Dublin; and in that for June 1788 we have an account, by Baron Dietrich, of a man with seven fingers on each hand. (See also the curious work of Dr Barkow, entitled *Monstra Animalium per Anatomen indagata*, ii., 4to, Leips., 1828-36.)

Three opinions have been advanced by physiologists as to the causes of monstrosity by excess:—1. Duverney, Winslow, and Haller ascribed excess of organs to the coalition of two perfect germens. 2. Wolf and Meckel

considered it as owing to an original excess of productive power. 3. The celebrated Tiedemann ascribed it to abnormal vascular action, modified by pressure. The first opinion has been adopted by Treviranus, Otto, Burdach, Rudolfi, Mayer, and Müller: the second has been defended by Bäer and Himly; while the third has been maintained by Serres and Geoffroi St Hilaire. (For further information on the subject, see *Lectures on Medical Jurisprudence*, by Dr Traill.)

Monsters are more common and more extraordinary in the vegetable than in the animal kingdom, because the different juices are more easily deranged and confounded together. Leaves are often seen, from the internal parts of which other leaves spring forth; and it is not uncommon to see flowers of the ranunculus from the middle of which issues a stalk bearing another flower. Bonnet informs us, that in certain warm and rainy years he has frequently met with monsters of this kind in rose trees. This observer saw a rose from the centre of which issued a square stalk of a whitish colour, tender and without prickles, which at its top bore two flower-buds opposite to each other, and totally destitute of a calyx; and a little above the buds issued a petal of a very irregular shape. Upon the prickly stalk which supported the rose, a leaf was observed which had the shape of a trefoil, together with a broad flat pedicel. In the Memoirs of the Academy of Sciences for 1707 mention is made of a rose from the centre of the leaves of which issued a rose branch two or three inches long, and furnished with leaves. In the Memoirs for 1775, a singular instance is mentioned of a monstrosity observed by Duhamel in an apple tree ingrafted with clay. At the place of the insertion there appeared a bud which produced a stalk and some leaves; the stalk and the pedicle of the leaves were of a pulpy substance, and had the most perfect resemblance both in taste and smell to the pulp of a green apple. An extraordinary *chamœmelum* is mentioned in the *Acta Helvetica*. Bonnet, in his *Recherches sur l'Usage des Feuilles*, mentions likewise some monstrous productions which have been found in fruits with kernels, analogous in their nature to those which occur in the flowers of the ranunculus and of the rose tree. He observed a pear from the eye of which issued a tuft of thirteen or fourteen leaves, very well shaped, and many of them of the natural size. He noticed a second pear which gave rise to a ligneous and knotty stalk, on which grew another pear somewhat larger than the first. The stalk had probably flourished, and the fruit had formed. Reynier has mentioned some individuals monstrous with respect to the flower, in the *Journal de Physique et d'Histoire Naturelle* for November 1785.

These vegetable productions, which are so extraordinary and so contrary to the common course of things, do nevertheless present deviations subject to particular laws, and reducible to certain principles, by distinguishing such as are perpetuated either by seed or by transplanting from those which seem to be only accidental. Monstrosities which are perpetuated exist in the original organization of the seed of the plant, such as marked or curled leaves, &c. The word *monster* is more properly applied to those irregularities in plants which arise from frequent transplantation, and from a particular culture, such as double flowers; but those monstrosities which are not perpetuated, and which arise from accidental and transient causes deranging the primitive organization of the plant when it comes to be unfolded, being the effect of diseases, of heat or cold, of a superfluity or scarcity of juices, of a deprivation of the vessels contributing to nutrition, of the sting of insects, and of contusions and natural grafts, retain also the name of *monsters*. Of this kind are knobs or swellings, stunting, gall-nuts, certain streaks, the inosculation of branches, and other similar defects.

MONSTRELET, ENGUERRAND DE, a French chronicler, was born of a noble family, and flourished in the first half of the fifteenth century. He was provost of the city of Cambray and bailiff of Wallaincourt; and he died in 1453. His *Chronicle* narrates with simplicity and truth, but with great diffuseness, the capture of Paris and of Normandy by the English, and the wars between the houses of Orleans and Burgundy. The first book begins with 1400, the year at which the chronicle of Froissart stops, and ends with 1422; the second stops at 1444 There is a third book, bringing down the history to 1453, which Buchon, the best editor of Monstrelet, considers to be spurious. The edition of Buchon was published in 15 vols. 8vo, Paris, 1826-7. Johnes, the translator of Froissart, translated Monstrelet into English, in 5 vols. 4to, 1810.

MONT DE PIÉTÉ (Ital. *Monte di Pietà*), a public benevolent institution established in Italy in the 15th century, by the Papal and other Italian governments, for lending money to the necessitous at a limited rate of interest. With the design of putting a check upon the usurious Jewish money-lenders of that age, Leo X., or according to some, Paul III., sanctioned the first establishment of a Monte di Pietà at Rome, which was a sort of bank, under the direction of a society of wealthy persons, who supplied the necessary funds, and lent upon pledges small sums for a fixed term at a low rate of interest. The interest charged was meant to defray the necessary expenses of the institution; and the funds were administered on the most economical and equitable principles, with the sole design of benefiting the borrower. Similar establishments were afterwards set on foot throughout the most of the Italian towns, and soon extended to the Netherlands and to Spain. These institutions, which are still in existence in Italy, were plundered by the French under Napoleon during the Italian invasion of 1796–7; and the Pope himself was obliged during the same period to seize upon the pledges of the Monte di Pietà, to enable him to pay the war contributions exacted by the French.

The *Monti Frumentarii* are granaries established in different parts of Italy to supply the needy with grain on the same principle as that on which money is lent by the Monti di Pietà.

MONTAGNANA, a town of Austrian Italy, in the government of Venice, and province of Padua, is situated 22 miles S.W. of Padua. It is defended by walls and high towers, built of brick, and affording an excellent specimen of the fortification of the middle ages. The town has several old churches, one of which, of the fourteenth century, in the Italian-Gothic style, stands in the Piazza or principal square. There are also at Montagnana a castle, a theatre, a female school, and an hospital. The manufactures consist of woollen and linen stuffs, leather, and hats; and there is some trade in agricultural produce. Pop. 9800.

MONTAGU, BASIL, Queen's counsel, was the natural son of the fourth Earl of Sandwich and of that Miss Ray who was shot in the piazza of Covent Garden, in 1779, by her jealous lover, a clergyman of the name of Hackman. He was born in April 1770. His early education was received at the Charter-House School in London; and he studied and took the degree of M.A. at the university of Cambridge. He afterwards entered Gray's Inn, and was called to the bar in 1798. His professional eminence, however, was not the result of his power of pleading, but of the numerous works which he continued to write. The most important of these was *A Digest of the Bankrupt Laws, &c.*, which was published in 4 vols. in 1805, and which secured for him the office of commissioner of bankrupts. Montagu was also distinguished for his exertions to mitigate the severity of the penal code. He wrote several pamphlets on capital punishments; and in conjunction with

Wilberforce, Romilly, and others, he succeeded in abolishing hanging for forgery. To the reader of general literature, however, he is best known as the friend of Coleridge, and the editor of an elaborate edition of Bacon's works in 16 vols. He died at Boulogne in November 1851.

MONTAGU, *Lady Mary Wortley*, was the eldest daughter of Evelyn Pierrepont, Duke of Kingston, and Lady Mary Fielding, daughter of William, Earl of Denbigh, and was born at Thoresby, Nottinghamshire, in the year 1690. She was connected through the Pierreponts with Beaumont the dramatist. Villiers, Duke of Buckingham, was her grand-uncle, and Henry Fielding was her second cousin. Having lost her mother at the age of four, her education was left to a sensible grandmother, a superstitious nurse, and a weak governess. Under the tuition of her brother's preceptors, she acquired some knowledge of Latin, a smattering of Greek, and the rudiments of the French language. At the age of eight she had made considerable proficiency, and began to read all the books she could lay her hands on. Her first known poetical effusion was an *Epistle from Julia to Ovid*, written at the age of twelve, and which, besides the complimentary gallantry, exhibits a nice apprehension of the style of versification then in vogue. At fifteen she formed a project of establishing an English nunnery, and of electing herself lady-abbess, but had not the means to carry out her scheme. At twenty she translated Epictetus, most probably from the Latin version, under the eye of her friend Bishop Burnet.

The next step of importance in the life of Lady Mary was her marriage with Edward Wortley Montagu, son of the Hon. Sydney Montagu, and grandson of the first Earl of Sandwich. He was a country gentleman, not remarkably brilliant, but possessed of considerable scholarship. The marriage seems to have been ill-assorted, and certainly proved unfortunate. A radical incongruity of character existed between them which time could not correct.

In 1714 Mr Wortley obtained a place in the Treasury, and in consequence took his lady to court, where her wit, spirit, and beauty attracted general admiration, and made a considerable impression on the Prince of Wales, afterwards George II. In 1716 Mr Wortley, who had made no great figure at home, was appointed ambassador to Constantinople, where his success was not more remarkable. But he took his wife with him to the capital of the Turkish empire, and thus afforded her an opportunity, in her *Letters from the Levant*, of charming the world with the most luxurious pictures ever yet given of a voluptuous people, and of bringing away with her, in the shape of inoculation for small-pox, a talisman for the preservation of beauty. From these, and indeed from all her future letters, it is clear that her good sense was sound and uncompromising, with an ever-increasing tendency towards universal justice. Besides Constantinople, Lady Mary and her husband, whilst abroad, visited several parts of Germany; and on their return sailed through the Archipelago, touched on the coast of Africa, and, crossing the Mediterranean to Genoa, reached home through Lyons and Paris in October 1718. From all these places we have letters of the liveliest kind, and, considering the time at which she wrote, of the most original description. A traveller so shrewd and observant was till then unknown, and her sex gave to the novelty an additional attraction. The manners of Italy she found peculiarly congenial to her disposition; and accordingly, when in 1739 she resolved to pass the remainder of her life on the Continent, she betook herself to that country, and remained there until within less than a year of her death.

On her return from the East, Pope prevailed on her to come and live near him at Twickenham. Both were then in the zenith of their reputation, and mutual admiration seemed to give assurance of the stability of their friendship. But a short time sufficed to prove that this anticipation was ill founded. Various causes have been assigned for the sudden rupture which ensued. According to Lady Mary's own statement, the truth of which is borne out by other evidence, Pope at some ill-chosen time made such passionate love to her, as, in spite of her utmost endeavours to be angry and look grave, provoked an immediate burst of laughter, from which moment the mortified poet became her implacable enemy.

On her return from Constantinople, she introduced inoculation for the small-pox into England, through the medium of the medical attendant of the embassy. She had lost her only brother by the disease, which had also destroyed her own beautiful eye-lashes; and she was resolved to give to her family and the world the benefit of a practice which promised to save the lives and to preserve the beauty of millions. With courageous love, she began with her own offspring, and lived to see her innovation triumphant, though not until it had encountered such an opposition that she almost repented of her philanthropy. In the month of July 1739 she left England without her husband, with a resolution to pass the remainder of her life on the Continent. She proceeded at once to Venice, and took possession of a deserted palace on the banks of Lake Iseo, in the Venetian territory, where she planned a garden, applied herself to the business of a country life, and solaced herself with books, which in some measure supplied the want of society. On the death of Mr Wortley, which took place in 1761, she yielded to the solicitations of her daughter, Lady Bute, and after an absence of twenty-two years, returned to England. But her health had suffered much from a cancer with which she was afflicted; and before ten months had elapsed, she expired, on the 21st of August 1762, in the seventy-third year of her age. Lady Mary Wortley Montagu was undoubtedly the most remarkable woman of her time. She was the presiding female wit in the days of Pope, the benefactress of her species by the introduction of inoculation, and the keen satirist of the fashionable circles. Her poems are indeed little else than wit in rhyme,—mere *vers de société*; but her prose is truly admirable. It is idiomatic, easy, fresh, racy, and piquant; sparkling with wit, and often equally remarkable for strong sense and sarcastic bitterness. The conventional shows of things could not deceive her; she saw beneath the painted masks which are worn in society, and fearlessly published her discoveries. It is only to be regretted that she occasionally overlooked what was worthy in human nature, and wasted her fine powers on objects that only served to embitter her life.

The best edition of her *Letters and Works* is that published by her great-grandson Lord Wharncliffe, London, 1837, in 3 vols. 8vo, containing a very spirited life of Lady Mary, under the title of *Biographical Anecdotes*, supposed to be from the pen of her grand-daughter Lady Louisa Stuart. A new edition of her *Letters* appeared in New York in 1856, in vol. ii. of *The Library of Standard Letters*.

MONTAGU, *Edward Wortley*, only son of Edward Wortley Montagu, Esq., and Lady Mary, the subject of the preceding article, was born at Wharncliffe in Yorkshire in October 1713. In 1716 he accompanied his parents to Constantinople, and, on their return to England in 1718, was placed at Westminster School. Here he gave the first indication of his wayward disposition by running away, and eluding all search, until about a year afterwards, when he was accidentally discovered at Blackwall, with a basket of fish on his head, having bound himself, by regular indenture, to a poor fisherman. Emancipated from this degrading condition, he was again placed at Westminster School; but ere long he absconded a second time, and bound himself to the master of a vessel engaged in the Oporto trade,

Montaigne. who, supposing him a friendless boy, treated him with great kindness and humanity. He had scarcely landed at Oporto, however, when he ran away, and contrived to get employment for two or three years in tending vines. Here he was at length discovered, brought home, and, on promise of amendment, pardoned; but unhappily with no better effect than before. He ran away a third time, after which his father procured him a tutor, who so far reclaimed him to habits of regularity, that he obtained an appointment in one of the public offices. In 1747 he was elected one of the knights of the shire for the county of Huntingdon; but he does not appear to have in any way distinguished himself as a member of Parliament, nor did he long retain his seat, his expenses having so far exceeded his income, that towards the close of the year 1751 he found it prudent once more to leave England. He proceeded to Paris, where in a short time he was imprisoned in the Châtelet for some fraudulent gambling transaction in which he had been concerned, but soon effected his escape. In the Parliament which assembled in 1754 he was returned for Bossiney. Besides some dull communications to the Royal Society, he published a book on the *Rise and Fall of the Ancient Republics*, the merit of which was afterwards claimed by his tutor, Mr Foster. His father died in the year 1761, at an advanced age, and by his will bequeathed to his son a considerable annuity. His mother died in the year 1762, and left him only one guinea. He had offended her irreconcilably by his misconduct. But as his father's bequest had rendered him independent, he took a final leave of his native country, passed the remainder of his life in foreign parts, and died at Padua in 1776. Before his death he became first a Catholic and then a Mohammedan, in which latter character he ended his days. He travelled in the East; and among other pieces is said to have published an *Explication of the Causes of Earthquakes*.

MONTAIGNE, Michel Seigneur de, was descended from an ancient English family named Eyquem, and was born at the castle of Montaigne, in Périgord, on the 28th of February 1533. His father, a brave and loyal squire, who had served in Spain and Italy, where he had cultivated his mind and improved his taste, bestowed much attention on his education, and in particular initiated him into the knowledge of languages by a process much less tardy and laborious than that ordinarily pursued in schools. He provided his son with a German master, who, being entirely ignorant of French, but well versed in Latin, spoke to him only in the latter tongue, which he consequently acquired as a vernacular language, and at the age of six was able to converse in it with tolerable freedom and fluency. Greek was also taught him as a sort of diversion. By means equally attractive, he was led to acquire some knowledge of science; and, without forcing his inclination or imposing the necessity of severe application, his habits were formed, and his powers agreeably exercised. All this care and attention he repaid by the most tender affection for the memory of his father; indeed filial piety is said to have formed a conspicuous trait in his character, though it must be confessed that he sometimes displayed it in a manner sufficiently singular. At an early age he was sent to the college of Guienne at Bordeaux, then the most flourishing in France, where he had as masters Nicolas Grouchy, William Guérente, George Buchanan, and Muret, under whom he appears to have made considerable proficiency. Having completed his studies at the age of thirteen, Montaigne resolved to study law; and in 1554 he became a counsellor or advocate at Bordeaux, and continued to practise as such until the death of his elder brother, when he abandoned a profession to which he never had any real liking, and which he appeared afterwards to consider as derogatory. In 1566 he married Françoise de la Chassaigne, to please his friends, he says, rather than himself, for he was not much disposed for a married life. He, however, proved a faithful husband, and enjoyed the matrimonial state much better than he had "promised or hoped." But he reconciled himself, as he says in his own familiar, gossiping, satirical way, by reflecting that "it is too late to kick when the fetters are on." He had one daughter as the fruit of this marriage. Montaigne.

At his father's request, Montaigne translated in 1569 the *Theologia Naturalis* of the Spanish divine Raymond Sebonde; and in 1571–2 edited the posthumous works of his lamented friend Etienne de la Boëtie. He kept aloof from public affairs during the civil and religious dissensions then desolating France, and thus rendered himself obnoxious both to the Protestants, with whom he really sympathized, and to the Roman Catholics, to whom he was attached by the ties of education and loyalty. His feelings were as humane as his sentiments were liberal; and the horrors of St Bartholomew plunged him into a deep melancholy. For the improvement of his health, and with a view to the study of men and manners, he travelled through various parts of France, Germany, Switzerland, and Italy, making observations on everything curious or interesting in society, and receiving several marks of distinction in the course of his peregrinations. The private journal which he kept of this tour was discovered two centuries afterwards, and published under the title of *Journal de Voyage de Michel de Montaigne en Italie, par la Suisse et l'Allemagne, en* 1580–81, Paris, 1774. It was about this period that he began to write his celebrated *Essais*, which were published in March 1580. In 1581 he was admitted a citizen of Rome, in which city he then sojourned; and the same year he was elected mayor of Bordeaux, an office in which he seems to have given much satisfaction to his fellow-citizens. In 1582 he was sent on a special mission to court about some affairs of importance; and on the expiration of his mayoralty he was again elected to the same office. In 1588 he appeared to some advantage at the assembly of the states at Blois, and, though not a deputy, took a share in the proceedings, but on what pretence or in what capacity does not clearly appear. During one of his visits to court he received the cordon of the order of Saint Michel, a distinction which he appears to have greatly coveted, though we afterwards find him complaining of the discredit into which it had fallen. Having retired to his family residence, he devoted himself to study; but his tranquillity was disturbed by the civil wars which desolated Guienne; and being driven from his house, he wandered about during six months seeking shelter for his family, and often with difficulty obtaining an asylum amongst those who had shared his hospitality. It appears, from a statement of De Thou, that Montaigne had sought to bring about a reconciliation between the Duke of Guise and the King of Navarre, afterwards Henri IV.; and on his return from Paris, where he had completed a new impression of his *Essais* in 1588, he was with the historian at Blois when the Duke of Guise was there assassinated. In his old age he was very much afflicted with stone and nephritic colic; but he never could be prevailed on to take medical advice. He died on the 13th of September 1589, and was buried in the church of the Feuillants at Bordeaux, where a monument was erected to his memory. Notwithstanding his constitutional tendency to scepticism, and certain unguarded expressions which seem almost to intimate an entire absence of the sentiment of religion, he is said to have died a Christian. He at all events had mass celebrated in his chamber in his last moments, and expired during the elevation of the host.

To form anything like a correct idea of Montaigne, it is absolutely necessary to make a study of his *Essais*. Nothing but a weak and dwarfish picture of the man could be

Montaigne. formed from selections or quotations from his familiar pages, however judiciously made. His book, he informs us, is about himself, and himself alone. Whatever else of anecdote, speculation, narrative, or remark, is introduced into it, has only a place there from its relation to the living centre around which it has been collected. In what to him seemed a wide sea of conflicting opinion, shoreless and without a horizon, the only fixed and really tangible object he considered to be himself. To disclose himself, accordingly, in all phases of his nature, whether of strength or weakness, nobility or meanness, beauty or deformity, wisdom or folly, he made the business of his calm, meditative life. He records his virtues and his vices, his merits and his defects, with a familiar candour and easy simplicity which at once disarms criticism and secures sympathy. One feels, as he listens to this strange blending of simple gossip and deep wisdom, told in an easy, rambling, picturesque style, as if he occupied a seat in that small round study of Montaigne's, with its "three noble and free prospects," from "the third storey of a tower" of his high, windy Montaigne Castle, and enjoyed the close and familiar friendship of this robust, indolent, thoughtful old Gascon. As to his personal appearance, he was of low stature, he informs us: "I am, as to the rest, strong and well-knit; my face is not puffed, but full; my complexion, betwixt jovial and melancholic, moderately sanguine and hot." He deplores his incorrigible awkwardness and want of personal dexterity. "My hands are so clumsy that I cannot so much as write so as to read it myself." He consoles himself, however, for these physical defects by the reflection, that "my bodily qualities are very well suited to those of my soul; there is nothing sprightly, only a full and firm vigour. I am patient enough of labour and pains; but it is only when I go voluntarily to the work, and only so long as my own desire prompts me." (*Essais*, t. ii., c. 17.) He dwells now upon his want of memory and his perfect truthfulness,—upon his occasional absence of mind,—upon his dislike of ceremony and love of politeness,—and upon his disbelief in omens and ghosts. Again, he has a profound sense of the sad instability of all human affairs, becomes gravely thoughtful, and shows symptoms of a real though passing melancholy as he meditates on death. He wore for his device a balance, with the characteristic motto, "*Que sçay je?*" was vain of his cordon of honour, and was fond of showing his coat of arms. He was strongly averse to all cruelty and malignity of feeling, and never fails to denounce injustice, inhumanity, and uncharitableness.

His reputation as a writer is founded solely on his *Essais*, which were at one time extremely popular, and which are still read by a numerous class. As a writer, he imparted to the French language an energy which it did not before possess, and which but few of his successors have equalled. As a philosopher, his object was to describe man as he is, without reserve and without exaggeration; he studied himself, and recorded his observations with surprising acuteness and fidelity. He united in a high degree the powers of observation and reflection, without which the study of man can never be successfully prosecuted; and although there is no doubt much truth in the acute but severe strictures on his character by the Port-Royalists, who freely expose his vanity, his self-love, and the indulgent manner in which he speaks of his vices; yet, as Mr Stewart observes, "this consideration, so far from diminishing the value of his *Essais*, is one of the most instructive lessons they afford to those who, after the example of the author, may undertake the salutary but humiliating task of self-examination." In the first *Preliminary Dissertation* (part i., section ii.), to which the reader is referred, will be found an exposition and criticism of Montaigne's philosophy. Montaigne's Life was first written by the President Bouhier, and prefixed to a supplementary volume of his works in 1740. In 1774 the Academy of Bordeaux awarded a prize to Talbert for an *éloge* on Montaigne; and the French Academy bestowed a similar honour on Villemain in 1812. This masterly *éloge* is attached to the 8-vol. edition of Montaigne's *Essais*, Paris, 1825. The best English translation of the *Essais* is that of Cotton, first published in 1700, but revised and corrected in 1759.

Since the above was written a new *Life of Montaigne* has been published by Bayle St John, Lond. 1857. (For valuable papers on Montaigne, see Sterling's *Essays and Tales*, Emerson's *Representative Men*, and *Oxford Essays* for 1857.)

Montalegre | Montalvan.

MONTALEGRE, a town of Brazil, in the province of Para, is situated on an island in the Amazon, near the mouth of the Gurapatuba, 150 miles E.N.E. of Para. It has a church, a saw-mill, and a considerable trade in mandioc, cotton, cocoa, coffee, &c. Pop. 4000.

MONTALEMBERT, MARC-RÉNÉ, MARQUIS DE, a distinguished French engineer, was descended from a noble and ancient family, and was born in July 1714, at Angoulême. After receiving an education suitable to his birth, he entered the army at the age of eighteen, and was present at the sieges of Kehl and Philipsburg. He was next engaged in the war with Bohemia. On the conclusion of peace he turned his attention to the cultivation of those sciences upon which the military art is founded. He became a member of the Academy of Sciences in 1747, and contributed to its Memoirs several papers on fortification. He also established forges at Angoumois and Périgord, for the purpose of supplying the French navy with cannons and projectiles. During the Seven Years' War the important post of French agent in the Russian and Swedish armies was entrusted to him. In 1776 he began to publish at Paris his *La Fortification Perpendiculaire, ou l'Art Defensif supérieur à l'Offensif*, a large work, which was completed in eleven volumes in 1796. Meanwhile he had been charged in 1779 with the task of fortifying the Isle of Aix against the attacks of the English. The wooden fort, which he constructed on a new plan, proved efficient in spite of the prognostications of his fellow-engineers. By these efforts for the promotion of military art Montalembert brought himself into debt, and was compelled to sell his foundries to the government. But the price of them could not be obtained even after frequent applications. It is no wonder, therefore, that, aristocrat though he was, he became a supporter of the principles and practices of the French revolution. A pension, awarded to him for the loss of an eye during his services to the government, was resigned for the behoof of the state; and, like a true democrat, he divorced his wife to make room for the daughter of an apothecary. In return for such conduct he was allowed to recover his sequestered estate, and to sell it for the supply of his wants. The assignats, however, which he received as the price, fell immediately in value, and left him as poor as ever. Towards the close of his life Montalembert recommended himself to the notice of the Committee of Public Safety; and was frequently consulted by Carnot on the subject of military operations. He died of dropsy in March 1800. Besides his chief work, already mentioned, Montalembert wrote *Correspondance pendant la Guerre de* 1757, 3 vols. 8vo, 1777; *L'Ami de l'Art Defensif*, 4to, 1796; and *Relation du Siége de Saint-Jean-d'Acre*, 8vo, 1798.

MONTALVAN, JUAN PEREZ DE, an eminent Spanish dramatist, was the son of the King's bookseller, and was born at Madrid in 1602. His youthful genius was stimulated by the example, and guided by the advice and assistance, of the great dramatic writer Lope de Vega. So strong, indeed, was the mutual esteem between the two poets, that the elder treated the younger as a son, and the younger adopted the elder as his model in almost everything. Like his admired master, Montalvan entered the

priesthood, and accepted an office in the Inquisition. He was also a most voluminous writer. By his thirtieth year he had produced thirty-six dramas; and in 1636 the number had increased to about sixty. In their success, as well as in their flimsy construction and careless execution, he likewise resembled Lope de Vega. One of the last works of Montalvan was an extravagant panegyric on his great friend, published in 1636. By this time his intense and incessant labours had begun to derange his brain. Not long afterwards he fell into a state of imbecility, which continued till his death in June 1638. Montalvan's collected dramatic works appeared in 1638–39, and were reprinted in 1652.

MONTANARO, a town of Piedmont, in the province of Turin, is situated near the Orco, 14 miles N.N.E. of Turin. It is well built, and has two squares, a church, a castle, a court-house, and several schools. Some trade is carried on here in cattle and tobacco. Pop. 4400.

MONTANCHES, a town of Spain, in the province of Caceres, is situated in a hilly region, 20 miles S.E. of the town of Caceres. The streets are steep and well paved; the principal buildings are a town-house, prison, church, nunnery, and several schools. The town has many flour and oil mills; but it is chiefly noted for the excellence of its hams. Pop. 5587.

MONTANUS, the founder of the sect of the Montanists, appeared as a teacher of new doctrine at the village of Ardaban, on the borders of Phrygia, about the middle of the second century. At that time the church was suffering under bloody persecutions from without and distracting heresies from within. In his burning desire to cheer and enlighten her, Montanus began to imagine himself to be the passive instrument in the hands of God for dispensing new revelations. He foretold the near approach of those judgments that would sweep all persecutors from the earth, of the second advent of Christ, and of the commencement of the blessed millennium. With such a prospect at hand he admonished all Christians to live soberly and righteously, and more especially to risk all for the martyr's crown. At such startling announcements many scoffed; but others, including two females of fortune, Maximilla and Priscilla, became converts, and fell immediately into ecstacies of exhortation and prophesying. Stimulated by this success, the delirious imagination of Montanus began to create more portentous delusions. He fancied himself to be an inspired prophet sent to the entire church to complete the code of moral duties, to extinguish all heresies by new light from on high, and to prepare the church for the coming of her Lord. He even pointed out a paltry Phrygian village, called Pepuza, as the future site of the New Jerusalem.

Such presumptuous ravings, in order to merit the name even of heresy, required a systematic arrangement which the crazed brain of Montanus was too weak to execute. This arrangement was afterwards effected by Tertullian, the greatest of the Montanists, and may be represented in the following outline:—Christianity, like all the other works of God, undergoes a gradual development, and is constantly approaching perfection. This developing process may be distinctly seen running through the successive ages of the patriarchs, the prophets, and the teachers of the New Testament. But in the last of these periods it had not attained perfection; for Christ explicitly foretold the coming of a Comforter who should elucidate all the mysteries of the truth; and even after the death of the apostles there remained pagan practices to be condemned, heresies to be refuted, and obscure passages in the Scripture to be explained. It therefore stands to reason that the Spirit of God, the same in all ages, should descend with resistless influence in these latter times, as in the days of the Hebrew prophets and at Pentecost, and should fill certain chosen vessels with that supernatural illumination which is to light the church on to perfection. Accordingly Montanus, like the Apostles, became the passive recipient of the Holy Ghost. Nor was the supernatural gift restricted to the priests, who claimed to be successors of the Apostles. Christians of every grade fell into divine rhapsodies, and even women, as Joel had foretold, began to prophesy.

The precepts with which these enthusiastic teachers eked out the moral code were, as might have been anticipated, full of severe asceticism and a stoical contempt of pain. The old fasts were prolonged, and new fasts were added. Those who were guilty of the more deadly crimes were excluded from the church for ever. Martyrdom was held up as the great object of ambition, and to attempt to shun this kind of death, or to wish for any other, was denounced as a sin. Those believers who wished to become superior channels for the stream of revelation passing from heaven to earth, were required to remain in celibacy. Marriage was defined to be a bond, not merely bodily and temporal, but also spiritual and eternal; and therefore they who married a second time were treated as adulterers. A denouncement also fell upon all usages and all arts and sciences that arose during the reign of heathenism.

The followers of Montanus, in the midst of much controversy and persecution, continued to increase under the several names of *Montanists*, *Cataphrygians*, and *Pepuzians*; they were found in Asia, Africa, and a part of Europe. They still existed in the time of Augustine and Jerome. (See Neander's *History of the Church*.)

MONTARGIS, a town of France, capital of an arrondissement of the same name, in the department of Loiret, is situated on the Loing, 40 miles E.N.E. of Orleans. The town, which is partly walled, is well but irregularly built, and formerly contained a castle, which was entirely destroyed in 1809. Montargis has a church, two hospitals, and a theatre. Manufactures of cloth, leather, and paper are carried on here; and the town has a considerable trade in cattle, corn, honey, wax, leather, &c. Pop. 7757.

MONTAUBAN, a town of France, capital of the department of Tarn-et-Garonne, is situated on an elevated plain on the right bank of the Tarn, which is here crossed by a brick bridge of seven arches, 342 miles S. by W. of Paris. It is small and irregular, and the houses ill built; but on the other side of the river stands a suburb called Ville Bourdon, which is regularly and well built. The town itself has three squares, one of which, called the Place Royale, is large and surrounded by handsome houses. There is a fine promenade called Les Terrasses, which commands an extensive view of the surrounding country as far as the Pyrenees and the sea. Montauban was formerly strongly fortified; but the only remains of its defences at present are its gates. The principal buildings are,—the cathedral, a cruciform building in the Italian style, with two turrets; the church of St James; the prefecture; the town-hall, a square building with four turrets; and the bishop's palace. Montauban has also a college and several other educational institutions. The manufactures are extensive, consisting of silk, woollen, and cotton stuffs, leather, starch, soap, earthenware, brandy, &c.; and some trade is carried on in these articles and the produce of the neighbourhood. Montauban has a court of first resort, a tribunal of commerce, a chamber of manufactures, a public library, and a society of agriculture, science, and literature. Five fairs are held here annually. Montauban was founded in 1144 by Count Alphonse of Toulouse. At the Reformation the people embraced the Protestant cause; and the town was ineffectually besieged by the adverse party in 1580. It afterwards, in 1621, resisted for three months the assaults of Louis XIII., and did not yield till after the fall of Rochelle in 1629. The fortifications were soon after destroyed. The Ville Bourdon was founded by Protestants expelled from Montauban in 1562. Pop. (1851) 23,314.

MONTBELLIARD, or MONTBÉLIARD (German *Mümpelgard*), a town of France, capital of an arrondissement of the same name, in the department of Doubs, is situated at the confluence of the Allan and the Luzino, 48 miles N.E. of Besançon. The town is well built, and adorned by several fountains. The principal buildings are,—the castle, now used as a prison, situated on an eminence; the town-hall; and the churches of St George and St Martin. The manufactures consist of silk, cotton, and woollen fabrics; leather, clocks, watches; scythes, and other implements of husbandry. There is also an active trade carried on in timber, corn, cheese, &c., with Switzerland and the south. Montbelliard was in former times a place of some strength, and the capital of a county that originally formed part of the kingdom of Burgundy, but was transferred to the Wurtemberg family in 1395. Although twice taken by the French in the seventeenth century, it was not finally ceded to them till 1796. Pop. (1851) 5605.

MONT BLANC, the highest mountain in Europe, belongs to the Pennine Alps, and is situated on the confines of Savoy and Piedmont. This mountain, along with the adjacent branches, forms an oval mass, extending from N.E. to S.W., between Mont Catogne, above Martigny, and the Col du Bonhomme, a distance of 30 miles; and having a breadth of 13 miles between Chamouni and Courmayeur. The appearance of Mont Blanc, when viewed from Chamouni, is that of a round smooth summit, covered with snow, and towering above the other peaks of the same group. The colour of the summit is generally an orange-yellow when lighted by the sun; but at sunset and sunrise the most remarkable and beautiful changes of appearance take place. When the sun's rays have ceased to illuminate the lower mountains, and Mont Blanc alone has the light of the sun still shining on it, its bright hue appears much brighter by reason of the contrast with the surrounding darkness; it assumes a clear roseate tint, and its lustre is sometimes nearly equal to that of the stars. Soon after, however, this brightness passes away as the sun's light is gradually withdrawn, and the mountain assumes a pale-blue appearance. This is owing to the contrast between the mountain, now in the shade, and the thin clouds and vapours which hang above it, and are still lighted by the sun. The geological structure of the central mass of Mont Blanc, as well as of the group of mountains to which it belongs, is granite; but on the sides are found strata of limestone, sloping upwards from the centre; while on the further side of the valleys by which the mountain group is bounded, the limestone strata slope in an opposite direction; and beyond these granite is again found. From the central summit of Mont Blanc many ridges branch out in all directions; between which are ravines, filled with glaciers, and sloping down to the valleys on each side. These valleys are four in number, and form the separation between the group of Mont Blanc and the rest of the Alps. They are separated from each other by ridges, called *cols*, of comparatively small height, which join Mont Blanc at various points to the other mountains. The valley of Chamouni lies to the N.W. of Mont Blanc, and is bounded at its head by the Col de Balme. It is watered by the Arve, which flows in a S.W. direction to the foot of the valley, where it turns N.W., and flows round the Col de Voza and the Col de Forclaz, which separate the valley of Chamouni from that of Montjoie. The latter valley, which bounds Mont Blanc on the W., is traversed by the swift stream of Bon Nant, which flows northward, and joins the Arve below the point where these two valleys finally unite. The head of the valley of Montjoie is formed by the Col du Bonhomme and the Col des Fours, on the S. side of which rise the head waters of the Isere, which flow directly away from Mont Blanc. The S.E. and E. boundaries of the mountain group are formed by the Allée Blanche and the valley of Ferret. The head of the Allée Blanche is formed by the Col de la Seigne, from which the valley extends in a N.E. direction, being traversed by one of the main streams of the Doire, a tributary of the Po. The other branch of this river flows in an opposite direction, from the Col de Ferret through part of the valley of Ferret; and both streams join a short distance above Courmayeur. The Col de Ferret divides the valley of the same name into two parts, or rather into two distinct valleys, the Piedmontese and the Swiss, the latter of which extends northwards as far as Mont Catogne, the north-eastern extremity of the group of Mont Blanc. The Col de la Forclaz extends to the N. between Mont Catogne and the Col de la Balme. The main ridge of the Alps consists of the Col de Ferret, which extends eastward to the Great St Bernard, and the Col de Seigne, which stretches southward to the Little St Bernard. The principal glaciers which descend into the valley of Chamouni are,—the Glacier du Tour, the Glacier d'Argentière, the Glacier des Bois, the Glacier des Bossons, and the Glacier de Tacconay; in the valley of Montjoie the chief are those of Bionnassay, Niage, and Trelatile; in the Allée Blanche,—the Glacier de l'Estellette, the Glacier de l'Allée Blanche, the Glacier de Miage, forming the opposite side of that of the same name in the valley of Montjoie, and the Glacier de la Brenva. In the Piedmontese valley of Ferret there are the Glacier of Mont Frety, that of Entrêves, the Glacier de Rochefort, the Glacier de la Grande Jorasse, the Glacier de Triolet, and the Glacier of Mondolent. The glaciers in the Swiss valley of Ferret are not of great size; and the only other remarkable one is that of Trient, which stretches northward between the Col de la Forclaz and the Col de Balme. There are also several glaciers in the centre of the mountain group; the principal of which is the Mer de Glace, which forms the upper portion of the Glacier des Bois. The height of Mont Blanc is 15,744 feet above the level of the sea; and on the S. side it rises 11,700 feet almost perpendicularly from the Allée Blanche. Its appearance from this side, accordingly, is much more imposing than when seen from Chamouni, as the acclivity consists entirely of steep and rugged rocks on which no snow lies. (See ALPS.)

MONTBLANCH, a town of Spain, in the province of Tarragona, and 19 miles N.W. of the town of that name. It has a town-house, several churches and schools, an hospital, and a prison. There are distilleries, tanneries, cotton factories, flour and oil mills; and some trade is carried on in wine, brandy, and fruits. Pop. 4200.

MONTBRISON, a town of France, capital of the department of Loire, is situated at the foot of a high and steep rock, on the Vizézy, 37 miles W.S.W. of Lyons. The streets are narrow and crooked, and the houses poor and ill built. The town was formerly fortified; but the walls are now replaced by fine boulevards. It has a Gothic cathedral of the thirteenth century, a court-house, a college, and several schools. Manufactures and trade are carried on to a very trifling extent. Pop. (1851) 6435.

MONT-DE-MARSAN, a town of France, capital of the department of Landes, is situated on a sandy plain, at the junction of the Midon and Douze, which form the Midouze, 63 miles S. of Bordeaux. The streets are broad, regular, well paved, and clean, and contain several fountains. The principal buildings are,—the church, town-hall, court-house, college, theatre, barracks, and prison. There are also public baths, and a public library. Manufactures of sail-cloth, blankets, leather, and brandy, are carried on; and some trade in wine, brandy, oil, wool, and the produce of the neighbouring country. Pop. (1851) 4463.

MONTE CHIARO, a town of Lombardy, on the left bank of the Chiese, 12 miles S.E. of Brescia. It is walled, and was formerly defended by a castle, of which one tower is all that now remains. There are two churches, and

several hospitals. Manufactures of silk are carried on; and there is a considerable trade. Near this town the French gained a victory over the Austrians in 1796. Pop. 6700.

MONTECUCULI, RAIMONDO, *Count de*, Prince of Melfi, and generalissimo of the imperial armies of Germany, was descended from a noble family, and was born at Modena in 1608. He entered the imperial forces as a volunteer, was engaged in the war against the Swedes, and quickly rose through the several grades of rank until he was placed in command of 2000 horse. At the head of these, in 1639 he surprised an army of 10,000 before Numslau in Silesia, cut them to pieces, and took their artillery and baggage. But he was speedily overtaken and captured by General Bannier near Prague. After a captivity of two years, spent in close study of the military art, he returned with renewed eagerness to the scene of war. His reputation as a general was retrieved by the defeat of Wrangel at Triebel in 1647. On the peace of Westphalia in 1648, he visited his native duchy; but being so unfortunate as to kill one of his dearest friends, Count Manzani, in a tournament held in honour of the marriage of Duke Francesco I., he hastened his return to Germany. His next expedition was against Prince Ragotski and the Swedes, who, in 1657, were threatening to drive John Casimir, King of Poland, from his kingdom. No sooner had he forced these to conclude a treaty, than he was despatched to relieve the King of Denmark from the Swedish force that was besieging his capital. In this enterprise he continued to experience his usual success until peace was re-established in the north by the death of Charles Gustavus, King of Sweden. He was then sent to check the advance of the Turks into Hungary. At the head of a very inferior force, he continued, by the rapidity of his movements, to baffle all the projects of the grand vizier, until, receiving reinforcements from the French, he came forth boldly into a fair field of battle, and finished the war in 1664 by the brilliant victory of St Gothard. Montecuculi was reserved for achievements still greater. On the outbreak of the war with France in 1673, he was placed at the head of the imperial troops, and contrived to effect a junction with the Prince of Orange, in spite of the manœuvres of the great general Turenne. In the following year the elector of Brandenberg was chosen to supersede him. But it was soon manifest that none but Montecuculi could cope with Turenne: he was therefore reinstalled in the supreme command in 1675. Then began a series of manœuvres and counter-manœuvres more glorious than an equal number of victories. For four months these two generals continued to follow each other, to watch every movement, and to be ever on the alert to seize the slightest advantage. Yet endurance, rapidity, and stratagem were all tried in vain, and could not affect the equality of the contest. Each divined the purposes of the other by supposing what he himself would have done in his position; and no sooner had the one begun to execute any plan than he found that he had been anticipated and thwarted by his opponent. At length the scarcity of provisions rendered it necessary for both parties that a battle should be risked. Turenne was already reconnoitring the ground, when a random ball from a cannon shot him dead, to the deep regret of the magnanimous general whom he had been ready to attack. His place was taken by the Prince of Condé. But not even that great commander could out-manœuvre Montecuculi; and the war was closed without any decisive action. Montecuculi had now finished his last and most glorious campaign. He spent the remainder of his life in the enjoyment of the distinction and honours which his great deeds had won, and in promoting the cause of learning and science. He died at Lintz in October 1681. The military memoirs which he wrote show how profoundly skilled he was in his profession. They were published in Italian at Cologne in 1704, and in Latin at Vienna in 1718. A French translation, with a Life of the author, appeared at Amsterdam in 1752.

MONTECUCULI, *Sebastiano di*, the alleged poisoner of the eldest son of Francis I., was a gentleman of Ferrara, and was originally in the service of the Emperor Charles V. He came to France in the suite of Catherine de Medici, and was appointed cup-bearer to the Dauphin. It was in this capacity that he accompanied the crown prince on a journey up the Rhone in the midsummer of 1536. While halting at Tournus, the Dauphin, in the midst of a game at tennis, became over-heated, and commanded his cup-bearer to give him a draught of cold water. He drank it off with great avidity, dropped down sick, and expired in a quarter of an hour. Montecuculi was immediately suspected of having poisoned him. His knowledge of medicine, and the fact that a treatise on poisons was found in his possession, confirmed the suspicion. He was therefore examined at Lyons in the usual manner of the day, and a wavering confession was wrung from him by torture. At one time he affirmed that he had been employed to perpetrate the crime by two of the generals of Charles V.; at another time he shifted the accusation on Catherine de Medici. But as he could adduce no facts in proof of either of these charges, he was dragged on a hurdle to the scaffold and executed. The infuriated populace tore his still quivering limbs into a thousand pieces, and threw them into the Rhone. Yet since that time historians have generally agreed in thinking that the Dauphin died of pleurisy, and that Montecuculi was innocent.

MONTEFIASCONE, a town of Italy, in the Papal States, situated on a hill, 9 miles N.N.W. of Viterbo, and 54 N.N.W. of Rome. The only public buildings are a cathedral and a few convents. Some remains have been found here of an ancient Etruscan city, the place of which is occupied by the modern town. The wine of the vicinity is reckoned of fine quality. Pop. 4800.

MONTEFORTE, a town of Naples, province of Principato Ultra, 5 miles W.S.W. of Avellino. It is situated at the foot of a hill, on which stand the remains of a castle formerly the residence of the family of De Montfort, who thence derived their name. The ruins are very picturesque; and from them a fine view of the neighbouring country may be obtained. Pop. 4000.

MONTEGO, a town of Jamaica, capital of Cornwall county, is situated on a bay of the same name, on the N. coast of the island, 17 miles W. of Falmouth. The town is defended by a battery; and the harbour is protected by a breakwater, but is exposed towards the N. There is a considerable trade carried on here. Pop. 4000.

MONTELEONE, a town of Naples, in the province of Calabria Ultra II., in a lofty position, 15 miles N.E. of Nicotera. Its imposing appearance is heightened by its castle, which overlooks the town. The town itself is irregularly and meanly built, chiefly of wood, and is badly paved. There are four churches, with some fine paintings; a royal college; and a court of commerce. The inhabitants are chiefly engaged in the tunny fishery; but there are also some silk-mills; and a considerable trade is carried on. N. of the town, and on the coast, stands the village of S. Pietro di Vivona, where there are some remains of the harbour of Hipponium or Vibo, a city of considerable importance in ancient times. It was originally a colony from the Epizephyrian Locrians, on the other side of the peninsula of Bruttium; but was taken B.C. 389 by Dionysius of Syracuse, who transported the people to that town. Ten years later they were restored by the Carthaginians; but soon afterwards the town fell into the hands of the Bruttians, in whose possession it remained till conquered by the Romans. A colony was established here by the latter in 192 B.C., and the city became one of the most flourishing in this part of Italy. It had large dockyards for ship-building, and was

conveniently situated for trade both by land and by sea. The ancient town probably stood on the same site as the modern, which is not older than the thirteenth century; but there are no ancient remains to be seen. Pop. 6630.

MONTELIMART, a town of France, capital of an arrondissement of the same name, in the department of Drome, is situated at the confluence of the Roubion and the Jabron, 26 miles S. of Valence. The town is defended by Gothic walls, is entered by four gates, and has a castle standing on an eminence in the centre. The houses are well built, and the streets broad and paved with basalt. It derives its name, Monteil d'Adhemar (Mons Adhemari), from an ancient noble family who had possessions here as early as the time of Charlemagne. Montelimart was one of the first towns of France to adopt the Reformed doctrines; and is noted in the civil wars of the Reformation. It has a court of primary instance, and a communal college. Manufactures of silk, leather, hosiery, tiles, &c., are carried on; and the place is famed for a sort of cake made of almonds and honey. Some trade is carried on in these articles, as well as in cattle, corn, &c. Pop. (1851) 8632.

MONTEN, Dietrich, an eminent battle-painter, was born at Düsseldorf in 1799. The love of his art seems to have been strong from his earliest boyhood. The descriptions of warlike encounters in Homer, Tasso, and Ariosto were the favourite readings of his school-days, and furnished subjects for his first attempts in sketching. That he might become thoroughly intimate with military scenes, he volunteered into the Prussian army in 1828, and served for a year. The next two years were devoted to study in the Academy of Arts in his native town. He then placed himself under the tuition of Peter Hess at Munich, and with the aid of that great battle-painter began to develop his own peculiar style of art. His pictures were executed with a rapidity that left no time for faithful design and elaborate finish. Yet they were full of spirited figures, boldly drawn, and strikingly coloured. In 1827 they had obtained for him the patronage of the painter Cornelius, and of Ludwig I., King of Bavaria. By the former he was employed to execute on the arcade of the Hofgarten three frescoes, representing the scenes from Bavarian history of "The Storming of the Turkish Entrenchment at Belgrade in 1717," "The Battle of Arcis-sur-Aube," and "The Granting of the Bavarian Constitution by Maximilian Joseph I. in 1818." For the latter he painted "The Battle of Saarbrück," and "The Departure of the Poles from their Fatherland." Among his other important historical pieces are "The Death of Gustavus Adolphus," and "The Great Camp in 1838 at Augsburg." Monten died in 1843. (See Bryan's *Dictionary of Painters and Engravers.*)

MONTENEGRO (called by the natives *Zernagora*, and by the Turks *Karadagh*, all which names are derived from the dark forests with which the mountains are covered) is a small state in European Turkey, tributary to the Porte, but virtually independent. It extends from 42. 10. to 42. 56. N. Lat.; and from 18. 41. to 20. 22. E. Long.; and is bounded on the N. by Herzegovina, E. and S. by Albania, and W. by Dalmatia. Area about 1450 square miles. This country consists for the most part of a mass of mountains, forming a part of the Dinarian Alps. The slope towards the sea is very steep; so that there are no rivers of any size on that side, and very little vegetation is found on the rocky acclivities. The lowest parts of this mountainous district are probably more than 2000 feet in elevation, and many of the higher summits rise upwards of 5000 feet above the sea. The interior is intersected with numerous ridges, forming valleys, which, however, are of no great size. Towards the E. the mountains diminish in height, till they are lost in the plain of the Moratsha; and the access to the high lands from this side lies through several narrow gorges. The Moratsha is the only river of any importance in Montenegro; it flows southward, and falls into the Lake of Skutari, which is situated in Albania, on the confines of Montenegro. The climate is healthy, but cold, owing to the elevated position of the country. The winter is long, and the spring and autumn are often very severe. Owing to the configuration of the country, there are few streams or rivers, and wells do not occur in large numbers; so that the inhabitants are obliged to collect the rain-water in cisterns to supply their wants. Except in a few well-watered spots, the fertility of the soil is not very great; and the ground is not largely cultivated. Indian corn, potatoes, cabbages, and other vegetables are raised; but the inhabitants depend for support chiefly on the live stock which they rear. Sheep, goats, and pigs are numerous, but there are few horses or cattle. Most of the mountains are covered with forests, chiefly consisting of oak and beech, which, though they do not attain their full height on the higher elevations, are often of great size in the lower regions. The Venetian sumach, a shrub, the wood of which is largely used in tanning, is found here in great abundance, and forms an important article of trade. The Montenegrins, from fear of invasion, have made no roads in their country; and internal communication is carried on by means of footpaths impassable for beasts of burden. A good deal of trade is carried on with the inhabitants of Cattaro in Dalmatia; but the Montenegrins are not allowed to carry on any intercourse with the neighbouring Turkish towns. They export live stock, smoked mutton, bacon, cheese, tallow, sheepskins, wool, &c., as well as the sumach wood and firewood; while they import wine, spirits, oil, salt, gunpowder, fire-arms, and other manufactured articles. The average value of the annual exports to Austria is L.1392, and that of the imports from that country L.434. Montenegro proper consists of four *nahias* or cantons—Katunska, Rietshka, Zermnitshka, and Lieshanska; but besides these there are some other tribes which belong to the confederation. These also are divided into four cantons, called *berdas*, distinguished by the names of Bielopovlitshka, Piperska, Kutshka, and Moratshka; and the inhabitants are called Berdiani, to distinguish them from the Montenegrins proper, or Zernagorzi. The government is in the hands of a vladika or prince, residing at Zetlinie; and the office is hereditary in the male line. The religion of the people is that of the Greek church; of which the vladika was formerly a bishop, uniting the supreme civil and ecclesiastical authority in his own person; but since 1851 these offices have been separated. There is a Senate, or council of elders, consisting of 12 members, to assist the prince. The people are tall, hardy, and athletic. They have great hospitality and a strong feeling of patriotism; but their mode of warfare is barbarous and unsparing, and they are constantly making plundering forays into the neighbouring districts. Their system of defence, when their country is invaded, consists of posting sharpshooters in various positions in the mountains, and enticing the invaders into these fastnesses, where they are gradually shot down by the unerring aim of the Montenegrin riflemen. When out of their own country, however, these mountaineers cannot stand against regular troops. The language spoken in Montenegro is a dialect of the Slavonic, the same as that spoken in Servia. Education is in a very low state, and it is thought a great accomplishment to be able to read and write. There are only two schools, one at Zetlinie and one at Dobroskoselo, both of which have been founded since 1841. The Montenegrins were reduced under the dominion of the Turkish empire in the reign of Solyman the Magnificent, and they remained in this condition till the year 1700, when, at the instigation of the Vladika Daniel, all the Mohammedans were put to death, and the country declared independent. In 1712 the inhabitants of the canton of Katunska took up arms in

favour of Peter the Great, and defeated a large Turkish army. The remaining three cantons united with that of Katunska in a confederation, after another victory gained over the Turks in 1796; and the tribes of Bielopovlitshka and Moratshka were added about the beginning of the present century. The last to join the republic was the tribe of Kutshka, which did not do so till 1831. The independence of Montenegro, however, although virtually complete, was never recognised by the Ottoman Porte, nor by any other of the European powers, with the exception of Russia. The emperor of that country took the Montenegrins under his protection, and sent to the vladika an annual remittance of L.4000, to meet the tribute paid to the Sublime Porte. The Austrian government also was always favourable to the independence of Montenegro. In 1851, on the death of the Vladika Pierre Petrovitsch, his nephew Daniel, who was appointed by his will to succeed him, refused to assume the office of bishop, and proposed to the Senate of Montenegro that the civil and ecclesiastical power should thenceforth be disjoined. This change in the constitution was approved of by the Senate and by the Emperor of Russia; and the prince, on his return from St Petersburg, was received amid the acclamations of the people. In 1853, in consequence of the seizure by the Montenegrins of the fortress of Zabliak, on the Lake of Skutari, the country was invaded by a Turkish army of 34,000 men, under the command of Omer Pasha; but after gaining a few successes in bloody conflicts, the interference of the Austrian and Russian cabinets induced the Sultan to recall this force, and leave Montenegro in its former state of independence. The population of Montenegro is about 120,000.

MONTEREAU, or MONTEREAU-FAUT-YONNE, a town of France, in the department of Seine-et-Marne, is situated at the confluence of the Yonne and the Seine, 12 miles E. of Fontainbleau. It is divided into three parts by the two rivers, which are crossed by bridges, the largest part lying on the left bank of the Yonne. The town is for the most part well built, and has a collegiate church, an hospital, and a town-hall. Manufactures of hosiery, leather, and earthenware are carried on, and there is a considerable trade with Paris in grain, timber, cattle, &c. Montereau is remarkable in history for the murder of the Duke of Burgundy at the bridge over the Seine in 1419, and for the last victory of Napoleon, February 18, 1814. Pop. 4826.

MONTEREY, a town of Mexico, capital of the state of New Leon, is situated on the Tigre, at the head of an extensive and picturesque valley, 85 miles E. by N. of Saltillo. The town is well built and paved, most of the houses being in the Moorish style, with flat roofs. The climate is mild and healthy, and there are gold, silver, and lead mines in the neighbourhood. Monterey is well fortified, and offered some resistance to the invading army of General Taylor in 1846; but after an assault of three days, it surrendered on honourable terms. Pop. about 13,000.

MONTE ROSA, a mountain of the Pennine Alps, on the borders of Switzerland and Piedmont, is a union of several mountain chains rather than a single summit. Four mountain chains radiate from a centre point, N., S., E., and W., respectively. A ridge of inaccessible mountains extends E. and W., from the Cime de la Pisse on the E. to the Col du Mont Cervin on the W.; and this is intersected at right angles by another chain, extending northwards as far as the Cima di Jazy, and southwards as far as the Col d'Ollen. The centre where these branches unite, called the Signal Kuppe, is not the most elevated point, there being three of greater height on the northern range. The first of these is called the Zumsteinspitze, and is the only one of the three which has been ascended; the second is the Höchste Spitze, or highest of all, which is connected with the former by a narrow and sharp ridge, descending steeply on one side into a tremendous abyss; and the third is the "Nord-End," which, like the highest, has not yet been ascended. The difference of the height of these four peaks is not, however, more than 200 feet between the highest and the lowest. The height of the highest is 15,158 feet above the sea. The four branches of Monte Rosa inclose between them four glaciers,—viz., that of Macugnana on the N.E., that of Gorner on the N.W., that of Lys on the S.W., and several of less size in the valley of Sesia on the S.E. The geological formation of Monte Rosa is gneiss and mica-slate; and it separates the waters flowing to the Rhone from those which join the Po. (See ALPS.)

MONTE SAN GIULIANO, a town of Sicily, in the province of Trapani, is situated on a mountain 2184 feet high, 5 miles E.N.E of Trapani. It has a large number of churches and convents, and an hospital. The mountain was in ancient times called Eryx, and had a temple of Venus on the top, founded, according to tradition, by Æneas. This is now replaced by a Saracen castle. The town of Eryx belonged to a Sicilian tribe called Elymi, but afterwards fell into the hands of the Carthaginians. Though taken by Pyrrhus in 378, it was regained by the Carthaginians, who abandoned it in the first Punic war. It does not seem to have been restored by the Romans. Pop. 6600.

MONTESQUIEU, CHARLES DE SECONDAT, *Baron de la Brède et de*, was descended from an ancient and noble family of Guienne, and was born on the 18th of January 1689, at the castle of La Brède, near Bordeaux, where he passed his early days, and composed those works which have acquired for their author an imperishable reputation. His father having early discovered in him indications of genius, and a promise of future eminence, bestowed the utmost pains on his education, which appears to have been conducted with equal judgment and success; and being destined for the magistracy, he employed the energies of his active mind in studying the immense collection of the different codes, and in endeavouring to detect the motives, and unravel the complicated relations, of the obscure or contradictory laws contained in them. His taste for this study was insatiable; and if it proved the source of his future glory, it was also that of his greatest happiness. He has himself stated, that he never had to reproach himself with an hour of reading wasted or misspent. When exhausted with his arid labours upon jurisprudence, he recruited his mind with books of history and travels, and with the productions of the classical ages of Greece and Rome. Enchanted, as he says, with antiquity, he at the age of twenty composed a work, in the form of letters, wherein he sought to prove that the idolatry of the pagans did not appear to deserve eternal damnation; but this first production of his genius he wisely abstained from giving to the world. On the 24th of February 1714 he was received as counsellor to the Parliament of Bordeaux; and on the 13th of July 1716 he was, through the influence of his paternal uncle, named president *à mortier*. The same year he was admitted into the Academy of Bordeaux, which had been recently founded by a number of persons possessing a common taste for music and works of entertainment. Conceiving, however, that its object was too limited, and desirous to extend the sphere of its utility, he undertook to convert this coterie of wits into a learned society; and his views in this respect were warmly seconded by the Duke of La Force, who founded a prize, and held out several other inducements to the cultivation of science. As a member of this learned association, he contributed his contingent of memoirs or communications, chiefly on subjects connected with natural history, a species of study for which he had a particular taste. But his physical constitution disqualified him for that minute observation which is essential to the successful prosecution of this particular science. He was not only short-sighted, but his vision was weak:

and this infirmity increased so much with time, that towards the close of his life he became almost blind. It may also be observed that, at the period when Montesquieu applied himself to natural history, the fundamental principles of that science had not yet been established. In 1719 he circulated, by means of the journals, an *Histoire Physique de la Terre ancienne et moderne ;* and he read successively to the Academy of Bordeaux a dissertation *Sur la Politique des Romains dans la Religion*, an *Eloge du Duc de la Force*, and a *Vie du Maréchal de Berwick*, a production which in several points recalls the manner of Tacitus.

Montesquieu, however, was by no means in haste to appear before the public in the character of author. He preferred waiting until his faculties were ripened by time and matured by reflection; nor was it until the year 1721 that he entered upon his literary career, by the publication of the *Lettres Persanes*, the first idea of which seems to have been borrowed from the *Siamois* of the *Amusemens Sérieux et Comiques* of Dufresnoy, though, in works of genius, the primary conception is of little moment compared with the execution. The success of the *Lettres Persanes*, and the influence which they exercised, were unparalleled. This is to be ascribed to two causes; the circumstances of the period at which the book appeared, and the form into which it was cast. On the death of Louis XIV. libertinism succeeded to devotion, effrontery to hypocrisy, familiarity to respect, and audacity to submission. The liberty of saying or writing anything with impunity led men to examine and to combat all that had been agreed to without opposition, or even assented to with enthusiasm. In the midst of this general effervescence appeared the book of the *Lettres Persanes*. From the shape into which it was cast, it had all the attractions of a romance; it abounded in voluptuous details, which flattered the taste of the age for pleasure, and in irreligious sarcasms, which gratified its tendency to infidelity; and it treated with contempt Louis XIV. and his reign, which people now sought to depreciate. But it must nevertheless be admitted, that, with all these faults, the book displays an ardent love for the welfare of mankind; a courageous zeal for the triumph of reason and virtue; luminous views upon commerce, public law, criminal jurisprudence, and the dearest interests of nations; a penetrating insight into the vices of society, as well as those of governments; and, generally, strong evidence of profound reflection, which takes the reader the more by surprise that it seems to be the constant object of the author to disguise it under the mask of frivolity. Its principal attraction, however, and that which won the suffrages of all, consisted in the keen, animated, sprightly, satire of French manners and caprices, and in a style always lively, sparkling, full of happy innuendos and unexpected contrasts, the pointed irony of which sometimes rose to the most energetic eloquence.

Four years after the publication of the *Lettres Persanes*, Montesquieu caused to be printed separately, in 1725, the *Temple de Gnide*, an ingenious trifle, though cold and without interest, being equally devoid of easy wit or natural grace, and which Madame du Deffand happily called the "Apocalypse of Gallantry." The same year, at the opening of the Parliament of Bordeaux, he delivered a discourse on the duties of magistrates, advocates, attorneys, and all those connected with the administration of law, which, though but little noticed, is written in a fluent, impassioned style, different from the ordinary manner of Montesquieu, and in that vein of eloquence which addresses itself more to the sentiments than to the reason of men. In 1726 he sold his office and withdrew from the magistracy, the duties of which he had so well described. The desire to regain his freedom, and apply himself entirely to philosophy and letters, was no doubt one of his motives; but the principal cause of this determination seems to have been a sense of inadequacy to fill the situation in which he was placed. He informs us, indeed, that his whole merit as president consisted in rectitude of purpose and understanding sufficiently the questions themselves; but that he had never been able to master the forms of procedure, although he had applied himself to the subject.

Being now at liberty to devote himself exclusively to philosophy and letters, he presented himself as a candidate for the place in the French Academy vacant by the death of M. de Sacy; but Cardinal Fleury wrote to the Academy that the King had declared he would not give his approbation to the author of a work containing impious sarcasms against religion. Montesquieu, however, though at once amazed and offended by the refusal of the King and his minister, contrived, by a device more dexterous than candid, to propitiate the cardinal. He asserted his claim with firmness, yet disavowed those letters of the book which formed a legitimate ground of objection against him. The King was appeased by the intervention of the minister, and on the 24th of January 1728 he was received into the Academy, on which occasion he delivered an inaugural discourse, which appears amongst his printed works. Montesquieu having accomplished this object, resolved to travel, and in the course of his peregrinations visited almost all the countries of Europe. He proceeded first to Vienna, where he often saw Prince Eugene; he then passed into Hungary, whence he journeyed to Italy, and at Venice became acquainted with John Law of Lauriston, who, from the height of grandeur, wealth, and celebrity, had fallen into obscurity, neglect, and poverty; and also with the Comte de Bonnevol, who had as yet only gone through part of the cycle of his romantic adventures. From Venice he proceeded to Rome, where he became acquainted with Cardinal Corsini, afterwards Clement XII., and with Cardinal Polignac, author of the *Anti-Lucrèce*. He next visited Genoa, but having met with a cold reception there, he soothed his ill-humour by writing some satirical stanzas, which, however, he did not think fit to print. From Italy he passed into Switzerland, and traversing the different countries watered by the Rhine, stopped some time in Holland, where he met Lord Chesterfield, with whom he had become acquainted at Venice. He then visited England, where he resided about two years, was admitted a member of the Royal Society, and treated with marked distinction by Queen Caroline. On his return to his own country, he retired to his castle at La Brède, where he resumed his favourite pursuits. He had either before or during his travels caused to be printed in Holland a little work entitled *Réflexions sur la Monarchie universelle*, which is now but little known, and extremely rare, though it is referred to by the author himself in a passage of the *Esprit des Loix* (l. xxi., c. 22). The object of this piece was to prove that, in the actual state of the modern nations of Europe, it is impossible even for the ablest and most ambitious of sovereigns to establish a universal monarchy.

After two years spent in his retreat at La Brède, Montesquieu published in 1734 his *Considérations sur les Causes de la Grandeur et de la Décadence des Romains ;* a work which, if not the most remarkable, is perhaps the most finished of all his productions, and in which he had to enter into competition with several eminent men, both amongst the ancients and the moderns, particularly Polybius, Machiavelli, Saint-Evremond, and Bossuet. But Montesquieu was the first writer who grappled with this great subject in all its details, and who compared all the facts with laborious sagacity. He overlooked none which could afford matter for reflection, or warrant any inference of importance, and yet he managed to compress the whole into a volume of moderate size. The *Dialogue de Sylla et d'Eucrate*, which is subjoined to this work, and may be considered as forming part of it, is one of those productions in which

Montesquieu has displayed the greatest eloquence; and with this may be classed another piece not less remarkable, namely, *Lysimaque*, in which he has delineated, in a manner altogether sublime, that system of stoicism which raised man above the ordinary weaknesses of his nature, and enabled him to brave with joy, and even with pride, the cruelties of tyrants and the iniquities of fortune.

The *Considerations on the Grandeur and Decline of the Romans* make us acquainted with the history of a single people; but Montesquieu had long been engaged in studying that of all other nations, in discovering the causes of those revolutions which had successively changed the face of the world, and in investigating those laws and customs which had contributed to their prosperity or decline. The success of the treatise on the Roman people, which in some sort formed only a detached portion of the vast plan he had conceived, served to increase his ardour in the execution of so great an undertaking, to the completion of which fourteen more years of incessant labour were devoted. Sometimes he thought that he advanced rapidly, and would speedily accomplish his design; at other times he appeared to recede, and to become perplexed by the immensity and complication of the subject. At length, after twenty years of unremitting application, he had the satisfaction to put the last hand to a production upon which he had expended so much anxious labour and meditation, and which he entitled *L'Esprit des Loix*. But before sending this work to the press, he judged it prudent to consult one of his intimate friends, whose talents and knowledge he respected; and with this view he sent his manuscript to Helvetius. The latter, however, was so little satisfied with the production after perusal, and so much alarmed for the danger to which the reputation of Montesquieu would be exposed by the publication of a work which he considered as so defective, that at first he did not venture to express what he thought of it, and solicited the author's permission to communicate the manuscript to a common friend, Saurin, the author of *Spartacus*. The latter coincided in opinion with Helvetius, and both agreed that, by the publication of this book, the celebrated author of the *Lettres Persanes* would injure his reputation, and lower himself in the estimation of the world. After some hesitation, this extraordinary judgment was communicated to Montesquieu, accompanied with an earnest entreaty on the part of both that he would subject the whole to careful revision, and upon no account publish the work in the crude and imperfect state in which it then appeared. The strange counsels of these friends, however, had so little influence on Montesquieu, that he sent the manuscript to the press without altering a word, prefixing this epigraph, "*Prolem sine matre creatam*," to indicate that his work had no model; and, as if to mark still more strongly how little he was moved by their unfavourable judgment, he congratulated himself in his preface on having produced a work which was not altogether destitute of genius. Nor did the result disappoint the just expectations he had formed. Its success was in fact so great, than in little more than a year and a half after its publication, it had gone through twenty-two editions, and been translated into almost every language of Europe. The *Esprit des Loix* appeared about the middle of the year 1748, and before the end of the year 1750 its reputation was universal.

If the *Spirit of Laws*, however, was much read, much admired, and much praised, the work, like all those which have produced a great impression, was also much criticised. Madame du Deffand said of it, that it was not *l'esprit des loix*, but *de l'esprit sur les loix*, a saying which had just that degree of truth which gives currency to an epigram. But the work was not of a kind likely to interest the epigrammatic mind at all. It was written with quite a different aim, and has had quite a different reputation now that men have had time to judge of its merits. Its author addressed himself to men of reason and experience, to statesmen and thinkers in general. Those political problems which had been hitherto shaded by uncertainty, or obscured by ignorance, and with which the world had been occupied previous to his time, Montesquieu either solved or placed in a clear light for subsequent investigators. And although not a few of the hostile criticisms with which his work was assailed appeared to be well founded, the reputation of Montesquieu was greatly enhanced by the publication of the *Spirit of Laws;* and it may be said with truth, that this work alone would have been sufficient to insure him lasting renown, and to constitute a noble monument of his genius, sagacity, and wisdom. For an estimate of the relative merit and true historical position of the *Esprit des Loix*, in establishing just ideas of jurisprudence, see the *First Preliminary Dissertation* (part i., sect. iii.)

Montesquieu had resolved not to reply to any of the criticisms which might be made on the *Esprit des Loix;* but the attacks of an anonymous author, who, in a journal called *Nouvelles Ecclésiastiques*, had, amongst other things, represented him as an atheist, induced him to deviate from this resolution. In the *Lettres Persanes* he had treated the Christian religion with too much levity; but afterwards, when his mind was fully matured by age, study, and reflection, he had seen cause to alter his views; and hence in the *Esprit des Loix*, he recommends Christianity in expressive terms, not only as the most perfect of all religious systems, but also as the most powerful support of the whole social system. He therefore deemed it of importance to repel the calumnious insinuations of the ecclesiastical journalist, and at the same time he wished to refute by anticipation the theologians of the Sorbonne, who, being dissatisfied with some passages in the *Esprit des Loix*, were proceeding to condemn the work. It was with this double purpose that he wrote his *Défense*, which may be considered as a model of solid discussion, light pleasantry, and contemptuous moderation. "What pleases me in my *Défense*," said he, "is not seeing the venerable theologians gravelled; it is seeing them laid gently upon their backs." But he took no notice whatever of a crowd of *brochures*, filled with absurd criticisms or gross abuse, which appeared against the *Spirit of Laws*. "The public," said he, "avenge me on the one by their contempt, and on the other by their indignation."

The appearance of a book like the *Spirit of Laws*, naturally formed an epoch in political and literary history; but its effect was different in different countries, being greatest in Britain, where it obtained a reputation, which has since continued to increase, and least in France, where its influence was and still is but small. This may be accounted for partly from the different circumstances in which these countries were respectively placed, and partly also from the fact that, while Montesquieu pointed out the hazards to which the British constitution was exposed from the incessant conflicts of a tyrannical oligarchy and a turbulent democracy, he had confined his researches to the dark ages of the French monarchy, in regard to which his efforts were doubtful, and his conclusions disputed. But if his work did not prove as useful to his country as he had hoped, the reputation which he had acquired in his lifetime far exceeded that which men of letters can ordinarily aspire to obtain. He was considered throughout all Europe as the legislator of nations, and the founder of the philosophy of jurisprudence and politics. But, far from being dazzled by this high reputation, he continued to live like a sage, and to enjoy the society of his friends, dividing his time between his castle of La Brède and Paris,—that is, between study and the world. In the country, he occupied himself with gardening and agricultural improvements, and, though jealous of his seignorial rights, was much beloved by the peasantry, whose comfort and happiness it was his

Montesquieu.

object to promote. In the capital he was always a welcome guest, although simple and somewhat negligent in his dress, as well as in his conversation. He was always disposed to render justice to talents, and to relieve merit in distress. One day he received from Henry Sully, an English artist, who had greatly contributed to improve horology in France, the following letter:—"I am tempted to hang myself, but I believe nevertheless that I should not do so if I had an hundred crowns." To this Montesquieu immediately replied,—"I send you an hundred crowns, my dear Sully; do not hang yourself, and come to see me."

Although in some of his opinions Montesquieu sympathized with the philosophers of his day, yet he loved neither the proselytism of impiety nor the excesses of the spirit of cabal. Nor was this the only cause of his estrangement from Voltaire. Being in a great measure insensible to the charms of verse, he thought the reputation of that celebrated man usurped, and did not hesitate to express his opinion to that effect; whilst Voltaire, on the other hand, was by no means sparing in malignant reflections and bitter criticisms. In fact, they mutually accused each other of having too much wit, and frequently abusing it in their writings. But Voltaire had an exquisite sense of literary merit, which triumphed over his strongest antipathies; and, under its benign influence, he did justice to the author of the *Spirit of Laws*, by observing, that "when the human race had lost their titles, Montesquieu found and restored them;" a fine thought, notwithstanding the epigrammatic form in which it is expressed. But whatever might be his sentiments in regard to Voltaire and the other men of letters of his time, it was only in conversation, or in the intimacy of familiar intercourse, that he allowed the secret of his opinions to escape; he never wrote against any of his contemporaries, and conducted himself with a dignity and wisdom which were the effect of the moderation of his passions, as well as the result of reflection. At the solicitation of D'Alembert and the Chevalier de Jaucourt, Montesquieu, having completed the *Esprit des Loix*, consented to write for the *Encyclopédie*, and composed for that work the *Essai sur le Goût*, some inedited chapters of which were afterwards published in the *Archives Littéraires* (tom. ii., p. 301).

It appears that soon after the publication of the *Esprit des Loix*, his physical strength diminished rapidly, and no longer corresponded to his ardour in literary pursuits. He had conceived the design, as he informs us in his journal, of giving greater extension and depth to several parts of the *Spirit of Laws*; but he found that he had become incapable of carrying his intention into effect. "Mes lectures," says he, "m'ont affaibli les yeux; et il me semble que ce qu'il me reste encore de lumière, n'est que l'aurore du jour où ils se fermeront pour jamais." And in fact he died soon afterwards, on the 10th of February 1755, at the age of sixty-six; that is, only seven years after the publication of his great work. He was attacked at Paris with a violent inflammatory fever, which, in spite of every effort to arrest its progress, carried him off after an illness of about a fortnight. But the benignity of his character sustained him to the last moment; no complaint, no sign of impatience, escaped him. He knew from the first that he was in imminent danger, and occasionally asked his physicians, "Comment va l'espérance à la crainte?" The Jesuits tried to gain him over in his last moments, and, with this view, sent to him Fathers Routh and Castel, who were accused of exercising their ministry with undue importunity. He observed to them, "I have always respected religion; the morality of the gospel is the finest present which God has made to men." As the Jesuits pressed him to put into their hands the corrections he had made on the *Lettres Persanes*, that the irreligious passages might be effaced, he refused to comply with their request; but he afterwards placed the manuscript in the hands of the Duchess of Aiguillon and Madame Dupré de Saint-Maur, saying, "I wish to sacrifice everything to religion, but nothing to the Jesuits; consult with my friends, and decide if this ought to appear." Nevertheless, he received the viaticum from the hands of the parish priest, who, at the same time, observed to him, "Monsieur, vous comprenez combien Dieu est grand;" "Oui," replied the dying philosopher, "et combien les hommes sont petits."

Montesquieu left a great number of manuscripts. They consist of,—1. A little romance entitled *Le Métempsycosiste*, by no means worthy of the author of the *Lettres Persanes*; 2. Morceaux qui n'ont put entrer dans *l'Esprit des Loix*, et qui peuvent former des dissertations particulières, amongst which are one on *Paternal Authority*, another on *Verbal Obligations*, and a third on *Successions*; 3. Three large volumes in quarto, bound, consisting of extracts made by him in the course of his reading, with reflections annexed. In these volumes there are several original pieces of considerable extent, particularly a sort of introduction to the History of Louis XI., which is considered as equal to anything that Montesquieu ever wrote. He is said to have written an account of his travels, which if it exists at all, must be in a very imperfect state; and as to the *Notes sur l'Angleterre*, inserted in some of the last editions of his works, we know not whether they were extracted from the materials which he had prepared for the *Relation de ses Voyages*.

Among a vast number of editors and commentators on the works of Montesquieu, we may cite the following distinguished names:—Voltaire, Condorcet, Helvetius, D'Alembert, Mably, La Harpe, Destutt de Tracy, and Villemain. (J. B—E.)

Monteverde ‖ Monte-Video.

MONTEVERDE, Claudio, a remarkable Italian composer, was born at Cremona about the year 1565. He entered into the service of the Duke of Mantua as a performer on the viol, and received lessons in counterpoint from Marc Antonio Ingegneri, the Duke's chapel-master, to whose office he afterwards succeeded about 1604. On the 19th of August 1613 he was appointed chapel-master of St Mark's at Venice, and held that place till his death in the autumn of 1649. The first two books of his Madrigals are so incorrectly written as to prove that his study of counterpoint had not at that time (1587) been very profound. In his third book of Madrigals he appeared to more advantage; and the ideas which had emanated from Florentine musicians regarding the necessity of expressing the sense of the words in vocal music, had evidently stimulated his genius to explore new paths of composition. Regarding the harmonic novelties and the new tonality introduced by Monteverde, see the articles Music and Tonality in the present work. (G. F. G.)

MONTE-VIDEO, or San Felipe de Monte-Video, the capital of Uruguay in South America, is situated on the northern shore of the estuary of the La Plata, 130 miles E.S.E. of Buenos Ayres, S. Lat. 34. 53., W. Long. 56. 16. It stands on a gentle eminence at the extremity of a small promontory which forms the east side of the harbour, a bay 4 miles in length by 2 in breadth. The houses are well built, and floored with unbaked bricks. They are for the most part only one storey high, and have flat roofs. The streets are broad, regular, and well paved. There are no great public buildings, except the cathedral, a handsome stone edifice, and the town-hall. Monte-Video is surrounded by walls, which are mounted with guns; and there is also a citadel. The climate is healthy, and the soil of the surrounding country rich and productive; but water is very scarce, and can only be obtained by wells dug on the sea-shore, or by collecting the rain-water in cisterns. The harbour is shallow, varying from 14 to 19 feet in depth; but the bottom is soft, and does not injure the vessels that

may run aground. The winds from the S.S.W. blow into the harbour and cause a considerable swell. The number of vessels that entered the harbour in 1856, including the coasting trade, was 1220, and their tonnage 149,567; while those that cleared were 978, and their tonnage 141,131. The trade of Monte-Video is very considerable; the exports, consisting of wool, hides, tallow, salt beef, &c.; and the imports of cotton and woollen fabrics, hardware, wine, provisions, &c. A line of steamers was established in 1856 between Monte-Video and Genoa; and there is also another, supported by the government of Brazil, between this place and Rio Janeiro. Pop. about 12,000.

MONTFAUCON, Bernard de, an eminent critical and antiquarian writer, was descended from a noble and ancient family, and was born at the chateau of Soulage, in Languedoc, in January 1655. After a short attendance at the college of Limoux, he was left to educate himself, and he passed his days in the library of the family castle, Roquetaillade, perusing books in different languages and on almost every variety of subject. During his historical readings he had become partial to a soldier's life. Accordingly, he enlisted as a volunteer in the regiment of Languedoc in 1673, and served two campaigns in Germany under Marshal Turenne. But grief for the loss of his parents rendered him weary of the world, and induced him in 1675 to assume the garb of the Benedictines in the congregation of St Maur. The rest of his biography is little else than a recital of his many important works. He now consecrated his leisure to the study of Greek and the Oriental languages. His enthusiastic devotion to learning, supported by a robust and well-regulated constitution, carried him rapidly through his extensive field of labour and research, and the result of his studies issued in quick succession from the press. The work that established Montfaucon's reputation was a new edition of Athanasius, in Latin and Greek, 3 vols. folio, 1698. His next great undertaking was the editing of the works of Chrysostom. In the prosecution of this task he spent three years in Italy, visiting the principal cities, and consulting the manuscripts in the principal libraries. In 1718, sixteen years after his return, his *Chrysostom* began to be published; and in 1738 it was completed in 13 folio volumes. It is still considered the best edition of that eloquent father. Montfaucon died in December 1741, at the age of eighty-seven. The most important of his other works are,—*Analecta Græca sive varia Opuscula*, 4to, Paris, 1688; *Diarium Italicum*, 4to, Paris, 1702; *Collectio Nova Patrum Græcorum*, folio, Paris, 1707; *Palæographia Græca, sive de Ortu et Progressu Literarum Græcarum*, folio, Paris, 1708; *Le Livre de Philon de la Vie Contemplative*, 12mo, Paris, 1709; *Bibliotheca Coisliniana*, folio, Paris, 1715; *L'Antiquité Expliquée et Representée en Figures*, 10 vols. folio, Paris, 1719; *Les Monuments de la Monarchie Française*, 5 vols. folio, Paris, 1729–33; and *Bibliotheca Bibliothecarum Manuscriptorum Nova*, 2 vols. folio, Paris, 1739.

MONTFORT, Simon de. See England.

MONTGOMERY, Alexander, an old Scottish poet, who flourished in the reign of James VI. The little that is known about his life is involved in doubt. His nickname of "The Highland Knight," which is mentioned by Dempster, seems to indicate his descent, and at the same time confirms, to a certain extent, the generally-received opinion that he was brought up in Argyllshire. He is supposed to have been an officer in the guard of the Regent Morton, a circumstance that may account for his ordinary title of "Captain Alexander Montgomery." His fame as a poet appears to have been great among his contemporaries. James VI. quoted some of his poems in a work entitled *Reules and Cautelis*; and bestowed upon him a pension of 500 merks. But this latter expression of royal favour afterwards led Montgomery into a tedious lawsuit, which brought in its train several other evils. His life was thus embittered, and his poetry assumed a tone of complaint and of severe satire against judges and lawyers. His principal work, the allegorical poem of *The Cherry and the Slae*, was published in 1607. Between this date and 1611 the poet is said to have died. Montgomery's entire works were published at Edinburgh in 1822, under the superintendence of Mr David Laing, and with a biographical preface by Dr Irving. His chief characteristics as a poet are a vigorous and lively fancy, a love for rural objects, and a power of versification beyond most of his contemporaries.

Montgomery, *James*, one of the most popular of the sacred or religious poets of England, was born at Irvine in Ayrshire, on the 4th of November 1771. His parents were Irish—his father a preacher of the Society of United Moravian Brethren. James was designed for the same office, and in his sixth year was placed in the Moravian establishment at Fulneck, near Leeds, where he was as effectually excluded from the world and all its ways as if he had been immured in a Dominican convent. A love of poetry was kindled in him by hearing one of his masters read aloud Blair's *Grave*. He refused to study for the ministry; and both his parents being then dead (they had died in Barbadoes, his father having been sent on a missionary enterprise to the West Indies), the Brethren at Fulneck put James apprentice to a grocer in Mirfield. He disliked the drudgery of the shop, wrote verses, and at length ran away, with three shillings and sixpence in his pocket. After some wayside hardships and wanderings, he got engaged as shop-boy in the pretty Yorkshire village of Wath, where he remained for a twelvemonth. He next removed to London, intent on publishing a volume of poetry; but the Brethren of the Row were as adverse to his poetical ambition as the Brethren of Fulneck; and he was glad to obtain employment from one of the number, Harrison, a well-known publisher, as clerk and assistant. He soon tired of London, and retraced his steps back to Wath, perhaps induced in some degree by recollection of a certain Nancy Wainwright, "one of the Wath beauties, whom, I am afraid," he says, "I sometimes looked at in church more than was proper." The looks came to nothing; and this is the only instance of anything like an approach to gallantry in the long bachelor life of Montgomery. In his twenty-first year he made another and final removal. He went to Sheffield as clerk to Mr Gales, an auctioneer and publisher of a weekly newspaper, the *Sheffield Register*. This paper was liberal in its tone and tendencies, and Mr Gales was marked out as a disaffected man. The whole nation was at that time agitated by the example or by dread of revolutionized France; spies and informers abounded; and local rulers, like the government, were jealous and eager to convict. The Sheffield editor was wrecked in the political storm; the *Register* went down, and in its place the *Iris* came forth, with James Montgomery for its conductor and proprietor. He was now in a congenial and independent position; he had a weekly outlet for all his thoughts and musings, whether in prose or verse; and, though no politician, he had a true poet's love of liberty and hatred of meanness, fraud, or oppression. He was determined to be prudent; he was by nature inoffensive; yet within a twelvemonth, before he had completed his twenty-fifth year, he was twice convicted, fined, and imprisoned for libels. He had printed for a hawker some copies of two old songs that remained in type in the office. One of them related to the destruction of the Bastile in 1789, and was surmounted by a rude woodcut representing Liberty and the British lion. The hawker sold the songs in the streets, ingeniously drawing attention to his wares by crying "straws to sell." The purchaser of a straw, price one halfpenny, obtained a copy of the ballads; and one of the Sheffield constables, acute as Dogberry, smelt treason in this device of the straws, and in the

"effigies" of Liberty and the Lion. The printer was traced; he was found to be the suspected editor of the *Iris*; and Montgomery, after a form of trial, was sentenced to three months' imprisonment in York Castle, and to pay a fine of L.20. His second offence consisted in some reflections on the conduct of a colonel of militia, who had displayed superabundant zeal and recklessness in quelling a street riot. After an extraordinary scene of contradictory evidence, a verdict was given against the publisher of the *Iris*, and he was sent again to York Castle, but for a period of six months, and with the further penalty of a fine of L.30. Such oppression seems almost incredible now; and Montgomery said, that "no man who did not live amidst the delirium of those evil days and that strife of evil tongues, could imagine the bitterness of animosity which infatuated the zealous partisans." In his own case he lived to see it all extinguished. He ultimately found friends among his old opponents—even the fiery militia colonel; but for some years he was neither democratic enough for the wild reformers, nor submissive enough to serve the purposes of the local magnates, and his editorial life was truly a life of martyrdom. He was able to retire from it altogether in the year 1825, and on that occasion a great public banquet, presided over by Viscount Milton, was given him by his townsmen and neighbours, men of all ranks, classes, and distinctions. Politics and political strife were now buried for ever, and there was a long day of warmth and sunshine after the cold blasts of the morning.

The literary career of Montgomery dates from his incarceration in York Castle. He wrote there, and published in 1797, *Prison Amusements*, a series of short poems, which had only a local reputation. In 1805 he issued another poem, *The Ocean;* and in 1806 *The Wanderer of Switzerland, and other Poems.* The last of these volumes had gone through two editions, when it happened to fall into the critical hands of Francis Jeffrey, and received a check which, to the sensitive poet, seemed to threaten nothing less than the annihilation of his hopes and labours. The *Edinburgh Review* denounced the unfortunate volume in a style of such authoritative reprobation as no mortal verse could be expected to survive. The critic, however, proved a bad prophet: the work continued popular because it was really worthy of popularity; and the criticism must be set down as one of those wanton sins against good taste and proper feeling which the *Review* occasionally perpetrated in its nonage, before it had attained to years of discretion. Montgomery's next poetical production was written to commemorate the abolition of the slave-trade, and was entitled *The West Indies.* It is in the heroic couplet of Dryden and Pope, and exhibits the poet's command of that peculiarly English style of verse, the best of all for narrative poetry. In 1813 appeared *The World before the Flood*, also in the same measure; in 1819, *Greenland*, a poem founded on the Moravian mission to that remote territory; and in 1827 *The Pelican Island*, a descriptive poem in blank verse, and which is unquestionably the most original and powerful of all Montgomery's works. Numerous exquisite little pieces from his pen came forth in the annuals and other periodicals; and he collected two volumes of sketches, published under the quaint title of *Prose by a Poet.* In the winter of 1830–31 he delivered a course of lectures on poetry and general literature at the Royal Institution, which were afterwards published in one volume. He was now recognised as a standard English classic, unrivalled in popular sacred poetry and in the poetry of the domestic affections by all but Cowper. His verse was clear, copious, and flowing; always musical, and often strikingly picturesque. If he had no secret beauties of diction or subtle trains of thought and imagination, his works displayed a high and pure moral feeling and strong religious faith, untinctured by sectarian formality or exclusiveness. In his poetry, as in his life, James Montgomery exhibited a catholic spirit that embraced whatever was lovely and of good report. He looked beyond the grave, but never neglected any form of suffering humanity or call of active duty and brotherly sympathy.

In 1841 a collected edition of Montgomery's works was published in four volumes; and so late as 1853 he issued a series of *Original Hymns.* To his limited means—the small hoard accumulated through years of toil and anxiety—the government, on the recommendation of Sir Robert Peel, added a pension of L.150 per annum. The latter years of the old poet were thus passed in ease and comfort. To all benevolent and missionary schemes he lent a willing hand; his townsmen were proud of him, and his society was much courted. When he had nearly reached the allotted period of threescore and ten, he made a pilgrimage to Scotland, and finding out the house in the "Half-way" of Irvine where he first saw the light, he shed a flood of tears at the humble scene of his birth. He was publicly received by the magistrates and other inhabitants of Irvine; and in Edinburgh he also met with a marked and honourable reception. His history altogether affords a fine example of virtuous and successful perseverance, and of genius devoted to pure and noble ends,—not a feverish, tumultuous, and splendid career, like that of some greater poetical heirs of immortality, but a course ever brightening as it proceeded,—calm, useful, and happy. He attained to the great age of more than eighty-two years, dying at his residence near Sheffield on the 30th of April 1854. Memoirs of his life and writings, with extracts from his correspondence and journals (somewhat too voluminous and indiscriminate), have been published, in 7 vols. 8vo, 1855–6, by two of his friends, John Holland and James Everett. A complete edition of his poetical works appeared in 1855, in 4 vols. 12mo. (R. C—S.)

Montgomery, *Robert*, the author of several religious poems, was born at Bath in 1807. He had hardly reached his twenty-first year when his poetical fame was established by the publication of his *Omnipresence of the Deity.* His swelling epithets, and the pompous roll of his versification, satisfied the majority of the readers of poetry; his choice of his theme recommended him to the religious public; and at the same time the dullness of his intellect, the barrenness of his imagination, and his many broken metaphors, passed undetected. The poem, therefore, reached an almost unprecedented popularity, and passed through eight editions in an equal number of months. Stimulated by this success, his versifying faculty produced in the same year another volume containing, *A Universal Prayer, Death, A Vision of Heaven*, and *A Vision of Hell. Satan* followed in 1829, and raised the author's reputation to its greatest height. Montgomery now began to contemplate studying for the church. He entered Lincoln College, Oxford, in 1830, took the degree of B.A. in 1833, and was ordained in 1835. His first pastoral charge was the curacy of Whittington in Shropshire. From it he removed in 1836 to Percy Street chapel, London. By this time his preaching was acquiring a popularity scarcely less false in its foundation than that which had greeted his poetry. The crowds that flocked to hear him mistook his affected attitudes for studied elegance, his vague generalizations for profound thinking, and his noisy ranting for true oratory. His fame as a preacher continued to increase after he had removed, in 1838, to his ultimate charge of St Jude's chapel, Glasgow. Towards the close of his life he published several works, both prose and poetical, on religious subjects. He died at Brighton in December 1855.

MONTGOMERY, a municipal and parliamentary borough of Wales, capital of the county of the same name, is placed at the foot of a high and well-wooded eminence, about 1½ mile from the Severn, and 168 N.W. by N. of

London. It is small but well built; and has four principal streets, meeting in a market-place in the centre. The principal buildings are,—the church, an old edifice in the form of a cross, with a modern tower; the guildhall; and the county jail. The borough returned a member to Parliament from the time of Henry III. till the passing of the Reform Act; but since that time it has formed one of six boroughs which together elect one representative. The ancient castle of Montgomery, of which some ruins still remain, was founded by Baldwin, a follower of William the Conqueror, who was appointed Lieutenant of the Marches by that monarch. In consequence of its situation on the borders of England and Wales, it was long considered an important stronghold; and was the subject of frequent contention between the Saxons and the Normans. It received its present name from Roger de Montgomery, Earl of Shrewsbury, by whom it was enlarged and strengthened. It afterwards passed into the hands of the crown, by whom the stewardship was granted, in the fifteenth century, to the Herberts of Cherbury. Pop. (1851) 1248.

Montgomery, a town in the United States of North America, capital of the state of Alabama, is built on an eminence on the left bank of the Alabama River, 197 miles N.E. of Mobile, and 331 miles above it by river. The town contains 7 churches, 2 academies, a state-house, a bank, and 6 newspaper offices. In the neighbourhood of Montgomery is one of the richest cotton-producing districts of Alabama, and 75,000 bales are annually shipped here. The river is navigable for steamers as far as Montgomery; and as it is never impeded by ice, large vessels ply between this town and Mobile at all seasons of the year. The town is also connected by railway with Atlanta in Georgia; and another line is in progress towards the west. Montgomery has several very pleasant suburbs; and is a very prosperous and enterprising town. Pop. (1850) 4935; (1853) estimated at 7000.

MONTGOMERYSHIRE, an inland county of North Wales, having on the E. Shropshire, N. Denbighshire and Merionethshire, W. Cardiganshire and Merionethshire, and S. Radnorshire. It is of an irregular form, its greatest length from E. to W. being about 40 miles, and its greatest breadth from N. to S. 36 miles. Its area measures 755 square miles, and contains 385,290 statute acres. It is thus third in point of size of the Welsh counties.

This county, traversed as it is throughout its entire length by one of the largest of British rivers, the Severn, possesses scenery of the most varied and attractive character. It has few very lofty mountains; but the whole county is diversified with a succession of hill and dale and the most beautiful river scenery. Towards the English border there are extensive tracts of finely-cultivated land, and everywhere the surface is beautified by fine woods, chiefly of oak. The parks of Lord Powis, Lord Sudeley, and other large landed proprietors in this county, vie in beauty with any in the British Islands. The principal mountain range is that of Plymlimmon, 2463 feet in height, which gives birth to the rivers Severn and Wye. The Dovey, the Tanat, and the Vyrnwy are the other principal streams. There are but few lakes of importance.

The climate is for the most part mild; and agriculture has made greater progress in this than almost any of the other divisions of the principality. Many of the farms are of large size, and are cultivated in a spirited manner. Mr Naylor's model farm at Leighton Hall, near Welshpool, is one of the most complete establishments of the kind the British Islands can boast of. The cultivated crops consist of wheat, barley, oats, buckwheat, and rye; vetches, peas, beans, clover, and clover-seed; mangold, carrots, turnips, and potatoes; flax and rape. There are also extensive orchards. Montgomeryshire has long been famous for its breed of hardy horses and ponies, for which high prices are obtained. The cattle are chiefly of the Hereford breed, and the sheep the Shropshire Downs; but there is a breed of small sheep produced on the borders of this county known as "Cluns," which are highly prized.

The lead mines of this county are very important, and are now (1857) yielding largely. At Llangynog the famous Llangynog Mine, in the hands of Sir Hugh Middleton, yielded for a long period more ore than all the other mines in Britain, furnishing those immense resources which brought the New River to London, and which greatly contributed to the wealth of the then lords of Powis. The ore was quarried like stone in great open quarries. These mines afford the finest example of what is called a "gash" vein known in the world. The whole county rests upon the Upper and Lower Silurian group of rocks; but there are numerous outcrops of intercalated beds of trap, affording, when investigated by means of the mines, a curious and most interesting study to the geologist.

This county is connected with the Dee at Chester by the Chester and Ellesmere Canal. It has also lately completed a small railway from Newtown to Llanidloes, and has got acts for two others.

Besides Montgomery, the principal towns are,—Welshpool, Newtown, Llanidloes, Machynlleth, and Llanfyllin. Welshpool is the thriving, general business town of the county. Newtown and Llanidloes are chiefly devoted to the manufacture of Welsh flannels, of which they form the chief seat, and possess mills of great size, which are worked by the newest and most improved machinery. Montgomeryshire returns one member to Parliament, and has done so since 1536. It possessed 2986 registered electors in 1852; and the political influence is wholly in the hands of Sir W. W. Wynn and the Earl of Powis.

The population, by the last census, was 67,335, of which 33,634 were males, and 33,701 were females. The population was less in 1851 by 1300 persons than in 1841. In 1851 there were 13,350 inhabited houses, 716 uninhabited, and 25 building. These figures give 89 persons and 18 houses to a square mile, or 7·2 acres to each person and 36·2 acres to a house,—nearly the same proportions as Brecon possesses.

The amount of real property assessed for income-tax in 1851 was L.340,192; amount of property rented to the poor, L.280,833. It is computed that 15 per cent. of the population live by agriculture, and 10 per cent. by trade. About one-fourth are labourers, servants, &c.; 400 persons are in professions; and 1000 possess independent means.

The total number of churches in Montgomeryshire in 1851 was 346, with 62,886 sittings. Of the former, 66 belonged to the Church of England, 191 to the Methodists, 58 to the Independents, and 26 to the Baptists. According to the census of 1851, there were in Montgomeryshire 1272 day schools, with 6194 scholars (3857 males and 2957 females), of which 72 schools, with 4854 scholars, were public. Of the public schools, 3, with 136 scholars, were supported by general or local taxation; 18, with 1264 scholars, were supported by endowments; and 51 schools, with 3554 scholars, were supported by religious bodies. There were also 312 Sunday schools, with 23,001 scholars (11,612 males, and 11,389 females); and 6 evening schools, with 130 scholars. English is more spoken in this county than Welsh, owing probably to its manufacturing industry.

MONTI, Vincenzo, an eminent Italian poet, was born in the Romagna on the 19th of February 1754. He received his elementary education at the seminary of Faenza, where he acquired an extensive knowledge of the Latin language, and became passionately attached to the Roman poets. By his father he was destined to follow the profession of agriculture; but as he continued to evince a predilection for literature, the elder Monti sent the youthful poet to the university of Ferrara to study law or medicine. Young

Monti ultimately resigned himself wholly to the cultivation of literature and poetry. His first Italian poem was entitled, *The Prophecy of Jacob;* and although an unequal production, it contains some vigorous, and even sublime passages. About this time the perusal of Dante opened up to him new and splendid views of the grand old style of his native land, and henceforth the bard of the *Divina Commedia* became his model and his master. His admiration of Dante bordered on idolatry, and catching a portion of the inspiration of that great poet, he wrote the *Vision of Ezekiel*, in which he displayed that grandeur of imagery and fluent command of language which distinguish his compositions. Monti was at this time scarcely eighteen years of age. His genius attracted the notice of Cardinal Borghese, who conducted him to Rome. Here he extended his knowledge of the classics, and his acquaintance with the learned; but it was not until 1780 that public attention was directed to him. The compositions which he recited on the occasion of the celebration of the quinquennali of Pius VI. drew forth such general applause, that Don Luigi Braschi, the Pope's nephew, made him his private secretary. His next composition of any importance was his tragedy of *Aristodemo*, written, it is said, to rival the *Virginia* of Alfieri, which he had heard the poet read before a literary club. The very great success of his *Aristodemo* induced Monti to write another drama, entitled *Galeotto Manfredi*, which proved an entire failure. His genius was not dramatic, but lyrical; and highly-wrought imaginative rhapsodies were more in accordance with the natural bias of his mind, than the concatenation of plots and the delineation of human passion.

Monti being attached to the papal court when the revolutionary Basseville was stabbed in the streets of Rome, laid hold of this circumstance, and celebrated at once the repentance of Basseville and the decapitation of Louis XVI. in a poem entitled the *Basvilliana.* This production is entirely supernatural in its construction. The soul of the murdered man, like the body of Moses, is contended for by the angel of God and the enemy of mankind; and although the former is triumphant, yet the disembodied spirit of the republican is doomed for a certain period to hover about the banks of the Seine, and to witness all the atrocities which are there perpetrated. The subject is treated with great power, and the imagery with which the poem is adorned is in the highest degree original and majestic. As a whole, it approached more nearly to the grandeur and sublime daring of Dante than anything which had been produced for centuries; and the fame of Monti rose above all rivalry. But the tide of French republicanism having now set in upon Italy, entirely changed the aspect of affairs in that country, and brought Monti into close contact with some of Napoleon's generals. To this circumstance we must attribute the admiration which the poet began to entertain for the French hero, and the lively anticipations of good to be derived by his country from the new order of things which were awakened in his mind. The enthusiasm of Monti hurried him away with the general current in which so many ardent young hearts were borne along.

In a mythological poem entitled *Musogonia*, he paid court to Napoleon; and in a still finer production, *Prometeo*, he enthusiastically celebrates the triumphs of the Gallic chief, at the same time pouring out the vials of his wrath upon England. On the decay of the Napoleonic influence in Italy, Monti was compelled to seek refuge beyond the Alps, where he fell into a state of the most deplorable destitution. The return of Napoleon, however, and his new victories in Italy, afforded Monti an opportunity of partially retrieving his fortunes. He returned to Milan, and there published his poem, the *Mascheroniana*, the chief object of which is to bind new wreaths of victory around the brow of Napoleon. Shortly afterwards, Monti produced a third tragedy, entitled *Caius Gracchus;* and in 1802, an ode, in which he calls upon his military idol to place himself at the head of the Italian people, which Bonaparte did not long hesitate to do. The rewards of the poet were, first, a professorship at Pavia, and, a few years subsequently, a number of offices and honours at Milan. In 1805, when Napoleon was crowned king of Italy, the event was celebrated by Monti in a poem called *Il Benificio.* Indeed, every fresh victory and new conquest of the Emperor of France afforded a theme for the courtly muse of the Italian poet. The triumph of Jena resounded in his ode entitled the *Spada di Federico;* the attempted usurpation of the Spanish throne was sung in the *Palingenesi;* and various other conquests were celebrated in numerous odes and hymns. Besides these works, he finished, in less than two years, a translation of the *Iliad*, which, without possessing much spirit, is considered elegant and faithful.

The overthrow of Napoleon in 1814 deprived Monti of all his public employments; and after this period, although he composed an occasional poem, his labours were chiefly confined to prose. The principal of these are, considerations on the difficulty of properly translating the poetry of the *Iliad*, and several dialogues on the Italian language, full of wit and acute criticism. By an order of government to reform the national dictionary, his attention was for a time engrossed with the subject of language. He undertook a crusade against the Della Cruscans, attacking their decisions with the utmost vigour and no common success. He continued to reside at Milan; and in 1823 he once more turned his thoughts to poetry. He restored the true reading of the *Convito* of Dante, wrote an idyl on the nuptials of Cadmus, and then contemplated the completion of the *Feroniade*, a poem which he had begun many years before. He had nearly accomplished his design when death put a final period to his labours on the 13th October 1828, in the seventy-fourth year of his age. (J. F. S.)

MONTIVILLIERS, a town of France, department of Seine-Inférieure, pleasantly situated at the head of the fertile valley of the Lézarde, 6 miles N.E. of Havre. Many of the houses are of wood, and have an antique and picturesque appearance; but the beauty of the town arises chiefly from the clear stream which flows through it, and the trees by which it is surrounded. The church, which is in the Romanesque style of architecture, formerly belonged to a Benedictine abbey of the seventh century. Manufactures of cotton and woollen stuffs, lace, paper, leather, and sugar are carried on here. There is also some trade in corn, cattle, groceries, &c. Pop. 4195.

MONTLUCON, a town of France, capital of an arrondissement of the same name, in the department of Allier, is situated near the Cher, here crossed by a stone bridge, 39 miles S.W. of Moulins. It is well built on the slope of a hill, the summit of which is crowned by the remains of a castle, formerly a place of much strength. Manufactures of linen, serge, candles, &c., are carried on; and there is some trade in cattle and agricultural produce. Pop. (1851) 8810.

MONTMORENCY, Anne de, constable of France, was descended from one of the most ancient French families, and was born at Chantilly in 1493. He was brought up along with the young Dauphin, afterwards Francis I., and on the accession of that prince he was raised to an influential position. He was not long in proving himself worthy of his good fortune. His chivalrous valour was conspicuous in several campaigns, and gained for him a marshal's baton in 1522, soon after the outbreak of the war against Charles V. Contrary to his advice, however, the battle of Pavia was fought in 1525, and he found himself in consequence a prisoner, along with his sovereign, in the hands of the Emperor. On being

ransomed, he contributed in no small degree to effect the release of his royal master. But as Francis I. refused to fulfil the conditions of his liberation, Montmorency was in course of time called upon to defend France against Charles V. He continued by his skilful manœuvres to harass and repel the enemy till war was superseded by negotiation. As a reward for these services, the office of constable of France was conferred upon him in 1538. In this lofty position, the austerity of his morals and the roughness of his manners appeared in greater prominence, and excited against him much dislike at court. It is not surprising, therefore, that he was disgraced in 1541. He bore his exile with great magnanimity, until the accession of Henri II., in 1547, recalled him to his office of constable, and to greater influence than ever. His military talents were called into requisition in 1557, to relieve St Quentin from a besieging army of Spaniards. But a hazardous plan, which he had begun to execute, for the purpose of entering the city, failed, and left him wounded and a prisoner in the hands of the enemy. As an aggravation of this misfortune, he discovered, when he was released at the peace of 1559, that the Guises, during his absence, had been supplanting him in the favour of the King. The death of Henri II., and the accession of Francis II., in that same year, completed his disgrace. He returned to court, however, on the accession of Charles IX., and played an important part in the struggle which was then beginning to convulse France. His firm devotion to the Catholic religion induced him to make common cause with his former enemy, the Duke of Guise, against the Prince of Condé and the King of Navarre, the leaders of the Huguenots. In the civil war that followed in 1562, he gained the victory of Dreux over Condé, but was himself made a prisoner. On his release in the subsequent year, he expelled the English from Havre. In 1567 the civil struggle was renewed, and Montmorency once more encountered the Protestants on the plains of St Denis. His troops were already in the full pursuit of victory when he received a mortal wound. He died on the 12th of November 1567.

Montmorency, *Henri II. Duc de*, grandson of the preceding, was born at Chantilly in 1595. His career began under the most favourable circumstances. He was the godson of Henri IV., and was constantly receiving marks of the royal affection. His illustrious name, his winning manners, his generous spirit, and his chivalrous valour, rendered him at an early age the darling of the court and the people. Hardly had he attained his eighteenth year when Louis XIII. raised him to the office of admiral. Yet his good fortune was not greater than his desert. He wrested several important places from the Protestants, and was present at the sieges of Montauban and Monpellier. On the renewal of the cival war in 1625, the fleet sent from Holland to the aid of the French King was placed under his command. Kindling the lukewarm Dutch soldiers by his fiery enthusiasm, he captured at their head the Isles of Rhé and Oleron. He then in 1628 measured his strength in Languedoc against the Duc de Rohan, and was not worsted in the contest with that famous leader of the Huguenots. His brightest laurels, however, were won during the following year in the war against the Spaniards in Piedmont. Falling in with an army under Doria at Veillane, he charged across a ditch at the head of the gendarmes of the King, struck down the hostile general with his own hand, and fought like a common soldier until the enemy was completely driven from the field. This brilliant victory was followed by the raising of the siege of Casal, and the appointment of Montmorency to the rank of Marshal of France. In the height of his fame and influence he was now solicited to join the opponents of Cardinal Richelieu. His pride, pampered by so many successes, was quick to incite him to hostility against one who was so deadly a foe of the nobility; and he rushed into open rebellion with his characteristic impetuosity. In his character of governor of Languedoc, he raised levies of troops and money in 1632, and, after forming a junction with Gaston, Duke of Orleans, saw himself at the head of an army of six or seven thousand. Negotiation was tried in vain; and in September Montmorency was confronted at Castelnaudary by an army under La Force and Schomberg. At this crisis he forgot the caution of the general in the headlong valour of the soldier. Bursting into the royal camp at the head of a few horsemen, he cut his way through six ranks of infantry amidst a continued shower of shot, and fought against overwhelming numbers, until his horse dropped dead, and left him in the power of his enemies. He was doomed to death by the inexorable Richelieu, as an example to the rest of the plotting nobility. In vain was his life begged by all ranks throughout France. The only palliation of punishment that could be obtained from Louis XIII. was that the execution should be in private. Montmorency was therefore beheaded in the Hotel de Ville of Toulouse in October 1632.

MONTMORILLON, a town of France, capital of an arrondissement of the same name, in the department of Vienne, is situated on both sides of the Gartempe, 27 miles S.E. of Poitiers. It was formerly a strong place, and still contains the remains of an old castle, part of which is now used as an ecclesiastical college. The town possesses a few paper-mills and bleachfields, and it has some trade in cattle. Pop. 4400.

MONTOIR, a town of France, in the department of Loire-Inférieure, 11 miles W. of Savenay. The manufacture of vitriol is carried on here; and large quantities of peat are obtained in the neighbourhood. Pop. 4500.

MONTORO, a town of Spain, in the province of Cordova, is situated on a rocky eminence, nearly surrounded by the Guadalquivir, 27 miles N.E. of Cordova. It is closely built; but the streets, though narrow and steep, are well paved and lighted. The town has a market-place and four public squares; a parish church, with a Gothic front and a lofty tower; another church; a town-house; an hospital; and several educational institutions. There are quarries and mines in the neighbourhood, but these are not now worked. The town has several flour and oil mills; and the principal article of export is oil. Pop. 10,732.

MONTPELIER, a town of Vermont, in the United States of North America, capital of the county of Washington, is situated on both sides of the Onion River, 200 miles N.W. of Boston, and 85 S.E. of Montreal. The principal edifice in the town is the State House, built of granite in the form of a cross, 150 feet in length by 100 in breadth, and surmounted by a dome 100 feet high. The portico in front has six pillars, each 6 feet in diameter and 36 in height. The cost of this magnificent building was about L.60,000. Montpelier has also a court-house, five churches, two banks, and five newspaper offices. The trade is considerable; and the town is connected by a branch with the great line of railway between the Atlantic and the St Lawrence. Pop. (1850) 2310.

MONTPELLIER, a town of France, capital of the department of Herault, is situated on an eminence on the right bank of the Lez, 30 miles S.W. of Nimes, and 17 N.W. of Cette, the port of this town. It is irregularly built, with narrow, steep, but generally clean streets; and the houses are mostly well built. The public places are for the most part small in size and irregular in form; and the public buildings are unworthy of so large a town. The latter consist chiefly of a cathedral, with no pretensions to beauty or interest; an exchange, with a fine Corinthian colonnade; a court-house; a medical school, &c. Of the fortifications with which the town was once surrounded there are now few remains, except the citadel and

Montpellier.

some of the gates; the ancient ditches being now occupied by boulevards, which, along with the esplanade between the citadel and the town, and the Promenade de Peyrou, occupying the summit of the hill at the other end, serve as public walks for the recreation and amusement of the inhabitants. The last of these, which forms the chief attraction of the town, but is perhaps overpraised when it is regarded as one of the finest public walks in Europe, consists of shady avenues and neat parterres, adorned with fountains and pieces of sculpture. It is surrounded by balustrades, and has a fine Doric arch at its entrance, an equestrian statue of Louis XIV. in the centre, and a Corinthian building of hexagonal form, called the Chateau d'Eau, at its further extremity. This edifice forms the terminus of an aqueduct, about 5 miles in length, raised for the distance of 2896 feet upon a double tier of arches, which conveys water for the use of the town, and supplies the numerous fountains which adorn it in different places. Montpellier is distinguished for its school of medicine, which was founded in the twelfth century by the Arabs who were expelled from Spain. This institution, which now occupies the old episcopal palace, is celebrated as the place where Rabelais studied medicine and took the degree of doctor; and it now rivals in excellence and fame the medical school of Paris. It has large anatomical collections, and a library of 35,000 volumes and 600 MSS. The botanic garden of Montpellier, the earliest collection of the sort in France, was established in the reign of Henri IV.; and having been for some time under the superintendence of the celebrated De Candolle, who was professor of botany at Montpellier, it is now one of the best arranged in France. Montpellier has also several hospitals, which are both large and well managed. Among the other celebrities of the town must be noticed the collection of paintings contained in the Musée Fabre, an institution founded in 1825 by an artist of that name who was born here. It includes, besides the picture gallery, a library of 15,000 volumes, including those which once belonged to Alfieri. The manufactures of Montpellier are considerable, and some of them, such as that of verdigris, which is obtained by placing plates of copper between grape husks, are carried on in few other places. There are, among other establishments, cotton and woollen factories, dye-works, paper-mills, distilleries, breweries, sugar-houses, and chemical works for the making of alum, Prussian blue, &c. An active and extensive trade is carried on with the port of Cette, and with the neighbouring towns and villages. The principal articles of export, besides the produce of the manufactures, are wine, oil, fruits, wool, and other rural produce. Montpellier enjoys a great reputation, especially in the north, as having a very temperate and healthy climate, and is frequently recommended as a residence for invalids; but though the heat is not so intense nor the air so close as at Marseilles, yet the temperature is very changeable, from the scorching glare of sunshine to the cold breezes of the *mistral.* The advantages of this town seem to have been exaggerated, both in respect of the salubrity of its climate and of the beauty and retirement of its situation. Towards the end of the eighth century, when the neighbouring city of Magueleonne embraced the side of the Saracens, and was in consequence destroyed by Charles Martel, Montpellier, which seems to have been formerly a small village, was first raised into the position of an important town, governed by hereditary lords under the bishops of Magueleonne. In the two following centuries the lords of Montpellier were not a little distinguished in the Crusades and other wars with the Infidels; while the town is represented as vying as a place of trade with the chief cities of that age. In 1202 the or ship of Montpellier passed by inheritance to the family of Aragon, and afterwards to a younger branch of that family, who were also Kings of Majorca. It was purchased in 1350 by Philip VI. of France from James III. of Majorca, for 200,000 crowns of gold. It was conferred by Charles V. on Charles of Navarre, in exchange for certain other lordships; but in 1578 the possessions of that monarch were confiscated for high treason, and Montpellier returned into the possession of France. The town still remained, however, distinct from the rest of France in its language and customs; and all the Kings of France, till the time of Louis XI., had to visit it in person in order to secure its allegiance. At the Reformation a great number of the inhabitants embraced the side of the Huguenots. In 1622 the town was attacked by Louis XIII., and after a siege of two months, surrendered; after which event the citadel was built to keep the town in subjection. Montpellier was the birthplace of Cambacérès and Cambon, who played an important part in the first French revolution; of the historian Daru; of the chemist Chaptal; and of several other distinguished characters. Pop. (1851) 40,222.

Montreal.

MONTREAL, a town of Lower Canada, capital of a cognominal county, and the largest city in British America, is situated on a triangular-shaped island of about 30 miles in length and 7 in breadth, at the confluence of the Rivers St Lawrence, and Ottawa, N. Lat. 45. 32. 22., and W. Long. 73. 32. 46. It was founded in 1642, and called Ville Marie, by a French company, which had for its object the conversion and civilization of the Indian tribes. During fifty years the settlers were harassed by the treacherous attacks of the Iroquois; but by a heroic resistance they at length succeeded in securing the tranquillity of the colony. On the 8th September 1760 Montreal was finally delivered up to the British, in whose hands it has since remained in peaceful possession. The town was then defended by some old fortifications, but these were demolished about the beginning of the present century, and replaced by wide and substantial streets. In 1815 the city scarcely contained 15,000 inhabitants; now its population is estimated at 75,000, and is steadily increasing.

The St Lawrence, on the left bank of which Montreal is situated, has a length of 742 miles above the city, and links together the celebrated combination of lakes which contain the largest amount of navigable fresh water on the surface of the globe; their total area being 98,000 square miles; while the extent of their coasts, if stretched out in a straight line, would measure upwards of 6000 miles.

The River Ottawa, which joins the St Lawrence both above and below the town, drains an area of about 80,000 square miles; and Montreal being the highest point to which the St Lawrence is navigable for sea-going vessels drawing 18 feet of water, it may be considered as the chief port of the great St Lawrence system.

The city is situated on the left bank of the St Lawrence, 300 miles from its mouth, and stands at the foot of an isolated hill, from which it takes its name. This eminence is composed of trap, which bursts through the Lower Silurian limestone of the vicinity, and rises to the height of 750 feet above the harbour. The slopes at its base are beautifully studded with orchards and villas, those on the side next the river gradually mingling with the buildings of the city.

The city occupies an area of 7 or 8 square miles. Its principal streets run parallel with the bank of the river; and all the public edifices, with a large proportion of the private dwellings, are built of cut limestone, derived from extensive quarries in the immediate neighbourhood. The majority of the houses, however, are of brick, roofed with tin, which from a distance produces a sparkling effect on the landscape.

The views from the mountain behind the city are very striking and beautiful. From the one side, looking to the upper end of the island, the eye takes in a fine expansion of the St Lawrence, called Lake St Louis, with a portion of the Lake of Two Mountains, backed by the

hills which give it name. A well-cultivated and wooded district stretches to the westward and north-westward, watered by the Ottawa, and bounded at a distance of about 30 miles by the Laurentian Hills.

On the east side of the mountain, on the other hand, the city occupies the foreground, adorned with the steeples of its numerous churches, and inclosed by the St Lawrence, which has here a breadth of from 1 to 2 miles. Above the city the bed of the river is occupied by Nun's and St Helen's Islands, the latter rising to a height of 150 feet. In the interval between these islets the great Victoria bridge is in course of erection, for the purpose of connecting Montreal Island with the mainland, and completing the links of the Grand Trunk Railroad. This stupendous bridge, which when finished in 1859 will be the largest in the world, is to be of the following dimensions:—Its total length will measure 10,384 feet; the span of each of the twenty-five arches will be 242 feet, with the exception of the centre one over the navigable channel, which will measure 330 feet. In this arch the height from the water-level of the river to the floor of the iron tube will be 60 feet. The limestone masonry, with rock-faced ashler work, will contain 2,900,000 cubic feet; the iron tube will weigh 10,400 tons; and the cost of the whole is to amount to L.1,250,000 sterling.

From the east side of the river, opposite Montreal, there extends a wide champaign country, the natural fertility of which is attested by the fact, that a large part of 1,000,000 bushels of wheat, exported from Lower Canada so early as the year 1801, was derived from it. This flat region is thickly studded with farm houses, and it is broken by a number of isolated trap mountains. Beyond these a prolongation of the Green Mountains of Vermont are visible, some of them attaining here a height of about 4000 feet above the St Lawrence. Some excellent roofing slates and beautiful white granite are found in the ridge, and are now partially used in the city.

At Montreal, and nearly all the way down to Lake St Peter, the channel of the St Lawrence is scooped out of a black bituminous shale; while 2 or 3 miles above the town this shale is cut by trap dykes, and becomes intercalated with trap beds. The river, changing its upward bearing from southward to westward, here crosses the stratification, and its wearing action having been resisted by the superior toughness of the trap and the solidity of the limestone, a natural dyke is formed, which keeps the Lake St Louis at a higher level by 44 feet than the harbour of Montreal, and gives origin to the Lachine or St Louis rapids. In these the whole body of the river, contracted to half a mile, rushes with a rapidity of 18 miles an hour; and although they are navigable downwards for steamers drawing 10 feet, they of course present an insuperable barrier to any ascent of the stream being attempted.

To obviate this and similar obstructions to the navigation, a magnificent system of canals has been established, called the St Lawrence Canals. These are nine in number, and 42 miles in length. Twenty-seven locks occur in the system, by which a rise of 205 feet is obtained, and which are capable of floating vessels of 200 feet in length by 45 feet in breadth, and drawing 9 feet of water. The lowest section, which avoids the Lachine rapids, commences at the port of Montreal, and, with a length of 9 miles, reaches Lake St Louis at Lachine, opposite Caughnawaga. The town, however, is otherwise benefited by the sudden fall of the river here, as great facility is thereby afforded for an ample supply of fresh water being conveyed into the city. By means of the new water-works the water is brought from the St Lawrence about 1¼ mile above the Lachine rapids, at an elevation of 37 feet above Montreal harbour, and conducted for 5 miles along an open canal, 43 feet wide by 8 in depth, to the pumping machinery, where it is forced up to reservoirs excavated out of the solid rock 205 feet above the level of the harbour, and which contain about 15,000,000 gallons of water. Gas-light is also abundantly supplied by a company incorporated in 1847, who had laid down a length of pipe in 1855 of 34 miles. What most attracts the stranger, however, in Montreal is the number of its public buildings, which could well be compared with those of any town of similar size in the New World. Of these the greater number are for religious or charitable purposes. One of the largest Catholic churches was consumed in the great conflagration of the 8th July 1852, which destroyed one-third of the city. The English cathedral was also destroyed by fire in December 1856. Preparations are now made for the rebuilding of both churches on a much larger scale. The Catholic parish church, which was opened for public worship in 1829, is one of the finest sacred edifices in North America. It measures 241 feet in length by 135 feet in breadth, and is surmounted by two lofty towers, which rise to the height of 213 feet. The cost of the whole building amounted to L.80,000. A chime of bells belonging to this church is much admired, particularly the great bell, which weighs 25,000 lb., and was cast in London twelve years ago by Mears. Besides these there are other Catholic churches—that of St James', erected on the ground of the ancient cathedral of Notre-Dame; Bonsecours and Recollet for the French Canadians; and St Patrick's and St Ann's for the Irish, who form one-third of the Catholic population. Of the Protestant churches the most remarkable are St George's, St Andrew's (a fine Gothic edifice), the Wesleyan church in Great St James' Street, Zion church, and St Thomas's. These, with the new Unitarian and other places of worship, among which is the Jews' synagogue, impart an elegance to the architecture of the city. Among the charitable institutions there are the Hotel Dieu, whose origin dates as far back as that of the colony itself; and St Patrick's Hospital, a branch of the same, both of which are attended by the nuns of St Joseph de la Flèche, who receive and assist the sick. The General Hospital, founded in 1747 by Madame d'Youville, is attended by the Gray Nuns, who receive foundlings, orphans, and infirm persons; and who also have lately opened two other asylums in the interior of the city. The House of Providence is also open for aged and infirm persons. The English General Hospital, maintained by the liberality of government, and erected in a salubrious situation, is a very fine edifice, open to Catholics as well as Protestants, and to which deceased merchants of the city have left large sums of money. The Protestant Orphan Asylum, the Protestant Industrial House of Refuge, the University Lying-in Hospital, the Seamen's Friend Society, with many others, have rendered the greatest service to the community, and are well supported by the people. Of literary and educational institutions, there are few cities in North America which afford such easy and abundant means of education as Montreal. Without mentioning a number of private schools, there is M'Gill College, founded by the Hon. James M'Gill, a merchant in Montreal, who died in 1813, bequeathing to the institution, which was to bear his name, L.10,000, and the estate of Burnside, of 46 acres, within the city. Litigation, however, having ensued as to the validity of the bequest, which was left in trust to the "Royal Institution for the Advancement of Learning," it was settled in 1835 by a decision of the Privy Council. The bequest of L.10,000 amounted then to L.22,000, of which L.15,000 were expended on buildings. In 1852 Her Majesty, by a new charter, appointed the members of the "Royal Institution of Learning" governors of this university *ex officio*; and in 1856 a sum of about L.15,000 was subscribed by the citizens of Montreal for its advancement and extension,

of which L.5000 were given by the Messrs Molson for the support of the "Molson Professorship of History and English Literature." The university is now in a flourishing condition, and has a principal, 5 professors of law, 9 of medicine, and 9 of arts, besides a high-school department, with a rector and 9 assistant-masters. The number of students was, in 1856, of law, 16; medicine, 96; arts, 54; and high school, 225; while the total number of volumes contained in the library amounted to 4036. The Montreal college, founded by the priests of St Sulspice a hundred years ago, and St Mungo's college, established a few years since by the Jesuits, number each about 200 students. There are also two normal schools, established in 1857. The M'Gill normal school is under the direction of the corporation of the university of M'Gill college. It is designed for the Protestant population of Lower Canada, and the instruction given is principally in the English language, although French is also taught. The Jacques Cartier normal school is also situated in Montreal, and is designed for the Roman Catholics of the surrounding districts. The instruction given is principally in the French language, but English is also taught. On the ground formerly occupied by the Mountain Fort, and commanding one of the most enchanting views in Canada, is erected a new theological Catholic seminary, an edifice of considerable dimensions. Besides these, there are the Canadian Institute for the French Canadians; the Mechanic's Institution, a building in the Italian style; and the Mercantile Library Association, the latter principally composed of young men acting as clerks in mercantile establishments. It is furnished with a library consisting of above 3000 volumes; and lectures on various subjects are delivered in its hall during the winter months. The national societies, so specially illustrative of colonial life, are likewise worthy of mention. They consist of the associations of St Andrew, St George, St Jean Baptiste, St Patrick, and New England, and have for their object the relief of such of their members as may become reduced in circumstances.

The only public monument in the city is one erected to Lord Nelson. It is situated in the market-place, is 60 feet in height, and is surmounted by a colossal statue of the hero. The Montreal Merchants' Exchange, the new post-office, and the several banks are all elegant buildings, and of various styles of architecture. The markets are well supplied with commodities; the largest of them are the Bonsecour's and the St Ann's. The town supports seven daily newspapers printed in English, and one daily in French; two French and one English semi-weekly paper; and three English weekly; besides sixteen other periodicals, published monthly and quarterly, on theological, medical, and literary subjects.

The commerce of Montreal, although it has from time to time received severe checks, has, in the aggregate, rapidly increased; and when the advantages of its position are considered, the ultimate importance of this city appears certain and immediate. As late as 1847 all Canadian produce was protected in the British markets. But in that year the differential duties were repealed, and the St Lawrence, which up to that time enjoyed a monopoly of Canadian trade, had to enter into competition with the United States; and the Drawback or Bonding Bill having at the same time come into operation there, the people of Western Canada were enabled to import foreign goods, or send their own produce through the United States in bond. On account of this change of commercial policy, and without the advantages arising from a repeal of the Navigation Laws, as now in force, the trade of Montreal suffered severely. The imports and exports, which in 1846 amounted to L.2,845,008, declined in 1849 to L.2,013,478; but in 1856 the value of imports and exports at the port amounted to L.4,992,565. A rivalry now exists between the state of New York on the one hand and East Canada on the other, as to which shall be successful in attracting the trade of Upper Canada and the Western States of the Union, to New York on the Atlantic, or to Montreal on the St Lawrence. The merchants of this port are well aware of the measures necessary to command success. The shoals which obstructed Lake St Peter and other parts of the river between Quebec and Montreal have been removed, and the depth of water increased throughout from 11 feet to 18 feet at the lowest water; while it is expected that in 1859 the channel from Montreal to the sea will be brought to a depth of 20 feet at the lowest water, and a width of 300 feet. The magnitude of this work can be estimated by the fact that, when completed, 5,074,491 cubic yards of silt will have been removed. Sailing vessels of 2000 tons, and steamers of 3000 tons, will then be able to enter the port of Montreal from the sea. New docks are also projected for the accommodation of such vessels; and with storehouses connected therewith, such facilities will be obtained for the ocean and western vessels exchanging their cargoes as cannot be excelled at any other port in North America. Montreal is 300 miles nearer Liverpool than the port of New York, and is nearer also to any port in Upper Canada, or in the Western States, than that city. At present, however, the shipping of Montreal is exceeded by that of Quebec, and many vessels from the former port are re-cleared at the latter, and *vice versa*. In 1854 an aggregate seaward tonnage of 72,305 entered Montreal, against 59,712 in the preceding year; and an aggregate seaward tonnage of 73,917 cleared from the port in 1854, against 59,902 in 1853.

By railway Montreal is connected with all the most important points. The Grand Trunk Railroad extends from St Thomas (30 miles below Quebec), and from Portland (Maine) to Montreal, and from thence to Stratford, having a total mileage of 850 miles. The Champlain Railroad extends from St Lambert, opposite Montreal, to Rouse's Point, in Lake Champlain, a distance of 45 miles. The Montreal and New York Railroad, including distance by ferry, extends from Montreal to the Province line, a distance of 39 miles; and these railroads, with the Great Western Railroad from Niagara Falls and Hamilton to Windsor on the Detroit River, place Montreal in communication with Quebec, Portland, and all ports of the United States. In addition to these advantages, Montreal is the terminus of the Canadian line of ocean steamships, now running every fortnight between Montreal and Liverpool, and also under contract to run in 1859 every week during the period of navigation, and once every fortnight during winter, to Portland. Lines of telegraph are in connection with all parts of Canada and of the United States; while a bill has been obtained by the Montreal Telegraph Company to carry a wire down the St Lawrence, to connect at Newfoundland with the projected cable across the Atlantic. Another work which must result greatly to the benefit of Montreal, is the construction of a ship canal from the St Lawrence, near the town, into Lake Champlain. The distance is about 28 miles. This would tend more than any other public work to give important advantages to the St Lawrence route.

Montreal is also the seat of a large manufacturing interest, and from the immense water-power, in the fall of 44 feet of the St Lawrence within a distance of 7 miles, it is evident that manufactures within and near the city must rapidly extend. At present the only water-power is furnished from the Lachine Canal, and here several thousand men are employed in cotton and woollen mills, edge-tool factories, boiler and engine works, saw-mills, sash, blind, and door factories, Indian-rubber, rope and cordage, nail, axe, and shovel factories. The manufacture of boots and shoes is likewise carried on to a large extent.

The value of assessed property in 1856 was L.6,391,333

Montrose. and the revenue of the town from all sources L.71,258. The city is divided into nine wards, and is municipally governed by a mayor, aldermen, and council, elected by householders who pay an annual rent of ten pounds sterling or upwards, or persons who own real estate producing half that amount of rent annually. The city returns three members to the provincial Parliament. Pop. (1851) 57,715, and in 1857 about 75,000. (J. T.)

MONTROSE, a royal and parliamentary burgh and seaport-town of Scotland, Forfarshire, 30 miles N.E. of Dundee; 56. 42. N. Lat., and 2. 28. W. Long. It is situated on the west side of a narrow sandy peninsula formed by the German Ocean on the E., the South Esk River on the S., and on the W. by a large basin not less than 7 miles in circumference, into which the tide, flowing up the South Esk, spreads itself after passing the town. This "basin" becomes dry at low-water; but its alternate filling and emptying as the tide ebbs and flows has an important effect in scouring and deepening the harbour. On the east side of the town, and between it and the sea, are extensive links or downs, belonging to the community of the burgh, and forming one of the finest golfing-grounds in Scotland. The town is in general well built, is lighted with gas, and amply supplied with excellent water, brought from the valley of the North Esk, 3 miles distant. The principal street extends, under various names, the whole length of the town; and the centre part of it, named the High Street, is spacious, and contains many elegant buildings. An excellent statue of Sir Robert Peel is one of the finest ornaments of this street, and another of Mr Hume is about to be erected. From the east side of this main street run several cross streets, which connect it with the different smaller streets and buildings lying in that direction. The town-house, which stands in the High Street, is a handsome edifice of three storeys, with an arcade below, and contains the council-room, guild-hall, court-room, news-room, and public library. Besides this, Montrose contains numerous public buildings, among which are two churches belonging to the Establishment, two to the Free Church, two to the United Presbyterian, and one each to the Independent, Methodist, and Scottish Episcopalian denominations. A chapel belonging to the English Episcopalians, burnt down in 1857, is shortly to be replaced by a commodious place of worship. The Baptists and Glassites have each a small place of worship. The old lunatic asylum in the Links, erected in 1780, is about to be sold, and a new one is in course of erection 2 miles from the town, at a cost of about L.25,000, and with accommodation for 400 patients. A spacious infirmary was erected in 1837; and in 1833 a commodious jail, adjoining which a police-office has since been built. Dorward's House of Refuge for the Destitute, built in 1839, and endowed by Mr William Dorward, affords accommodation for about 200 paupers. The Academy, a fine edifice, erected 1814, has a rector, an English teacher, 2 assistant teachers, a writing and a drawing master. Dorward's seminary, originally erected by the seven incorporated trades in 1832, but subsequently endowed by William Dorward, is now under the charge of his trustees. Besides these, there are two endowed free schools—White's, having 100 boys; and Miss Straton's, with 42 boys and 35 girls. There are also an infant and several private and denominational schools. There are two subscription libraries, the one having about 10,800 volumes, the other, supported chiefly by the working-classes, 3000 volumes. A newspaper was established in 1811, named the *Montrose, Arbroath, and Brechin Review*, which is published every Friday morning; and another in 1837, also published on Friday, called the *Montrose Standard*. A branch railway to Dubton, two miles distant, connects the town with the Scottish N.E. Railroad. The great northern turnpike crosses the South Esk by means of two bridges; one of stone, with a revolving drawbridge in the centre, on the S. side of the small island of Inchbrayock; the other a magnificent suspension-bridge, from Inchbrayock to the N. side of the river. It was designed by Captain Brown, the patentee of chain cables, and finished at a cost of about L.20,000. The foundation-stone was laid on the 18th of September 1828. The distance between the towers at the two extremities of the bridge, measuring from the centre of each, is 432 feet. There are four main chains, supported by two strong towers, 71 feet in height, and these form the grand entrance to the bridge on each side, through an archway 16 feet wide by 18 feet high. A pontage is levied at the bridge. In 1838 a large portion of the roadway of this bridge was blown down; after which it was much strengthened and improved. The harbour is formed by the outlet of the River South Esk, the channel up to the quays being 172 yards in width by 15 feet in depth at neap tides. A wet dock was constructed in 1839, 3½ acres in extent, with 19½ feet of water in spring, and 16 in neap tides, over the sill. There are two good lighthouses between the harbour and the sea, and a patent slip for repairing vessels. The harbour-dues for year ending May 1857 amounted to L.4301.

On 31st December 1856 there were 96 vessels, of 15,292 tons, registered at the port; and during that year 753 vessels entered the harbour; while in 1857 the number had risen to 925. The tonnage of these two years was respectively 60,515 and 75,503. In 1857 the principal imports were,—flax, 5551 tons; coals, 44,566 tons; timber, 17,668 loads; herrings, 7412 brls.; guano, 1682 tons; wheat, 9876 qrs. The chief exports were,—wheat, 7036 qrs.; barley, 7862 qrs.; oats, 1607 qrs.; timber, 7394 loads; potatoes, 39,677 bolls.

The chief manufacture is flax-spinning, carried on in 5 mills, employing about 2000 hands, and consuming nearly 5000 tons of flax annually. The number of small hand-looms has greatly diminished of late years. Instead of 600 in 1848, there are now only about 250. But, on the other hand, there are now about 160 power-looms employed on the Forfarshire fabrics, besides 80 broad looms on floor-cloth and wide linen sheetings of fine quality. Ship-building has for many years been actively carried on. There are four building-yards. Two saw-mills have recently been erected, driven by steam-engines of 80 horse-power, and giving employment to about 100 men. The other factories comprise three foundries, two machine manufactories, two breweries, two large rope and sail works, and two artificial-manure works, with bone-mills, a starch-work, four herring and fish-curing works employing 40 boats and 250 fishermen and others, two candle-works, and a large cabinet and upholstery manufactory.

The burgh of Montrose received its first charter from David I. about the beginning of the twelfth century; but, from the tenor of that charter, it seems to have been a burgh even before that time. Sir James Douglas embarked from this port in 1330 for the Holy Land, with the heart of King Robert Bruce. Montrose is distinguished as the first place in Scotland where the Greek language was taught, and as having sent forth from its seminary the learned scholar and divine Andrew Melville. The celebrated Marquis of Montrose was born here. In 1716 James the Chevalier embarked here for France, after his unsuccessful attempt to raise the country; while in later years (1777) it became the birthplace of Joseph Hume, the distinguished financial reformer.

The annual revenue of the burgh corporation amounts to nearly L.3000; while the estimated value of the property of the same, after deducting debts, was, in 1857, L.38,509. Montrose is governed by 19 councillors, including a provost, 3 bailies, dean of guild, treasurer, and master of the foundation called the Ancient Hospital. It unites with Arbroath, Forfar, Brechin, and Bervie, in returning a member to Parliament. Pop. of parliamentary burgh (1841), 15,094; (1851),

15,238; of royal burgh (1851), 14,328. The constituency is 432.

MONTSERRAT, one of the smallest of the British West India Islands, belonging to the Leeward group, and about equally distant (30 miles) from Antigua, Guadaloupe, and Nevis; N. Lat. 16. 40., and W. Long. 62. 10. It is of an oval form, mountainous on its eastern shores, and has a gradual slope westward to the sea. Area 30,720 acres. The island is of volcanic origin, and characterized by great abruptness, both in the elevation of its hills and in the descent of the valleys. Vegetation is everywhere abundant, and reaches in trees and shrubs to the greatest heights of the island, viz., about 2500 feet. The climate is remarkably salubrious. The chief productions are the sugar-cane, arrow-root, and timber. Owing to the heavy taxation on land, however, the full resources of its soil have not yet been developed, although of late years much has been done in lightening those burdens; and thus, in all probability, the planters here will shortly be able to compete with those on the other islands, or on the mainland. There being no other class or trade on the island than that of landholders, the legislature has been obliged to lay the entire taxation on them; and consequently in 1855 we find that 33 per cent. was taxed on the letting value of a farm for the purposes of government, besides about 25 per cent. more on the imports, which include here many of the necessaries of life. This system, however, is being gradually ameliorated in its effects by the rigid economy of the government. The trade of Montserrat is carried on exclusively with the neighbouring islands. In 1855 the imports amounted in value to L.7704; and in 1854 to L.8963; while the exports of the former year amounted to L.19,986, against L.14,515 in 1854. The chief imports are corn, cottons, dried fish and preserved meats, manure, and hardware; the principal exports, sugar (L.13,552 worth in 1855), molasses, and rum. In regard to the shipping, there was in 1854 a tonnage of 4562, against 3986 in the preceding year, entered; and a tonnage of 4589 in 1854, against 4310 in 1853, cleared from the island. The government of Montserrat is administered (under the governor-in-chief of the Leeward group) by a president and an executive council of eight members appointed by the crown, who also form the legislative council. There is, besides, a representative assembly, consisting of 12 members. In 1855 the revenue amounted to L.3500, and the expenditure to L.3264. Education, which has been productive of much good here, was dispensed in 1854 in 13 schools, attended by 1623 scholars, of whom 891 were females. This island was discovered by Columbus in 1493, and named after a mountain near Barcelona. In 1632 a party of Irish Roman Catholics from St Christopher's settled on it; and after experiencing a French invasion in 1712, the island was finally made over to Britain by the treaty of Breda in 1783. Representative government was first established here in 1689. Plymouth, the capital, is situated on the S.W. of the island. Pop. of island (1851) 7053, the great majority of whom are blacks.

MONTUCLA, Jean-Etienne, a learned mathematician, was the son of a merchant, and was born at Lyons in 1725. He attended the college of the Jesuits in his native city, and was early distinguished by his tenacious memory and his aptitude for mathematics. At the age of sixteen he removed to Toulouse to prosecute the study of law; and after taking the usual degrees he repaired to Paris. There his conversational powers, his solid information, and his acquirements as a linguist, soon introduced him to the notice of the learned. In the society of D'Alembert and Lalande, his taste for mathematical studies was confirmed and stimulated. After publishing two anonymous treatises on the *Quadrature of the Circle*, and the *Duplication of the Cube*, he gave to the world in 1758 the first part of his great work, *The History of Mathematics*. Not long after this his merits were recognised by the French government, and he was promoted to several important offices. He was appointed intendant-secretary at Grenoble in 1758, secretary to the expedition for colonizing Cayenne in 1764, and *premier commis des bâtiments*, and censor-royal for mathematical books, in 1765. During the next twenty-five years his time was divided between his official duties and the study of his favourite science. The Revolution then ensuing, deprived him of his income, and left him in great destitution. The offer in 1795 of a mathematical chair in one of the schools of Paris was declined on account of his infirm health, and he was still in straitened circumstances in 1798, when he published a second edition of the first part of his *History*. He also enlarged Ozanam's *Mathematical Recreations*, afterwards published in English by Dr Hutton, 4 vols., Lond. 1803. About four months before his death a pension of 2400 francs was conferred upon him. He died in December 1799. His *History of Mathematics* was completed by Lalande, and published in 4 vols. 4to, 1799–1802.

MOODKEE, a small town of Hindustan, 25 miles from the left bank of the River Sutlej, 1140 miles N.W. from Calcutta; Lat. 30. 48., Long. 74. 55. It is only remarkable for a victory gained by the British over a greatly more numerous force of the Sikhs on 18th December 1845. This was the first action in that war, and the loss of the English was very considerable, more than fifty European officers being killed and wounded.

MOOLTAN, or Moultan, a province of Hindustan, constituting one of the territorial divisions of the Punjab, and containing an area of 15,494 square miles, with a population amounting to 971,175.

Mooltan, the capital of the above province, situated 4 miles from the left bank of the Chinaub or Acesines, below the points where it receives the waters of the Ravey (*Hydraotes*) and the Jhylum (*Hydraspes*), and about 30 miles above its confluence with the Indus. It was formerly inclosed by a fine wall from 40 to 50 feet in height, with towers at regular distances; and had a citadel on a rising ground. The vicinity is covered with an amazing quantity of ruins of tombs, mosques, and shrines, which show the former extent and antiquity of the city. The adjacent country is fertile, well cultivated, well watered from wells, and productive of wheat, millet, cotton, turnips, carrots, and indigo. Mooltan is noted for the manufacture of silks, and for a species of carpet, which, however, is much inferior to those of the Persian manufacture. This is supposed to have been the city known anciently by the name of Malli; and in 1582 it is described by Abul Fazel as one of the most ancient cities of Hindustan. It was plundered by Mahmoud of Ghizni about the year 1006, and was again plundered by Timour in 1398. For many years the nawaub paid a tribute annually, for protection, to the sovereign of Cabul. In 1806 it was captured and plundered by Runjeet Singh. In 1809 the nabob was obliged to pay tribute to the Ameers of Sinde; and in 1818 it was again captured by Runjeet Singh, who cut to pieces the garrison of 3000, with the exception of a small number admitted to quarter. Subsequently to the death of Runjeet Singh, and during the distracted times which ensued, this place again furnished an object of contention. In 1848 the atrocious conduct of Dewan Moolraj, who held the fortress where two British officers were basely assassinated, called for the renewal of hostilities on the part of the British, which were rendered memorable by the energy and enterprise displayed by Major Herbert Edwardes, then only a subaltern. At that time the citadel of Mooltan was represented as being more regular in construction than any other stronghold laid down in India by native engineers. The wall was surrounded by thirty towers, and protected by a ditch faced with masonry. On the 2d January 1849 the city was

captured by a British force under General Whish, after an obstinate and gallant defence; and on the 22d, practicable breaches having been effected, the British troops were about to storm the citadel, when Moolraj with his whole garrison surrendered unconditionally. A few months later the destruction of the fort was completed by the elements, when the most violent storm ever remembered occasioned the flooding of the rivers of the Punjab. It was not thought advisable to repair the fortress. An obelisk, erected in the town by order of the British government, preserves the memory of those who fell in the Sutlej and Punjab campaigns. The circumstances under which this part of Runjeet Singh's territories became a portion of the British dominions will be found detailed in the article PUNJAB. The population of Mooltan, including the suburbs and cantonment, is given at about 80,000. Lat. 30. 12., Long. 71. 30.

MOON. See ASTRONOMY, part ii., chap. iii., &c.

MOOR, a market-town of Lower Hungary, in the province of Thither Danube, and county of Stuhlweissenburg, is situated in a valley 17 miles N.W. of Stuhlweissenburg. It contains a strong castle, large cavalry barracks, two churches, a monastery, a town-hall, and many well-built houses. There are several brandy distilleries here, and a considerable trade in corn, horses, and cattle. Pop. about 7000.

MOOR, JAMES, an eminent Greek scholar, was born at Glasgow on the 22d of June 1712. His father, James Moor, was a teacher of mathematics in that city, and was distinguished for great devotion to scientific and literary pursuits. Young Moor entered the university of his native city in November 1725, and soon attained to great proficiency in classical literature and mathematical science. In Greek he enjoyed the instructions of Alexander Dunlop, who combined with a thorough knowledge of the language a remarkable power of inspiring his students with a love for the study. The celebrated professor of mathematics, Dr Robert Simson, alludes repeatedly throughout his writings to the eminent talents of Moor for mathematical pursuits. After completing his academical course, he opened a school for classics and mathematics, but not succeeding in this undertaking, he speedily relinquished it. He now became a private tutor, and was connected successively in that capacity with the families of the Earl of Kilmarnock and the Earl of Selkirk. On the 11th November 1742 he was appointed librarian to the university of Glasgow; and during the same year, in conjunction with Dr Hutcheson, published an anonymous translation of *The Meditations of the Emperor Marcus Aurelius Antoninus.* On the resignation of the Greek chair by Dunlop in 1746, Moor was unanimously elected to the vacant professorship. He still continued to combine the study of classical literature with the study of the mathematical sciences; and during his residence in Paris in 1748, he received assistance from the eminent Greek scholar Capperonnier in researches on which he was then engaged connected with an edition of the Greek text of Pappus. This undertaking, which was never completed, was superseded by the more magnificent one of a complete and splendid edition of the works of Plato. This project originated with the Messrs Foulis of Glasgow, who, after being at great labour and expense in collecting materials for the undertaking, were compelled to relinquish a scheme which Dr Moor, the editor, and many other distinguished scholars throughout the kingdom, had very much at heart. The entire collection for this edition of Plato is now in the possession of the Bodleian Library at Oxford. The earliest fragment of Moor's *Grammar of the Greek Language* appeared in 1755; and after an interval of fifteen years, the work appeared with its final improvements, under the title of *Elementa Linguæ Græcæ; novis plerumque Regulis tradita, brevitate sua memoriæ facilibus,* &c., Glasgow, 1770, 8vo. A short time after the first appearance of his Grammar, he published (1759) a small volume of *Essays* on the influence of philosophy upon the fine arts, on the composition of the picture described in the Dialogue of Cebes, and on historical composition. His next work was his *Spartan Lessons, or the Praise of Valour in the Verses of Tyrtæus,* &c., which appeared anonymously in 1759. In 1763 he published an essay on that passage of Aristotle's *Poetics,* in which we are told that tragedy purifies the passions by means of pity and terror. Moor did not seem to understand how this was possible, and he accordingly questioned the ordinary interpretation of the author's language. His endeavour, however, to discover a new translation of the passage, was more ingenious than successful. The next production of his pen was an acute tract *On the Prepositions of the Greek Language, an Introductory Essay,* Glasgow, 1766. It was characterized by great ingenuity; but the soundness of his theory of the Greek prepositions has been called in question by several distinguished scholars. During the same year he published his *Vindication of Virgil from the charge of a puerility imputed to him by Dr Pearce, in his Notes on Longinus.* In addition to his original works, Moor is known to have assisted in editing various editions of those Greek classics which issued from the press of the Messrs Foulis. He edited the *Arenarius* of Archimedes; the works of Herodotus, 9 vols., 1761; the works of Thucydides, 8 vols., 1759; and, conjointly with Muirhead, the professor of humanity in Glasgow, edited the splendid copy of Homer, in 4 vols., which issued from the university press in 1756–58. As a relaxation of his severer studies, the professor is said to have indulged occasionally in the composition of English and even of Scotch verses. Some of these poetical effusions appeared in various publications of the time; but he does not seem to have been endowed with much genius for song. In 1761 he was appointed vice-rector of his university; and the senatus conferred upon him the degree of LL.D. in 1763. His health had been giving way for some time, and he was constrained to resign his professorship in 1774. He was allowed to retain his house and salary, but his domestic affairs got into disorder, and he was relieved from the annoyances of pecuniary embarrassments only by death on the 17th September 1779.

MOORE, EDWARD, a dramatist of the last century, was the son of a dissenting minister, and was born at Abingdon in Berkshire in 1712. He followed the business of a linendraper for some time in London, but was forced by ill fortune to become a literary adventurer. His first poetical work, entitled *Fables for the Female Sex* (1744), imitated with success the pungency and flowing versification of Gay. It speedily became popular, and secured for its author the patronage of several men of influence. A favour shown him by Lord Lyttelton was the occasion of his next work, a complimentary effusion, styled *The Trial of Selim the Persian.* Moore then turned his attention to the drama. His two comedies, *The Foundling* (1748), and *Gil Blas* (1749), were unsuccessful. But his rare power of riveting the attention by a tale of domestic sorrow secured for his tragedy *The Gamester* a footing on the stage, which it still retains. It was published in 1753, and has been often reprinted. Hitherto the labours of Moore had not been sufficiently remunerative. He was therefore installed as editor of *The World,* a periodical which had been established by his friend Lyttelton, for the purpose of affording him a sure income. In this office he continued until the serial was brought to a close in February 1757. By this time sixty-one papers had been contributed by his own hand. He died while the last number of his periodical was passing through the press. A quarto edition of his *Poems, Fables,* and *Plays* was published in 1756, and a separate issue of his *Dramatic Works* appeared in 1788.

Moore, Dr John ‖ Moore, Sir John.

MOORE, Dr John, was the son of a clergyman, and was born at Stirling in the year 1730. He received his medical education at the university of Glasgow, and at the age of seventeen he served with the army in Flanders. After the conclusion of peace, he prosecuted his medical studies at Paris, where he was appointed surgeon to the household of the English ambassador, Lord Albemarle. On his return to Scotland he settled as a surgeon at Glasgow, where he quickly rose to extensive and successful practice.

In the year 1769 he was called, in his medical capacity, to attend the young Duke of Hamilton, which led to his subsequently accompanying the brother of his patient to the Continent. An extensive and long-continued tour through Italy, France, and Germany, opened a wider range to his observation of character than he had hitherto enjoyed. After spending five years abroad, he settled as a physician in London; and about the same time commenced his literary career by publishing the fruits of his travels in his *View of Society and Manners in France, Switzerland, and Germany*, 2 vols., Lond. 1779. This work was so well received, that in 1781 he added to it two volumes, entitled *A View of Society and Manners in Italy*. In 1785 he published his *Medical Sketches*, consisting chiefly of observations on the animal economy and the treatment of fevers. His next performance, which appeared in the year 1789, was a novel entitled *Zeluco*, in which he has exhibited a character so atrocious as rather to excite horror than afford amusement or instruction. It was much admired, however, on its first appearance, and was hailed as a work of very great power.

In 1792 Dr Moore accompanied Lord Lauderdale to Paris, where he witnessed some of the principal scenes of the Revolution, of which he published an interesting account on his return to England, entitled *A Journal of a Residence in France during the Revolution* 1792–4. The same journey supplied him with materials for his *View of the Causes and Progress of the French Revolution*, which was published in 1795. The scenes which Dr Moore had hitherto exhibited, both in his travels and fictitious compositions, were copied from the manners of other countries. The novel of *Edward*, which he published in 1796, is entirely confined to the illustration of our domestic usages and national customs. *Mordaunt, or Sketches of Life, Character, and Manners in Various Countries*, possesses something of the same sort of merit as *Edward*, but in an inferior degree. He survived the publication of *Mordaunt* only two years, and died at London in 1802. In addition to the works already signalized, Dr Moore published an edition of Smollett's works in 8 vols., with a Life of the author, Lond. 1797.

The reputation of Dr Moore with posterity will rest on his travels and novels. As long as they are read, he will be acknowledged as a writer endowed with admirable good sense, a rich vein of original humour, keen insight into human nature, and a capacity of describing its intricacies with force and discernment.

A complete edition of his works, in 7 vols., with a Memoir of his life, was published by Dr Robert Anderson, Edinburgh, 1820.

Moore, *Sir John*, a consummate British general, a brave soldier, and an accomplished gentleman, was born at Glasgow on the 13th of November 1761. He was a son of Dr Moore, the author of *Zeluco* and other works, noticed in the preceding article, and received the principal part of his education on the Continent, whilst his father attended the Duke of Hamilton in his travels. In 1776 the Duke of Hamilton procured him an ensigncy in the 51st regiment, then quartered in Minorca; and he afterwards obtained a lieutenancy in the 82d, with which he served in America until 1783, when he was reduced with his regiment. By the interest of his former patron he was subsequently brought into Parliament for the Lanark district of burghs, which he for a short time represented. In 1787 or 1788 he obtained the rank of major in the fourth battalion of the 60th regiment, then quartered at Chatham, but afterwards negotiated an exchange into the 51st. In 1790 he succeeded by purchase to the lieutenant-colonelcy of the same regiment, which, the following year, he accompanied to Gibraltar. After some other movements, he was sent to Corsica, where, owing to a misunderstanding between the military and naval commanders, General d'Aubant resigned the command to him under the most critical circumstances; and here, though still a young officer, and without parliamentary friends, he was called to fight the battles of the army against a domineering old admiral, Hood, who possessed great influence at home, and who had shown himself capable of the most outrageous violence. By dint of firmness, however, he succeeded in controlling this daring, obstinate, clever man; and was at length relieved from the difficult and embarrassing situation in which he had been placed by the arrival of Sir Charles Stuart, who having assumed the command of the army in 1794, appointed Moore to command the reserve. At the siege of Calvi which followed, the latter particularly distinguished himself, and received his first wound in storming the Mozzello fort. He gave his opinion against besieging Bastia, which afterwards surrendered after a very feeble defence, though the place was strong and the garrison numerous; but this, as a military judgment before the event, was nevertheless sound and just, for Moore never could have anticipated that General Gentili would neglect to avail himself of the means in his power, "because he wished to do his duty and no more," and had property in England.

Sir Charles Stuart having been recalled in consequence of a disagreement with the viceroy, Colonel Moore returned to England in 1795, and being immediately appointed a brigadier-general in the West Indies, he was attached to a brigade of foreign troops, consisting of Choiseul's hussars, and two corps of emigrants. On the 25th of February 1796 he received orders to take charge of and embark with Perryn's brigade, destined to join the expedition to the West Indies under Sir Ralph Abercromby. Having hurried to Portsmouth, where he had scarcely time to prepare a few necessaries, he sailed for the West Indies on the 28th, with no other baggage than a small portmanteau. He arrived at Barbadoes on the 13th of April 1796, and there waited on the commander-in-chief, who had preceded him in the Vengeance line-of-battle ship. That calm and sagacious observer soon appreciated his merit; and in the operations against St Lucia, which immediately followed, employed him in every arduous and difficult service. During the siege of Morne Fortunée, his conduct, as expressed in general orders, was the admiration of the whole army; and after the capitulation he was appointed to the government of the island, notwithstanding he had earnestly requested permission to accompany the commander-in-chief and the troops in the reduction of the other islands. In this situation, beset with all manner of difficulties, his conduct was not less admirable than in the field, and, tempering justice with humanity, the severity of military examples with a due consideration of the circumstances which palliated the conduct of the Negroes and republicans, he subdued discontent, restored order, and re-established security.

Having completely re-established tranquillity in St Lucia, Moore was relieved from the command of the island, and returned to England in August 1797. In November, Sir Ralph Abercromby having received the command of the forces in Ireland, desired that General Moore should be placed on his staff, and the latter accordingly accompanied him to Dublin in the beginning of December. During the period immediately preceding the rebellion he held an important command in the south of Ireland, which, being much disaffected, was considered as the quarter where the enemy were, in the

event of an invasion, likely to attempt a landing. His head-quarters were at Bandon, and the troops under his command, amounting to 3000 men, formed the advanced guard of the south. When the insurrection broke out in 1798, he was at first employed under Major-General Johnstone at New Ross, but was afterwards detached towards Wexford, at that time in the hands of the insurgents. On this occasion he had only the 60th sharpshooters, 500 light infantry, 50 of Hompesch's dragoons, and 6 pieces of artillery; and with these troops he had not proceeded above a mile when a large body of insurgents appeared on the road advancing to attack him. The rebels, amounting to about 6000 men, headed by one Roche, attacked with great spirit, and maintained the conflict with much obstinacy, but were at length defeated, driven from the field, and pursued with great loss. After the action he was joined by two regiments from Duncannon, and took post for the night upon the ground where the combat had commenced. Next day, when he had resumed his march, he was met by two men from Wexford with proposals on the part of the insurgents to lay down their arms and submit on certain conditions; but General Moore, having no power to treat, declined entertaining these proposals, and continued his march to Wexford, which he delivered from the power of the insurgents. He was afterwards employed to suppress a remnant of the rebellion in Wicklow, where many of the insurgents had taken refuge amongst the mountains and bogs, whence they issued to wage a sort of desultory warfare. Speaking of this affair in his journal, he says, that moderate treatment by the generals, and the preventing of the troops from pillaging and molesting the people, would soon restore tranquillity; that the latter would certainly be quiet if the gentlemen and yeomen would only behave with tolerable decency, and not seek to gratify their ill-humour and revenge upon the poor; and he adds, that he judged their harshness and violence had originally driven the farmers and peasants to revolt, and that they were as ready as ever to renew their former ill-usage of them.

These and other similar observations on the insurrection of 1798, extracted and published from General Moore's journal, do equal honour to his head and heart, evincing the discriminating and unimpassioned sagacity of the statesman, united with that high and liberal feeling which forms the greatest ornament in the character of the accomplished soldier.

Immediately after quitting Ireland, General Moore engaged in the memorable expedition to Holland. The Dutch, whom we sought to rescue from the alleged tyranny of the French government, made common cause with the enemy. They received the French as friends and deliverers, because the House of Orange, aided by Prussia, had destroyed their republic, suppressing their constitution and liberties; and hence, after a short struggle, the Duke of York was obliged to capitulate. But the troops displayed their usual gallantry, particularly those under the command of General Moore, who, after being wounded in the hand and thigh, received a musket-ball in the face, and was with difficulty brought from the ground. Being carried back to his quarters, a distance of 10 miles, he was taken thence to the Helder as soon as he could be moved, and embarked on board the Amethyst frigate, which arrived at the Nore on the 24th of August. Soon after his return to England the King conferred on him the command of a second battalion which had just been added to the 52d regiment; and his wounds having closed in the course of five or six weeks, he joined his brigade at Chelmsford on the 24th of December.

Early in 1800 it had been resolved to send a body of troops to the Mediterranean under the command of Sir Charles Stuart, and General Moore willingly consented to serve under that officer, whom he greatly esteemed. The first intention was, that the expedition should consist of 15,000 men; but it afterwards turned out that the regiments destined for the service, part of which had lately been employed in Holland, mustered only 10,000 effective soldiers. About the middle of March the first division, amounting to 5000 men, embarked under General Pigott. But at this time a change took place in the plan, if not in the destination, of the expedition. Sir Charles Stuart, having some misunderstanding with ministers, resigned his command; and Sir Ralph Abercromby being appointed to succeed him, named as one of his major-generals, Moore, who, along with Pigott and Hutchinson, sailed about the end of April with the second division of the troops. During this expedition, which a variety of causes conspired to render abortive, General Moore had little opportunity of signalizing his exertions; nor was it until the following year, when his troops were ordered to proceed to Egypt under Sir Ralph Abercromby, that a theatre of action opened for the display of his talents. On his arrival at Malta he was sent forward to Jaffa to inspect the Turkish army, and judge as to the amount of co-operation which might be expected from it; but his report being unfavourable, Sir Ralph determined to land in the Bay of Aboukir, and to march immediately upon Alexandria. In the affair of the landing on the 4th of March 1801, in the combat of the 13th, and again in the battle of the 21st, where he received a wound in the leg, General Moore was actively engaged, and as usual, greatly distinguished himself. On recovering from his wound, which occasioned him much suffering, he continued to serve with the army in Egypt until the surrender of Alexandria, when he returned to England, where he received the honour of knighthood and the Order of the Bath.

Soon after his return to England, we find Sir John Moore actively occupied in the camp at Shorncliff, where his skill in training troops was proved to be equal to his courage in leading them. Many persons have been led to suppose that he was a harsh and odious disciplinarian; but this calumny has been refuted by the most irrefragable proof. "The officers of the regiments which were formed by his care," says Sir William Napier (*Edinburgh Review*, vol. lix.), "were ever after his warmest admirers. His discipline it has been their object to maintain; his maxims have been their guide; his reputation has been by them considered as a part of their own; his memory is cherished in their hearts to this day, and will be as long as those hearts retain an atom of a soldier's pride and honour." Such is the testimony of one who knew him thoroughly; and who, besides his pre-eminent qualifications for judging rightly, had the best opportunities of understanding his views and appreciating his real character.

On the renewal of the war after the short peace of Amiens, Sir John Moore's talents and services pointed him out as deserving of some important employment. He was accordingly sent to Sicily as second in command to Sir John Stuart; and when that officer had been superseded by General Fox, he virtually acquired the chief command in that island. Associated with such a nominal superior, Moore had full scope for the exercise of his ability and sagacity; and indeed his whole proceedings showed that his sense and judgment in civil matters were in no degree inferior to his talents in war.

When Sir John Moore arrived in England from Sicily, he was immediately sent with an expedition to Gottenburg, to aid Gustavus Adolphus IV., King of Sweden, against the encroachments of Napoleon. While engaged on this expedition, he became involved in a grave dispute with the unreasonable Swedish king; and had it not been for the ability and resolution which he displayed on that occasion, 10,000 of the finest soldiers of England would have been sacrificed.

We come now to the expedition to Spain, which terminated Sir John Moore's earthly career. In 1808 he was appointed to the chief command of an army to be employed in Spain; and Gallicia, or the borders of Leon, were fixed upon as the place for assembling the troops. He was ordered to send the cavalry by land, but it was left to his own discretion to transport the infantry and artillery either by sea or land; and being at the same time informed that 15,000 men were ordered to Coruña under General Sir David Baird, he was directed to give such instructions to that officer as should facilitate the junction of the whole force. Before he commenced his advance from Portugal, he was assured that his entry into Spain would be covered by from 60,000 or 70,000 men; and Burgos was the place fixed on for the junction of the different divisions. But he soon discovered that these assurances were fallacious, that little or no reliance could be placed upon the Spaniards, and that the patriotic enthusiasm which he had been taught to expect in the people had either never existed at all, or had entirely evaporated. Not only Burgos, but Valladolid, was in possession of the enemy; and he found himself, with an advance corps, in an open town, at the distance of only three marches from the French army, without even a Spanish piquet to cover his front. At this time he had only three brigades of infantry, without a single gun in Salamanca; and although the remainder were coming up in succession, the whole could not be assembled in less than ten days. At this critical moment the Spanish armies, instead of concentrating or uniting in a common effort with the British, were disseminated all over the Peninsula; Blake had been defeated, and his army totally dispersed; Romana, equally weak and obstinate, proved incapable of undertaking anything; and Sir David Baird, informed that the French were advancing upon him in two directions, was preparing to retreat upon Coruña, a movement which was countermanded by Sir John Moore, upon learning that the report was unfounded. (See Sir William Napier's *History of the Peninsular War*, vol. i.) Never was a general commanding an army placed in a more critical position than Sir John Moore; for, whilst he received information that there was now no army remaining in the field except his own, which was thus exposed to attack on all sides by overwhelming numbers, he was called upon to repel the most irritating interference, to guard against open treachery, and to counteract folly, equal in its effects to treachery. Yet, even in these circumstances, he was willing to attempt something for the cause, and even to risk the danger of an advance on the capital. With this view he commenced a forward movement from Salamanca on the 12th of December, intending to attack Soult on the Carrion, draw the mass of the French force towards the north of Spain, and thus afford the Spanish armies time to rally and adopt some new plan of operations. This movement, in a strategical point of view, was ably conceived, and it proved to be well-timed and successful; but Sir John Moore, with 23,000 men, could not maintain himself against the whole French army; and as Napoleon, having secured the capital, was now rapidly advancing at the head of from 60,000 to 70,000 men, a retreat became inevitable. It was now the depth of winter, and the retreat had to be effected through the mountainous region of Gallicia, which necessarily led to much suffering and disorder. There were not awanting many who blamed this retreat for precipitancy, but this charge has long since been shown by the best authorities to be unfounded. (See Napier's *History*, vol. i.)

The rear-guard quitted Astorga on the 1st January; on the 3d it repulsed the enemy in a sharp skirmish at Calcabelos; on the 6th it rejoined the main body at Lugo, having three times checked the pursuers during the march. It suffered no misfortune; and the whole army offered battle at Lugo for two successive days without being accepted. The retreat recommenced; the troops reached Betanzos on the morning of the 10th, and Coruña on the 11th; and five days afterwards fought and won that celebrated battle in which their brave commander fell.

After the fight the British troops embarked and steered home directly from Coruña; a terrible storm scattered it; many ships were wrecked, and the remainder, driving up the Channel, were glad to put into any port. The soldiers, thus thrown on shore, were spread from the Land's End to Dover. Their haggard appearance, ragged clothing, and dirty accoutrements, things common enough in war, struck a people only used to the daintiness of parade with surprise; the usual exaggerations of men just escaped from perils and distresses were increased by the uncertainty in which all were as to the fate of their comrades; a deadly fever, the result of anxiety, and of the sudden change from fatigue to the confinement of a ship, filled the hospitals at every port with officers and soldiers; and thus the miserable state of Sir John Moore's army became the topic of every letter, and a theme for every country newspaper along the coast. The nation, at that time unused to great operations, forgot that war is not a harmless game, and judging of the loss positively instead of comparatively, was thus disposed to believe the calumnies of interested men, who were eager to cast a shade over one of the brightest characters that ever adorned the country. Those calumnies triumphed for a moment; but Moore's last appeal to his country for justice will be successful. And if authority be sought for in a case where reason speaks so plainly, future historians will not fail to remark, that the man whose talents called forth the praises of Soult, of Wellington, and of Napoleon, could be no ordinary soldier.

"Sir John Moore," says Soult, "took every advantage that the country afforded to oppose an active and vigorous resistance, and he finished by dying in a combat that must do credit to his memory." Napoleon more than once affirmed, that if Moore committed a few trifling errors, they were to be attributed to his peculiar situation, for that his talents and firmness alone had saved the English army from destruction. "In Sir John Moore's campaign," said the Duke of Wellington, "I can see but one error; when he advanced to Sahagun he should have considered it as a movement of retreat, and sent officers to the rear to mark and prepare the halting-places for every brigade; but this opinion I have formed after long experience of war, and especially of the peculiarities of a Spanish war, which must have been seen to be understood; finally, it is an opinion formed after the event."

The fall of Sir John Moore is thus described by Captain (now Sir Henry) Hardinge:—"I had been ordered by the commander-in-chief to desire a battalion of the Guards to advance, which battalion was at one time intended to have dislodged a corps of the enemy from a house and garden on the opposite side of the valley; and I was pointing out to the general the situation of the battalion, and our horses were touching, at the moment that a cannon-shot from the enemy's battery carried away his left shoulder and part of the collar-bone, leaving the arm hanging by the flesh. The violence of the stroke threw him off his horse on his back. Not a muscle of his face altered, nor did a sigh betray the least sensation of pain. I dismounted, and, taking his hand, he pressed mine forcibly, casting his eyes anxiously towards the 42d regiment, which was hotly engaged; and his countenance expressed satisfaction when I informed him that the regiment was advancing. Assisted by a soldier of the 42d, he was removed a few yards behind the shelter of a wall. Colonel Graham of Balgowan (Lord Lyndoch) and Captain (now Sir John) Woodford about this time came up, and perceiving the state of Sir John's wound, instantly rode off for a surgeon. The blood flowed fast, but the attempt to stop it with my

sash was useless, from the size of the wound. Sir John assented to being removed in a blanket to the rear. In raising him for that purpose, his sword, hanging on the wounded side, touched his arm, and became entangled between his legs. I perceived the inconvenience, and was in the act of unbuckling it from his waist, when he said, in his usual tone and manner, and in a very distinct voice, 'It is as well as it is; I had rather it should go out of the field with me.' When the surgeons arrived, he said to them, 'You can be of no service to me; go to the soldiers, to whom you may be useful.' As he was carried slowly along in the blanket, he made the soldiers by whom he was borne frequently turn him round to view the field of battle, and listen to the firing, and he seemed pleased when the sound grew fainter. On arriving at his lodgings he suffered great pain, and could speak but little; at length, however, he said to Colonel Anderson, who for more than twenty years had been his friend and companion in arms, 'Anderson, you know that I always wished to die in this way.' He frequently asked, 'Are the French beaten?' and when he was told that they had been defeated at every point, he said, 'It is a great satisfaction for me to know that we have beaten the French;' adding, I hope the people of England will be satisfied; I hope my country will do me justice.' To Major Stanhope he said, 'Stanhope, remember me to your sister;' and having mentioned the name of his venerable mother, for whom he seemed anxious to offer up his last prayers, he lost all power of utterance, and in a few minutes afterwards expired without a struggle."

Thus fell, on the 16th of January 1809, in the forty-seventh year of his age, after gaining a victory which saved the remainder of the army from destruction, and which, in all its circumstances, was perhaps unparalleled in the annals of war, Lieutenant-General Sir John Moore, a perfect model of a British soldier at a time when such models were few, and a hero cast in the true classical mould. He was equally a stranger to fear and reproach, yet one whom the malignity of faction basely attempted to deprive of his just fame, whilst venal pens endeavoured to depreciate his achievements, and servile poets vainly sought to exclude his name from the list of the brave who had fought and fallen in the same struggle. But his country was well disposed to acknowledge his merits, and history has already placed his character and actions beyond the reach of contemporary injustice. (J. B—E.)

MOORE, *Thomas*, one of the most accomplished and versatile authors of the nineteenth century, and pre-eminently the poet of Ireland, was a native of Dublin, in which city his father carried on business as a small grocer and spirit-dealer. He was born on the 28th of May 1779. His parents were of genuine Celtic-Irish descent, Roman Catholics, devoted to poetry and music, and possessing the quick sensibilities and warm domestic affections common among their countrymen. The poet's mother (to whom he was fondly attached) seems to have been a woman of great vivacity and spirit; and she joined with his first schoolmaster, Samuel Whyte (who had been the teacher of Richard Brinsley Sheridan), in cultivating in her son a taste for recitation, music, and theatrical performances, in which he early became distinguished. He was made a "show-child," as he confesses; and in a certain sense this character continued with him to the last, the scene being shifted from the gay social circles and private theatres of Dublin to the saloons of Holland House, Bowood, and other patrician mansions of the English aristocracy. Almost from infancy Moore had been accustomed to act, sing, and rhyme; and in his fourteenth year he appeared as a contributor to a Dublin magazine. His juvenile verses he afterwards characterized as "mere mock-birds' song," which is true of nearly all boyish rhymes; but in the department of versification the Irish poet, guided by an exquisite ear, was from the first correct and harmonious.

In 1793 the penal laws against the Roman Catholics were relaxed, and Moore was enabled to enter Trinity College as a student of his native university. The country was then agitated by political excitement, the offspring of the French revolution, acting upon a keen sense of national wrongs and humiliation. The poet sympathized with his oppressed Roman Catholic countrymen, and was intimate with Emmet and the other young and ardent spirits who rushed into the memorable conspiracy and outbreak of 1798; but he joined in none of their secret unions or wild revolutionary schemes. He completed his college course and took his degree of B.A. in 1798, after which he proceeded to London. Of the small sum of money which he carried with him, part, he says, was in guineas, carefully sewed in the waistband of his pantaloons by his mother, and along with the gold she had inclosed a *scapular*, or bit of cloth blessed by the priest! The good woman's prayers no doubt accompanied this treasure, and were more potent than the charm. In repairing to London, Moore had two objects in view—first, to study law in the Middle Temple, and then, as subsidiary to this professional purpose, to publish a translation of the Odes of Anacreon by subscription. With the law he made little progress; but his subscription was highly successful. He obtained an introduction to the Earl of Moira; the Earl introduced him to the Prince of Wales; and the poet's winning address, his scholarship, singing, and genial buoyancy of spirits, soon made him a favourite in fashionable and influential circles. His Anacreon appeared in 1800, dedicated by permission to the Prince. All who had listened to the "warbling" of the young translator, and who took an interest in his fortunes, were loud in praise of the work; while by critics and scholars it was considered as at least better than any preceding version of the Greek poet, with the exception of the few inimitable paraphrases by Cowley. "Anacreon Moore," as he was now called, ventured next year on a volume of original verse, which he put forth under the title of *The Poetical Works of the late Thomas Little, Esq.* The name of "Little" was a thin disguise, thrown off after the first edition, and originally adopted in playful allusion to the poet's diminutive stature; for Moore, as Walter Scott observed, was the smallest of men, not to be deformed. He was, as Goldsmith said of Garrick, "an abridgment of all that is pleasant in man." The poems were amatory productions, elaborately polished, and remarkably melodious in style and diction; but the chief distinction and peculiarity of the volume was its Ovidian warmth and pruriency, bordering on libertinism, which exposed its author to just and severe censure. Part was afterwards omitted from the collected edition of his works. Moore was not studiously immoral—his fancy played the profligate, not his heart; and one of his Irish friends, with a touch of native humour, compared him to "an infant sporting on the bosom of Venus." Through the influence of Lord Moira the poet obtained a government appointment—that of registrar to the Admiralty in Bermuda, which he took possession of in October 1804. The little islands, so delicious in climate, fruits, flowers, and foliage, appeared to him all fairyland; and his arrival was the signal for a succession of fêtes and gaieties. But when business was forced on his attention, it soon became obvious that the new appointment was no lucrative prize, and that even a Spanish war would not make his income worth staying for. Three months of Bermuda sufficed; a deputy was engaged, and the poet returned to England, travelling over part of the United States and North America, during which he visited, with a poet's enthusiasm, the Falls of Niagara. He reached London, after fourteen months' absence, in November 1804. The result of his journey was a volume of *Odes and Epistles*,

published in 1806, and dedicated to Lord Moira. The work was well fitted to extend the poet's reputation. The Epistles contain many passages of beautiful and striking description, and are animated by a glow of generous sentiment, and a display of refined scholarly taste and subtle imagination peculiar to Moore among all the poets of his age. Some of the lyrical pieces in the volume—as the "Canadian Boat Song" and "The Woodpecker"—were set to music and instantly became popular. The work, however, was attacked with great asperity in the *Edinburgh Review*. Moore had indulged in severe strictures on the republican institutions and society of America, and some of the poems were tinged with that licentious freedom characteristic of the "Little" volume. Jeffrey branded the poet as a deliberate corrupter of the public morals. Moore replied by sending a challenge, and a hostile but bloodless meeting took place (August 12, 1806), which furnished a topic for nine days' wonder and ridicule, and proved the commencement of an acquaintance and life-long friendship between poet and critic.

About this time a musical publisher, Mr Power, projected a collection of the best original Irish melodies, with characteristic symphonies and accompaniments, and with words containing as frequently as possible allusions to Irish manners and history. Moore entered cordially into this patriotic undertaking, which ultimately became an important work, both as respected his fame and emoluments, and was extended to ten numbers. He knew the difficulty of the task. "The poet," he said, "who would follow the various sentiments which the airs express must feel and understand that rapid fluctuation of spirits, that unaccountable mixture of gloom and levity, which composes the character of his countrymen, and has deeply tinged their music." All this he felt and appreciated, and amply fulfilled. Burns alone has excelled Moore as a song-writer. If a third were added to form a lyrical trio, Béranger might be named; and all were intensely national, familiar with every shade of sentiment, prejudice, and feeling, in their countrymen. Moore has said that the real source of his poetic talent was the effort to translate into words the different feelings and passions which melody seemed to him to express; and his genius, thus inspired, ranged over all the fields of Irish song and story,—now swelling into heroic and martial verse, now revelling in joyous festivity, love, and wine, and now melting in strains of mournful regret, tenderness, and pathos. The union of poetry and music, their natural affinity and blended power, was never more felicitously exemplified than in these lyrics of Moore—the most universally popular, and, it may safely be predicted, the most imperishable of all his works. To the *Irish Melodies* were afterwards added *National Airs*, *Sacred Songs*, *Legendary Ballads*, *Evenings in Greece*, a *Set of Glees* (with music, also by the poet), and a number of separate songs and ballads. The lyric department of his poetry was at once the most voluminous and the most popular, and was constantly receiving additions.

For some years Moore was partially dependent on Lord Moira, and resided at his lordship's seat of Donnington Park. In 1811, however, he ventured on a step which gave a new turn to his feelings and prospects; he married a young Irish actress, Miss Dyke, the faithful "Bessy" of his *Journal*, who appears to have been every way worthy of his affection. Literature was now necessary as a profession; and in order that he might prosecute it with less interruption, Moore fixed his residence in an English village. He had an idea that the Irish neither fight nor write well on their own soil, and he seems never to have contemplated returning permanently to Ireland. He went to Kegworth in Leicestershire, but in the same year removed to Mayfield Cottage, near Ashbourne, in the county of Derby; and this spot may claim the honour due to scenes of poetical interest and veneration, for there Moore composed the best of his Melodies, and the greatest of his poems, *Lalla Rookh*. There was still a lingering hope that Lord Moira might be able to obtain some favourable appointment for the poet. His lordship was not indisposed to exert his influence, but his power was small; and in 1812 the removal of this nobleman to India put an end to Moore's expectations. He was averse to any application being made in his behalf to the ministry, and was resolved, he said, to work out his independence by industry. He had a justifiable reliance on the facility and versatility of his pen, and only wanted prudence to be one of the richest, as he was one of the best rewarded, of modern authors.

In 1813 Moore produced a political satire, *Intercepted Letters, or the Twopenny Post-Bag*, a series of light yet pungent rhyming epistles, suggested, perhaps, by Anstey's *New Bath Guide*, and which hit the public taste so well that thirteen editions were called for in a twelvemonth. The new and successful vein thus laid open was well cultivated in after years. Moore had previously tried the stately or Juvenalian style of satire; and in the years 1808 and 1809 produced three poems, *Corruption*, *Intolerance*, and *The Sceptic*, but they were heavy productions, and excited no attention. The lighter form of weapon to which he now betook himself was not only, he said, more easy to wield, but more sure to reach its mark. Up to the close of his poetical career Moore continued to throw off political squibs or satires on the topics of the day, and they are unsurpassed in our whole literature for wit, ingenuity, and brilliancy. They were published in the columns of the *Morning Chronicle* and *Times*, and seem to have brought their author an income of L.400 or L.500 a year. His imagination, he said, was the sole or chief prompter of this satire. It was possible, he conceived, to shower ridicule on a political adversary without allowing a single feeling of real bitterness to mix itself with the operation. Without a lively and fertile imagination such things could not indeed have been written; but Moore was a partisan as well as a poet; he felt keenly on all questions affecting his Irish Roman Catholic brethren, he was in daily association with the Whig leaders, and he had, besides, the natural antipathy of wit and genius to official dulness and pretence. But perhaps the main cause why a poet so little prone to bitterness should have so often and so long persisted in the use of this "flying artillery" of party warfare, was the unexampled popularity of his satires, and the large sums of money he obtained for them. When a few hours' occasional labour, that partook as much of amusement as of task-work, produced a cheque for a hundred pounds, and elicited immediate congratulation and applause, little else was required to stimulate the imagination. Moore was a man of quick rather than of strong or deep feeling; to such indignation or hatred as that of Swift he was a stranger. The political wrongs and injustice that lacerated the soul of Swift only wakened the poetical fancy and exercised the lively satirical ingenuity and wit of Moore.

The circumstances attending the publication of *Lalla Rookh* form an interesting chapter in literary history. In December 1814 the Messrs Longman, publishers, stipulated to give Moore the sum of L.3000 for a poem of the same length as Scott's *Rokeby*. They had seen no part of the work, and had to encounter, of course, the risk of failure; but they placed implicit trust in the genius and honour of Moore, and in the almost unbounded popularity of his name. After more than two years' delay the transaction was completed by the publication, in May 1817, of this eastern romance; and it is gratifying to be able to add that the enterprising and confiding publishers were fully compensated for their liberality and boldness, the poem having in the first year gone through seven editions. It possessed, indeed, all the elements of instant and decided success. *Lalla Rookh*

abounds in picturesque and highly-wrought delineations of Eastern scenery and manners. It has the interest and attraction of four romantic tales, happily linked together by a small golden thread of narrative; it has a profusion of similes and sparkling imagery, and in some of the characters and incidents there are pictures of the loftiest heroism and the tenderest love. The versification is varied, spirited, and harmonious. The poet moves in the fetters of rhyme, whether in the heroic measure of Dryden or in the octo-syllabic verse of Scott, with the ease and grace of Ariel himself; and Ariel could not have desired a greater command of voluptuous sweets—of bowers of roses and nightingales, crystal fountains and fragrant groves, made radiant by the Houris of the East. The subject justified a large amount of this ornamental splendour and sensuous beauty; and the poet drew his materials from diligent study of oriental histories and books of travel. All is correct in external embellishment, costume, and decoration. The defect of the poem is its very riches. There is too much glitter and perfume; too many startling contrasts of loveliness and deformity, of rapture and agony; too visible a presence of art and preparation. The reader is lost in admiration, but gets fatigued as in a picture-gallery or hot-house, and sighs for the fresh breeze and simple aspects of nature.

While enjoying this new accession of fame and of release from the responsibility of an anxious engagement, Moore accepted an offer from Mr Rogers to accompany him to Paris. They spent a month in the French capital, and it furnished matter for Moore's next work, *The Fudge Family in Paris*, a satire which, he says, "prospered amazingly—five editions in less than a fortnight, and his share of the profits for that time L.350." The Marquis of Lansdowne had long wished the poet to take up his abode somewhere in his neighbourhood, and Moore removed to Sloperton Cottage, near Devizes, which was within an easy walking distance of Bowood. His settlement in this neat and modest poetical mansion (a thatched cottage, with garden, rented at L.40 a-year) was followed by what seemed at first to be a serious and almost irremediable misfortune. His deputy at Bermuda proved faithless, having not only kept back part of the receipts of the office, but appropriated to his own use the proceeds of a sale of ship and cargo, deposited in his hands by some American merchants. The poet was involved, it was feared, to the extent of L.6000; and a suit was instituted against him in the Admiralty Court. Attempts were made at a compromise with the crown and the American creditors; and while these were pending, the poet, ever sanguine and light-hearted, resumed his literary labours and social festivities. His next poem was a "flash satire," entitled *Tom Crib's Memorial to Congress*, published in March 1819. In July the Bermuda cause was finally decided in court, and an attachment was issued against Moore's person. One friend advised him to seek an asylum for a short time in Ireland, another recommended a retreat to the sanctuary at Holyrood, and a third counselled him to fly to France. All offers of pecuniary assistance from his friends he steadily declined. He went to France; and shortly after his arrival in Paris (Sept. 1819) he went with Lord John Russell on a journey to Italy. They travelled together as far as Milan, the poet having by the way "shuddered and shed tears" over the mighty panorama of the Alps, which he saw in all its sunset glory. Lord John took the route to Genoa, and Moore proceeded alone on a visit to Lord Byron at his villa near Venice. He subsequently extended his tour to Rome, and was fortunate enough to fall in with two eminent English artists, Chantrey and Jackson, with whom he returned to Paris. This tour called forth a volume of *Rhymes on the Road*—miscellaneous pieces of unequal merit, but embodying the poet's impressions of the magnificent ascent of the Simplon, the appearance of Venice, and the glories of ancient art. On all such subjects the inferiority of Moore to Byron, thus made apparent, was strikingly manifest. Some reviewing for Jeffrey, and some additional Melodies for Power, helped to supply the exigencies of life in Paris; but Moore's celebrity and multifarious acquaintance were fatal to anything like severe study. Had he taken refuge in Holyrood he would have been saved many temptations, but he would also have missed much enjoyment; and his satirical poetry would perhaps have lost some of the Attic point and polish which familiarity with high life and public affairs in different countries was fitted to impart. At length, in September 1822, Moore received the welcome intelligence that he might safely return to England. The Bermuda claims had been reduced to a thousand guineas: towards this sum the uncle of the deputy contributed L.300, and the Marquis of Lansdowne deposited the remaining portion (L.750) in the hands of a banker, to be in readiness for the final settlement of the demand. Moore allowed the deposit to be thus applied, but immediately reimbursed his noble friend by a cheque on his publishers for the amount. And thus the harassing claim which had hung as an ominous cloud over the poet's household for more than three years was easily and independently liquidated.

The first publication of Moore, after his return to his Wiltshire cottage, was another romantic poem, *The Loves of the Angels*, founded on eastern story and rabbinical fictions, that allegorized the fall of the soul of man from its original purity. He next resumed satire in poetry and prose, having published *Fables for the Holy Alliance* (1823) and *Memoirs of Captain Rock* (1824). The latter is a lively epitome of Irish history, in which, under the name of a celebrated Irish chieftain, he detailed the violence and insurrection that had sprung from systematic oppression. Though bearing the character of a party pamphlet or special pleading, this volume evinced considerable research and a happy talent for dealing with historical and statistical facts. The same qualities were more strikingly displayed in his *Life of Sheridan*, published in 1825. As a work of contemporary history and biography, illustrated by personal anecdote and criticism, Moore's *Life of Sheridan* told much that was new and interesting; it was fairly and candidly written, presenting passages of powerful reasoning and eloquence; and was only objected to on the ground that it was too full of ornament and metaphor, the author having intruded poetry into the sober domain of historical prose. His next work was still more ornate, but there embellishment was graceful and appropriate. *The Epicurean, a Tale*, published by Moore in 1827, is the story of a young Epicurean philosopher who, in the reign of Valerian, visits Egypt, falls in love with an Egyptian maid, and ultimately, through her counsels and martyrdom, becomes a convert to Christianity. The philosophy and pathos of this little tale, and its exquisite descriptions, render it unique and unrivalled for brilliance among our works of fiction.

In 1830 appeared *The Letters and Journals of Lord Byron, with Notices of his Life*, by Thomas Moore, 2 vols. 4to. Thus modestly was ushered into the world a work that had cost Moore infinite trouble and anxiety, and which forms by far the most important and valuable of his prose productions. The noble poet had written memoirs of his own life—an autobiography, more or less complete, up to 1820—which he presented to his friend for publication after his death. Pressed as he always was by pecuniary necessities, Moore in 1821 sold the Byron manuscript to Mr Murray for 2000 guineas. In 1824 that event occurred which fell upon all Europe with grief and surprise—Byron suddenly died; and his friends became alarmed on account of the disclosures that might be made in the memoirs. Mr Murray expressed his willingness to give up the manuscript on repayment of his money with interest, and Moore unhappily was led into an arrangement by which the 2000 guineas were refunded,

and the manuscript reclaimed and burnt. That he acted from honourable and chivalrous feelings cannot be doubted. The pecuniary loss was to him a heavy sacrifice; but it must ever be matter of regret that he was precipitated into such a step. Byron had intrusted his defence to his hands; he owed a solemn duty to the memory of his friend and benefactor, and the public had a right to know

What desolating grief, what wrongs had driven
That noble nature into cold eclipse.

Whatever was objectionable in the memoirs (not amounting, according to Lord John Russell, to more than three or four pages) could easily have been expunged, or the publication might have been deferred for years, like the memoirs of Walpole, but now all was lost; and the rash act of destruction was equally a fraud on the memory of Byron and on the public. But though thus swayed by a fastidious delicacy and deference to Lord Byron's family and early friends, Moore was afterwards enabled to erect a suitable and lasting memorial of his friend. His *Life of Byron* is one of the most interesting and instructive of biographies, conceived in a right spirit, and executed with singular ability, care, and judgment. Considered merely as a composition, this work deserves, as Lord Macaulay has remarked, "to be classed among the best specimens of English prose which our age has produced." And as the fame of Moore was thus placed on its highest pinnacle, his fortunes were no less benefited. For the copyright of the Life Mr Murray gave the large sum of 4000 guineas, besides furnishing no inconsiderable part of the letters and journals with which the work is enriched.

With the Life of Byron may be said to close the happy and brilliant portion of Moore's literary career. He still held on his course, however, though with subdued vigour, and, until his faculties were clouded by mental disease, was rarely a day without some effort at composition. His social celebrity also continued. In 1831 he published a slight poetical performance, *The Summer Fête*, commemorating a holiday gathering at Boyle Farm in Ireland; and the same year he issued *Memoirs of Lord Edward Fitzgerald*, the weak but amiable victim of Irish insurrection. In 1833 he ventured on a polemical, but to him congenial, subject, *Travels of an Irish Gentleman in Search of a Religion*. Moore, though indifferent to mere forms of faith, still adhered to his old Roman Catholic creed, and vindicated what he conceived to be its superiority to all others in truth and antiquity. In 1835 appeared the first volume of his *History of Ireland*, written for Lardner's *Cyclopædia*, and extending to four volumes. He bestowed pains and research on this work, but without success adequate to his labour: it was too long and close for a popular digest, yet not sufficiently critical or learned to render it an authority on Irish history. In 1841 and 1842 he collected his poetical works, writing short prefaces to each volume, and adding some additional verses. He still occasionally threw off a squib or song, and he contemplated writing the life of Sydney Smith, a task well suited to his powers had it been required ten years earlier; but disease was now dealing with the accomplished and indefatigable worker. A softening of the brain took place, as in the cases of Swift, Scott, and Southey, and he sank by slow degrees into a state of helpless infirmity and childishness, though happily free from pain. The latter years of the poet had been darkened by domestic grief and calamity. His three children had predeceased him—one of his sons having by his imprudence seriously embarrassed his father, and occasioned to both parents the most poignant distress. In 1835 a pension of L.300 per annum was conferred on Moore, and in 1850 a pension of L.100 was settled on his wife, "in consideration of the literary merits of her husband, and his infirm state of health." The poet lingered on for two years longer, lost to the world, and died at Sloperton Cottage on the 26th of February 1852, being then in the seventy-third year of his age. It is a touching and characteristic trait of his last illness that he "warbled" or sung on the day of his death.

The *Memoirs, Journals, and Correspondence* of Moore, edited by Lord John Russell, have been published in eight volumes; and a volume of *Notes* from his letters to his music-publisher James Power, has also been given to the public. The best excuse for the voluminous, unconnected, and unsatisfactory work of Lord John Russell, is the fact that Moore left his papers for publication by his noble friend in order that some provision might be made for his family after his decease; and that Lord John obtained for the MSS. a sum of L.3000, which was invested for the benefit of the poet's widow. Lord John did little as editor; at least one-half of the diary should have been thrown out, and explanatory notes added to much of the remainder, if not the whole recast; but what he has written of his friend is honourable to his taste, judgment, and feelings. From the diary and other biographical materials we know more of the Irish poet, of his outer and inner life, than of any other of his illustrious contemporaries. His daily round of existence was of a very uniform tenor. His mornings were chiefly spent in study, his best poetry being composed in his garden or in the neighbouring fields. His evenings were devoted to society, and no poet—not even Pope—ever lived more among the great. In the country he enjoyed the refined intellectual hospitalities of Bowood; in London his company was eagerly courted in all circles. His table was covered with invitations. Authors, artists, booksellers, and musicians, ran after him. His journal for weeks together, through successive years, is little else than a record of morning visits, dinners, balls, the opera and theatres. The time and money thus spent kept him perpetually in difficulties. He could rarely leave home without forestalling the fruits of his brain by drawing on the Messrs Longman, on Power (his friendly banker on all occasions), or on the editor of the *Times*, and his literary tasks were in this way often delayed, and at last hurriedly finished. He saw the folly of such a course of splendid dissipation, and throughout it all he retained a relish for the quiet pleasures of home. But he could not resist the fascination of popular applause—the tumultuous delight with which his presence was hailed by the great, the beautiful, the witty, and accomplished; and the tears which were profusely shed over the songs he sung with so much sweetness. Never was vanity more fully gratified, or life more thoroughly enjoyed. No shadow could remain long on so bright and sunny a nature—his elastic gaiety of spirit was an overmatch for fortune! With most men this kind of existence would have led to a coarse unamiable selfishness; it did so with Sheridan and Byron, and we do not say that Moore escaped from it without injury—his vanity, like his demands on publishers, was apt to be exorbitant and unscrupulous. It was too much at times for his truth and affection. But altogether Moore was a man cast in a kindly, generous, and happy mould. In his intercourse with the great, though fed with soft flatteries all day long, and "dearly loving a lord," as Byron said, he preserved in a remarkable degree his independence, his frank cordiality, and freshness of feeling. He was, like Pope and Gray, devotedly attached to his mother (to whom he wrote two letters a week), he loved his wife and children, took a warm interest in all cheap and innocent pleasures, and tried to make every one about him happy. His love of Ireland was a principle or passion of a nobler stamp. *Her* he served with all his soul and strength, uplifting her banner in the hour of darkness and danger; and with the names of Grattan and Curran as Irish patriots, that of Thomas Moore will be for ever associated. (R. C—S.)

MOORS, the Arabian conquerors of Spain, well known by this name on account of their having come directly from the land of the ancient *Mauri*, or *Mauretania*. They first

invaded the Spanish territories in 711 under Tarik, the lieutenant of Musa Ibn Nosseyr; and in 712 that able general, landing his forces, speedily completed the conquest that had been begun, and subdued the entire country, with the exception of the mountainous districts of Asturias and Galicia. (See MUSA.) The conqueror then assumed the reins of government in subordination to the viceroy of Africa, and was the first of the amirs who ruled the country for the next forty-four years. In 756 Abd-el-rahman, a military adventurer, and a descendant of the deposed Mohammedan dynasty of the Beni Ommiyah, won the supreme power by the sword. Till 1031 he and his descendants reigned as sovereigns of Spain. The local governors then threw off their allegiance, and established themselves as independent potentates. A series of civil wars, however, left Mohammedan Spain, in course of time, under the power of a few great kings. The Christians also, taking advantage of the internal dissensions of their Moorish enemies, marshalled themselves under Alfonso "the Battler," and captured Castile, and its capital Toledo. They were pursuing their conquests in 1086, when Yusef Ibn Tashfin, a member of that religious sect, called the Almoravides, which had already subdued Northern Africa, suddenly appeared to retrieve the sinking Moslem cause. In the same year Alfonso was defeated at Zalaca, and the progress of the Christians was checked. Yusef was raised to the sovereignty of the country in 1099; but the Spanish dynasty of the Almoravides which he founded lasted only for a few generations. The Almohades, another religious sect from Africa, invaded Spain, and in 1146 the sceptre passed into their hands. During their sway the Christians continued to extend their conquests over the territory of the Moors until 1238, when Mohammed Ibn Alahmar, King of Granada, became the vassal of Ferdinand III., King of Castile. From this date the Moorish cause steadily declined beneath the attacks of the Christians, and the still more fatal attacks of a continuous series of treacherous conspiracies and internecine broils. At length in 1491 Ferdinand V., King of Castile and Aragon, captured Granada, and gave the death-blow to the power of the Moors. (See SPAIN.)

MOORSHEDABAD, a city of Hindustan, in the district of the same name, and province of Bengal, of which it was at one time the capital. Its original name was *Muksoosabad*, but this was changed to its present denomination. It extends, including Cossimbazar, eight miles on both sides of the Bhagiratty or Cossimbazar River, a branch of the Ganges, about 120 miles above Calcutta. It is a modern city, and was never fortified, excepting by an occasional rampart in 1742, during the Mahratta invasion. The streets are narrow and inconvenient, insomuch that they are impassable for European carriages. The buildings are in general bad. Most of the houses have only one storey, with tiled roofs; and the palace of the nawaub is so insignificant as to be passed without observation. From the market-place runs a long, narrow, winding street, composed of mean houses and huts, which is again intersected by others still more narrow and miserable. The sewers originally intended to carry off the water having been destroyed, the streets become nearly impassable after a heavy fall of rain, and emit putrid effluvia. In the year 1813 a canal was dug between the Bhagiratty and the great Ganges rivers, which, independently of its commercial benefits, tended to ameliorate the unhealthiness of the town. But notwithstanding these exertions, it was remarkably unhealthy in 1814, and many Europeans suffered in the general mortality which prevailed. A strong desire is stated to have been manifested by the present nawaub for the improvement of its sanitary condition. It is still, however, a place of great inland traffic, and the river is constantly covered with boats. A Mohammedan college was some years since founded here, to which an English professorship was subsequently attached. In 1757 Moorshedabad was superseded as the capital of Bengal by Calcutta. Long. 88. 15. E., Lat. 24. 12. N.

The district of which this place is the chief town has an area of 1856 square miles, and a population estimated at a million of inhabitants. Before the commercial charter of the East India Company had ceased, this district was the principal seat of its silk manufacture. The production and manufacture are still carried on by private individuals. The principal silk manufacture is that of Corahs. The dignity of the Nawaub of Moorshedabad, which has become purely titular, is supported by the grant on the part of the British government of the magnificent allowance of L.160,000 per annum. Shah Allum, the Emperor of Delhi, conferred the territory upon the East India Company by the grant of the Dewanny in 1765.

MOOSH, a town of Asiatic Turkey, capital of a small pashalic of the same name, under that of Erzeroom. It is pleasantly situated on the summit and sides of a conical hill, near the Murad Chaī, or eastern arm of the Euphrates, 75 miles S.S.E. of Erzeroom. The plain in which it stands is about 40 miles in length by 12 or 14 in breadth, and has an elevation of 4692 feet. It is well watered, though in some places dry and stony; and its climate is one of extremes. It contains about 100 villages; and produces grain, tobacco, and wine, the last being of good quality. The town itself has a wretched appearance, and is inhabited by Turks and Armenians, the latter of whom, having the whole trade of the place in their hands, are the wealthier class, and pay an annual tribute of about L.2000, from which the Turks are exempt. There are 7 mosques, 4 churches, and several large and well-stocked bazaars in the town. Coarse cotton cloth is manufactured here. The principal articles of export are tobacco and cattle; while a very small amount of European manufactures is imported. Pop. estimated at 6000.

MORA, a town of Spain, in the province of Toledo, 18 miles S.E. of Madrid. The streets are wide, but unpaved; and there are three market-places. The town has a church, a town-house, a prison, and several schools. The inhabitants are chiefly employed in agriculture, in the manufacture of articles from rushes, in flour and oil mills, and in soap-works. Pop. 5094.

MORADABAD, a town of Hindustan, and the principal place of the British district of the same name. It has considerably declined from its ancient consequence, having been the seat of a mint in which rupees were coined, which were current in Hindustan, until superseded by the new rupee of the East India Company. It is 838 miles N.W. from the city of Calcutta. The population, according to the latest official return, is 57,414, the majority of which is Mohammedan. The district of which this town is the chief place has an area of 2967 square miles, and a population of 1,138,461. The province was ceded to the East India Company in 1801 by the Nawaub of Oude. The town of Moradabad is in Lat. 28. 49., Long. 78. 50.

MORAL-DE-CALATRAVA, a town of Spain, in the province of Ciudad Real, is situated on the edge of the sierra of San Cristobal, 17 miles S.E. of Ciudad Real. The houses are generally low; and the town contains a church, town-house, prison, hospital, and several schools. There are also several flour and oil mills, and manufactories of cloth. Pop. 4120.

MORAL PHILOSOPHY.

INTRODUCTION.

1. Moral Philosophy is the science of *what ought to be* in human character and conduct. In this lies its fundamental idea, and by this is described the object with which it is versant. Whilst other sciences relating to man aim at the scientific theory of what *is*, Moral Philosophy has for its special province and aim the scientific theory of what *ought to be*. "The *quid est*," says Dr Chalmers, "is not to be confounded with the *quid oportet;* and moral truth is in every way as distinct from the facts or principles which make up the actual constitution of the human mind, as mathematical truth is distinct from the laws and properties of the material world. The question, What are the affections or purposes of the mind? is wholly distinct and dissimilar from the question which relates to the rightness and wrongness of those affections and purposes. My knowledge that such a purpose or passion exists is one thing; my judgment of its character is another. In the one case it is viewed historically as a fact; in the other case it is viewed morally as a vice or a virtue. In the one case it belongs to mental, in the other to moral science."[1] Generally, moral science proposes to determine the grounds on which moral distinctions rest; the criterion or standard of rightness and wrongness in actions; the nature, conditions, and principles of virtue; the place and operations of conscience in the human economy; the laws and divisions of duty; and, in short, all that goes to the determination of what man has to be and to do in order to acquit himself of the obligations under which he has been laid by God.

2. The proper object of this science is *actions*,—meaning by that term all that results from the energy of volition.[2] Whilst Psychology contemplates what is given in consciousness simply as phenomenal, and aims at discovering the laws under which the facts so obtained may be reduced, Moral Philosophy goes out upon the field of man's active life, and by a standard previously fixed, determines what actions are good and what bad; and thus dictates what course of conduct it behoves man to follow.

3. All human actions, however, do not fall within the province of this science. The Greeks distinguished between *πράξεις* and *ποιήσεις*, *doings* and *makings;* though all do not agree as to the limits of the distinction. Without entering here on these differences, we may content ourselves with what Aristotle says on the subject:—"The end of *making* (or production) is different (*i.e.*, from the making itself); but of *doing* it is not so, for the well-doing itself is the end."[3] "Making and doing differ specifically from each other. . . . . Now life is a doing, not a making."[4] "Prudence has to do with practice,—that is, with things which are the object of choice or aversion, and which it rests with ourselves to do or not to do. Nor is the faculty for doing and the faculty for making the same; for the latter has an end distinct from the making, as in the building art, where, since there is the making of houses, an end distinct from the building itself—namely, the house—is proposed; and it is the same with the joiner's art and others that have to do with making. In respect, however, of the practical, there is no other end besides the doing itself, but the very energy and action is the end. Hence prudence has to do with practice and practical things, but not with making and things made."[5] These passages seem sufficient to establish that the distinction between these two, in the mind of Aristotle, was determined by the fact, that the one class of actions is prompted by the emotive principles of our nature, and terminates in the satisfaction of the particular desire or passion by which the action is prompted; whilst the other class is more under intellectual control, and finds its terminus in the production of something distinct from itself. This is the distinction between moral conduct and productive activity; and it serves to define still more closely the boundaries of our science. Moral Philosophy has to do with those actions which are directed to the gratification of the emotive principles of our nature; it has nothing to do immediately with those actions the end of which is production, though mediately and indirectly it may have to do with these, inasmuch as they are sometimes the instruments by which the gratification of the desires is secured or sought. With the building of a house it has no concern; but it may have much to say in reference to the *proposal* to build it, the *end* for which it is built, and the *relations to each other* of those engaged in building it.

4. Of those actions which fall within its sphere Moral Philosophy has to determine the *rightness* or the *wrongness*, and consequently to indicate what practices are to be followed and what shunned. This, however, presupposes some standard of rectitude by which the moral character of actions may be determined; and this again presupposes a ground or basis of moral distinctions on which this standard rests. Before proceeding, therefore, to delineate a scheme of practical rectitude, it is necessary to institute an inquiry into the nature of rectitude itself, and to ask what s its true basis or primal reason, and what its just and fittest standard.

5. An action implies an agent; a moral action a moral agent. The consideration of moral actions, therefore, naturally leads to the consideration of moral agents; and here the question which arises is, In what relation do moral agents stand to rectitude? The solution of this question involves an inquiry into man's moral constitution, into the position he occupies as the subject of a moral government, and into what constitutes the virtue or moral excellence of one so placed.

6. Having determined these points, we may proceed to

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[1] *Moral Philosophy*, ch. i., Works, vol. v., p. 15.

[2] Per *humanam actionem* intelligimus non quemvis motum a facultatibus hominis procedentem; sed illum duntaxat qui provenit ac dirigitur ab iis facultatibus quas humano generi præ brutis Creator O. M. attribuit, nempe qui velut prælucenti intellectu, ac decernente voluntate suscipitur. (Puffendorff, *De Officio Hominis*, book i., ch. i., § 2.)

[3] Τῆς μὲν γὰρ ποιήσεως ἕτερον τὸ τέλος. Τῆς δὲ πράξεως οὐκ ἂν εἴη· ἔστι γὰρ αὐτὴ ἡ εὐπραξία τέλος. (*Nic. Eth.*, b. vi., c. iv., § 3, Lancaster's edit.) The style of Aristotle is so very condensed, that it may be well to add the paraphrase of these words by one of his commentators:—"Addit Philosophus illam distinctionem quod affectionis est alius ab ipsa finis, ut opus quod ars molitur: at actionis non semper est alius ab ipsa finis, cum ipsa perfecta ac absoluta soleat esse finis." (Ant. Riccoboni, *in Eth. Arist. ad Nic. Comment.*, p. 160, Oxon. 1821.)

[4] Διαφέρει ἡ ποίησις εἴδει καὶ ἡ πρᾶξις . . . . . ὁ δὲ βίος πρᾶξις οὐ ποίησις ἐστι. (*Polit.*, b. i., c. 4.)

[5] Ἡ δὲ Φρόνησις περὶ τὰ πρακτά, ἐν οἷς αἵρεσις καὶ φυγή, καὶ ἐφ' ἡμῖν ἐστι πρᾶξαι καὶ μὴ πρᾶξαι. ἔστι δὴ τῶν ποιουμένων καὶ πραττομένων οὐ ταὐτὸ τὸ ποιητικὸν καὶ πρακτικόν· τῶν μὲν γὰρ ποιητικῶν ἐστι τὸ παρὰ ποίησιν ἄλλο τέλος· οἷον παρὰ τὴν οἰκοδομικήν, ἐπειδή ἐστιν οἰκίας ποιητική, οἰκία αὐτῆς τὸ τέλος παρὰ τὴν ποίησιν· ὁμοίως ἐπὶ τεκτονικῆς, καὶ τῶν ἄλλων τῶν ποιητικῶν· ἐπὶ δὲ τῶν πρακτῶν οὐκ ἔστιν ἄλλο οὐδὲν τέλος παρ' αὐτὴν τὴν πρᾶξιν. ἀλλ' αὐτὸ τοῦτο τέλος ἡ ἐνέργεια καὶ ἡ πρᾶξις, &c. (*Magna Mor.*, b. i., c. xxxv.)

consider the practical course which the principles thus ascertained indicate as that which man ought to pursue. This is tantamount to an inquiry into the *duties* which devolve upon us as under moral government; for the sum of human duties comprises the whole of what, as an intelligent and accountable agent, man has to attend to.

7. "Every art and every method," says Aristotle, "likewise deed and choice, seems to aim at some good; wherefore the good is well defined to be that which all things aim at."[1] But if all the actions of men aim at some good, it becomes necessary to inquiry what is the sovereign good or supreme end of human activity. This will be found to be happiness,—"our being's end and aim." But if all men's actions are aimed at happiness, and at the same time must be in accordance with virtue, it becomes necessary to inquire in what relation happiness and virtue stand to each other,—whether they are identical, correlate, or subordinate the one to the other.

8. The science of Moral Philosophy thus branches off into four principal parts:—I. The theory of rectitude in actions; II. The theory of virtue in individuals; III. The scheme of practical duties; IV. The doctrine of happiness.

Obs. 1. Were the usage familiar in moral science which has been so extensively and with so much advantage followed in physical science, of naming separate branches by words compounded from the Greek, with λόγος, *discourse* or *science*, we might conveniently denominate these four divisions of our science thus: I. *Orthotetology*, from ὀρθότης, *rectitude*; II. *Aretology*, from ἀρετή, *virtue*; III. *Deontology*, from τὸ δέον, *that which is binding or due*; and IV. *Eudaimonology*, from εὐδαιμονία, *happiness*. Of these terms, some have been actually employed, and the others might with equal right be introduced.[2]

Obs. 2. To some it has appeared that there is no valid distinction to be taken between rectitude as a quality of action, and virtue as an attribute of individuals. Thus Dr Thomas Brown affirms, that "to say that any action which we are considering is right or wrong, and to say that the person who performed it has moral merit or demerit, are to say precisely the same thing;" and again, "the action, if it be anything more than a mere insignificant word, is a certain agent in certain circumstances, willing and producing a certain effect."[3] Many passages of similar import might be cited from his lectures, for he insists upon this point with an almost wearisome iteration. Now it may be admitted that to say "that action is right," and to say of the man who performed it, "he has acted virtuously," may often mean substantially the same thing; but it by no means follows from this that in both cases the mind is contemplating exactly the same object. Two forms of speech may convey the same general sense, and yet the things spoken of may not be identical. In the case before us the *action* is viewed in relation to a certain objective standard—that of rectitude; whilst the *agent* is viewed in relation to a certain subjective law—that of conscience. Moreover, though the rectitude of the action and the virtue of the agent may often concur, they are capable of existing separately. There may be virtue in the agent where the action itself is wrong; and there may be rectitude in an action where there is no virtue in the agent. This is so familiar a fact, that Dr Brown could not overlook it; but the way in which he endeavours to obviate the objection thence arising to his own doctrine is anything but satisfactory. Thus, in order to account for our approving an action as right, whilst we cannot approve of the individual who performs it, he supposes that we imagine the action as proceeding from a totally different individual, and as performed under totally different circumstances. Thus, it seems, we *do* distinguish between the action and the agent as respects moral worth, commending the one whilst we condemn the other. But we accomplish this by interpolating a second agent, an imaginary person, to whom we ascribe the action. The simple answer to this over-argute philosophy is, in the first place, that it is false in fact; for we do nothing of the sort affirmed; and in the second place, that it is unsound in principle; for how could an imaginary person confer a character on a real act? If the act have no moral character apart from the agent, then an imaginary agent can confer only an imaginary character. Dr Brown was betrayed into this fallacy by his peculiar theory of morals, of which more afterwards.[4]

9. Moral Philosophy has often been extended so as to embrace other sciences, which, though closely allied to it, are yet capable of being investigated apart from it, and are most advantageously so investigated. Aristotle, who regarded morals as a branch of politics, describes the science as ἡ περὶ τὰ ἀνθρώπινα φιλοσοφία, "the philosophy pertaining to human affairs."[5] This is sufficiently comprehensive, and would bring under one science not only Morals, Politics, and Economics, but also Psychology, Logic, Rhetoric, and Æsthetics. This general statement, however, must be qualified by what the author elsewhere insists on respecting the distinction between πράξεις and ποιήματα. It will then appear that Aristotle regarded as the proper province of moral science those actions which arise from passion, desire, or affection, with all the social arrangements and relations to which they lead. He thus classes under one general science,—Ethics, or the science of personal conduct; Politics, or the science of the relations of citizenship; and Economics, or the science of domestic relations. To this arrangement no objection can be urged, so far as the *matter* of the science is concerned, provided it be understood that the relations of citizenship and of the household are considered only under their *moral* aspect, and apart from legal, fiscal, or prudential considerations; but it seems better to confine the *term* Politics to the science of social and civil relations, in so far forth as these are determined by positive enactments or customs; and the *term* Economics to the management of households or communities, in respect of their physical and financial interests.

A recent writer on Moral Philosophy has claimed for it a province nearly as wide as the words of Aristotle, in all their unqualified breadth, would assert. "The laws," says he, "of which Moral Philosophy is in quest are the laws of human activity; the theory of that unceasing spirit of pursuit which every human action displays; the systematic view of all those various phenomena by which the instinctive restlessness of our nature is evidenced."[6] But if *all* human activity is to be included within the sphere of Moral Philosophy, this science will absorb the entire range of speculation and of art, leaving only the mathematical and physical sciences to be prosecuted as separate branches. That the author is prepared to assert this wide claim appears evident from his ranking not only Politics and Natural Theology under Moral Philosophy, but also Rhetoric, Poetry, and Logic, all of which "have their foundation in the active nature of man." It is difficult to see, however, what is gained by this clubbing of sciences, the materials and methods of which are different. It is no doubt true that all sciences which investigate the laws of human performance "have their foundation in the active nature of man;" but this is no more a reason for all these being reduced under one head, than the fact that all knowledges have their foundation in the intellect, is a reason for *every* science whatever being treated as a branch of Psychology. There is surely a wide and essential difference between performances which terminate on an intellectual composi-

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[1] *Nicom. Eth.*, at the beginning.

[2] Thus there is a work entitled *Aretologie, oder Philosophische Tugendlehre*, by Wilh. Traug. Krug; another, entitled *Aretologia*, by Dr Innes; and Bowring has designated the book in which he unfolds the ethical system of Bentham by the title of *Deontology, or the Science of Morality*.

[3] *Lectures*, vol. iii., p. 568.

[4] Aristotle distinctly recognises the distinction between rectitude in actions and virtue in the agent. Compare, *e.g.*, his reasonings in chapter iii. (iv.), book ii., of his *Nicom. Ethics*, where he argues that a man cannot become a good man simply by doing what is good, as he may become a musician simply by playing tunes; "for," says he, "it is not with virtues as with arts; in the latter the doing of the thing is what is required,—it is enough if anyhow it be done; but in the former it is not enough that the thing be done,—it is also required that the doer of it be rightly affected," &c.

[5] *Nicom. Eth.*, b. x., c. iii., p. 350 of Lancaster's edit.

[6] Hampden, *Course of Lectures introductory to the study of Moral Philosophy*, p. 76.

tion or a physical structure, and performances which terminate in the gratification of a desire, the manifestation of a disposition, or the development of a character. The laws which these two different classes of energies obey, the methods by which these are to be discovered, and the uses to which they are to be applied, are so different, that not only may they be studied apart, but it is for the interests of both that they should be so studied.

The teaching of Moral Philosophy, as comprehending the science of Mind as well as of Morals, has been complained of by Dr Chalmers as an evil connected with the scheme of instruction pursued in the Scottish universities, where, says he, Moral Philosophy has been made to embrace, along with its proper object, "the whole physiology of the mind, with all its feelings and all its faculties;" and also "the laws and methods of the human understanding."[1] The published writings of Reid, Stewart, and Brown go to corroborate this statement; for all of these philosophers, though occupants of the Moral Philosophy chair, deemed it their province to devote a large portion of their lectures to mental science, including Psychology, Æsthetics, and Logic. Practically the only disadvantage resulting from this arrangement has been, that too heavy a burden has been "laid upon one solitary professorship;" for by none of these eminent men, nor by any of their colleagues or successors, has the mistake been committed of in any degree confounding the two great branches of knowledge which their course of lectures was made to embrace. Nor has the union of the two in the prelections of one teacher been without its advantages. Important as it is to keep the branches distinct, it is yet possible to make the separation between them too precise and too broad. Mental Philosophy is not the science of morals, nor Moral Philosophy the science of mind; but nevertheless there can be no doubt that the two are closely related, and that it is not desirable that he who would accurately apprehend the one should wholly pretermit, or only carelessly scan the other. Part of the field is common to the two, in so far at least as the objects of study are concerned; for the whole of the emotional or conative part of our nature belongs alike to Psychology and to Moral Philosophy. Still, the two provinces are distinct; and whether cultivated by the same parties or not, they are best treated of as separate knowledges.

Moral Philosophy has also been sometimes extended so as to embrace Casuistry, Jurisprudence, and Political Philosophy. With these it undoubtedly stands closely associated; still they are not to be confounded with it. Paley says that Moral Philosophy and Casuistry "mean the same thing;"[2] but it is not so. The two differ as Mechanical Philosophy differs from the art of the mechanician; the former having for its end the establishing of the principles of morals, the latter having for its end the application of these principles to difficult *cases*, such as actually or potentially lie within the sphere of individual experience, especially such as seem to involve an apparent collision of duties.[3] Moral Philosophy has this in common with Jurisprudence, that both have to consider man in relation to *jus*; but in the former it is *jus* as determined by the unwritten law of nature, that comes into consideration; in the latter it is *jus* as expressed in statutes and conventions, that forms the subject of inquiry. Moral Philosophy has to expound the duties of man as a member of civil society, and therefore comes very close upon the province of Political Philosophy; but it belongs to the latter exclusively to examine the structure of governments, and to determine their comparative advantages in relation to the main end of government,—a subject sufficient in extent, variety, and importance, to entitle it to become the topic of a special science.

10. The ancient Greeks gave to the science of Morals the title of *Ethics*, ἠθικά, from ἦθος, *mos*; and this term has been much used by modern writers. It has been objected to, on the ground of being not sufficiently comprehensive, by some writers, who would confine it to that part of moral science which has to do with the intercourse of individuals in private life. Thus Bishop Hampden objects to it on the ground that, by adopting it we exclude Natural Theology and Politics from the domain of Moral Philosophy.[4] To this conclusion he and others have been led by unduly attending to the mere etymological force of the word. It seems, however, to have escaped them, that, on the same ground, we ought to discard the term *moral*; for "moral" is the synonyme of "ethical," with this difference, according to Quintilian,[5] that ἦθος involves more the idea of rectitude than *mos*, and is consequently the fitter root of the two from which to form a designation of the science of right conduct. But in all cases of this sort etymology can be allowed very little weight in determining the sense and compass of the terms. Here usage, "quem penes arbitrium est et jus et norma loquendi," must be allowed its full rights; and the same authority which extended "moral," so as to make it embrace all questions relating to man's duty and obligations, can give the same extension to the term "ethical." If, then, it shall be found convenient to employ the term Ethics instead of Moral Philosophy, it only needs usage to sanction the change to justify its being adopted. To us it appears that this necessary and authoritative sanction has been given, and we regard it as desirable that the change of terminology thus justified should be followed. The convenience of the change is the least of its advantages. In addition to this, by using the term Ethics we not only follow the analogy of cognate sciences,—such as Metaphysics, Dialectics, Æsthetics,—but we set free the term Moral to be used, in its antithesis to mathematical and material, as comprehensive of all the sciences resting upon probable evidence; and more than this, we obtain for our own science a more just and exact appellation than that we would supplant. On this last point the following observations from the pen of one of the ablest living thinkers of Germany are worthy of consideration:—"The best name for this science is Ethic, or doctrine of morals (*Sittenlehre*), as is clear from the relation of this word to the three fundamental concepts of morals,—Law or Duty, Virtue, and Chief Good. *Mos* or *mores* (whence *Disciplina Moralis*) respects rather the outward phenomenon than the inner source, and is not commensurate with the Greek ἦθος. *Mores* denotes, indeed, the character, but not the comprehensive source; whilst, on the other hand, ἦθος, originally the Ionic form of ἔθος, includes the habit, the appertaining conduct; and that not merely as an empirical *manner* (*mos*), which may be evil, but as what is sanctioned, what is according to order and rule. As the word, however, denotes that in which one is at home, in his element (ἦθος is allied to ἕδος and ἕζω, as *sitte*, custom, is to *sitzen*, to sit, so that the *ethos* denotes the inner ground-tone), it

[1] *Moral Philosophy*, Works, vol. v., p. 17.

[2] *Moral Philosophy*, b. i., ch. i., at the beginning.

[3] Die Casuistik ist kein besonderer wesentlicher theil eines systems der Moral, noch auch eine besondere wissenschaft, sondern nur eine anwendung der moralischen maximen auf einzelne schwierigere fälle, oder eine nähere bestimmung der allgemeinen vorschriften und formeln in beziehung auf solche fälle. (Staeudlin, *Lehrbuch der Moral*, 2d ed., p. 17.) See also Kant's *Tugendlehre*, Einleit., § 18, in his Collected Works, edited by Rosencranz and Schubert, vol. ix., p. 261; *Edinb. Rev.*, vol. xxvii., p. 231; Hallam's *Hist. of Literature*, vol. ii., p. 493, 2d ed.; Whewell's *Elements of Morality*, vol. i., p. 243.

[4] *Lectures*, pp. 36, 37.

[5] Ἦθος, cujus nomine, ut ego quidem sentio, caret sermo Romanus, mores appellantur, atque inde pars quoque illa philosophiæ ἠθικὴ moralis est dicta. Sed ipsam rei naturam spectanti mihi non tam mores significari videntur quam morum quædam proprietas. (*Inst. Orat.*, vi. 2.)

Introduction.

follows that it embraces, along with the objective law, still more definitely the subjective living conditionality, which, as good, is virtue,—consequently what we term morality (*sittlichkeit*); whilst good-breeding, decent behaviour (*sittigkeit, sittsamkeit*) express only the scrupulous conformity to social customs presumed to be good. But not only is there an *ethos* of individual persons, but also of communities,—for instance, in the family spirit; nay, the moral which specifies itself in moral communities has in the *ethos* of these its subsistence, its subjective-objective being, so that also the concept of good is incorporated with the words *ethos* and *ethic*, and so there lies therein also the transition to the forms in which the highest good is presented."[1]

11. By some Moral Philosophy has been regarded as a branch of Theology; while others have proposed to treat Natural Ethics and Christian Ethics as distinct subjects. Instead of adopting either view, it would be probably better to restrict Theology to the investigation of what has been revealed to us concerning God and his methods of dealing with his creatures; whilst Ethics would be versant with man's moral relations to God, and to those creatures of God, with which he is in any way connected. And in exploring this field, it seems wise neither to overlook what the Scriptures inculcate respecting man's moral relations and duties on the one hand, nor on the other to count it sufficient simply exegetically to expiscate from the sacred page a list of moral truths, without referring them to their philosophical basis, or assigning them their proper place in a scientific system. There is one department, however, of scriptural Ethics which must be suffered to fall under the head of Theology,—viz., that which embraces the special duties arising to the Christian, as such, out of the new relations into which the extraordinary scheme of human redemption brings all those who enjoy its benefits. This, in the strictest acceptation of the term, is *Christian* Ethics, because setting forth duties binding, not on man as man, but on such men only as are partakers of the redemption which is in Christ.[2]

12. Moral Philosophy is not to be ranked among the inductive sciences. From observing the moral constitution of man we may indeed draw the conclusion, that the final cause of such a constitution is, that man should be under moral government; but we cannot by this process discover what constitutes morality, what lies at its basis, or what expresses its principles. As little could we construct a system of Ethics from merely observing the conduct of men, or collecting their opinions on moral questions: at the utmost this would only enable us to declare empirically what they for the most part may have agreed to regard as morally right or wrong; it would give us no criterion by which to determine scientifically whether the judgment so reached was the just one. The question, "Quid oportet?" is one "to the solution of which," as Dr Chalmers observes, "we are guided by another light than that of experience. This question lies without the domain of the inductive philosophy, and the science to whose cognisance it belongs shines upon us by the light of its own immediate evidence."[3] "By induction," says another writer, "from particular observation of what transpires in our own minds, we may indeed ascertain that we are accountable; that we possess those powers or faculties which are presupposed in a system of moral agency; and that, according to the kind of conduct pursued by us is our happiness or the contrary, or at least the approbation or disapprobation of our own conduct. But from observation of what transpires within us merely, we can never by any process of induction arrive at a knowledge of the true nature of virtue and vice, or of their respective sources. We cannot in that way discover the standard by which good and evil are measured, the grounds of obligation to pursue the one and avoid the other, the causes on which success or failure in that pursuit depend, or the means to be adopted in order to the practice of virtue and the attainment of happiness. The very supposition that such a method of constructing a true moral philosophy can possibly succeed, must assume that the inquirer is in fact a perfect being—that what ought to be, and what is, are in him the same thing. How else, by any observation of his thoughts, feelings, volitions, and actions, can he ascertain the rule of requirement—the general law of rectitude?"[4]

13. For the successful pursuit of moral science it is important that the mind should be well disciplined in the analysis of moral phenomena; habituated to the weighing of probable evidence; accustomed at once to comprehensive views of things and to minute discrimination of differences; familiar with human nature, with men and their ways; and calm, deliberative, and sagacious in its processes of decision. Hence the inexpediency of including this science among the studies to be pursued by very young men. On this point the most eminent teachers of the science are agreed. "Beware, my dear," says the Platonic Socrates to a youthful friend, "lest you risk what is most precious to you; for there is much more hazard in the purchase of instructions than in the purchase of food. When one has bought eatables or drinkables, he may carry them from the shop and market in other vessels, and before, by eating or drinking them, he receives them into his body he may, having deposited them at home, and having called in some skilful person, take counsel whether anything is to be eaten or drunk, and how much and when; so that in such a purchase there is no great risk. But there is no carrying of instructions in another vessel; he who receives them must pay the fee and carry them in his soul itself, and having learned, must depart either injured or profited. Let us then consider these things [moral questions] with our seniors, for we are still too young to adjudicate so great a matter."[5] Aristotle repeatedly forbids the young to occupy this territory. He bids them study mathematics, but exhorts them to leave politics and morals till they have gathered experience. "Youths may become geometricians and mathematicians, and skilled in such [knowledges]; but it does not appear that a youth becomes wise [*i.e.*, morally wise, φρόνιμος]. The reason is, that wisdom has to do with particulars which become known from experience; whence a youth is not experienced, since it is number of years that gives experience."[6] And in the earlier part of the same work he says,—"A youth is not a fit auditor of political science; for he is without experience of those actions which have to do with life; whilst the discourses [he would have to hear] are out of these and concerning these. Moreover, being disposed to follow his passions, he would hear in vain and without profit, since the end is not knowledge but action. It matters not, however, whether he be a youth in years or youthful in habit; for the defect is not in respect of time, but from his living and pursuing everything by passion, inasmuch as to such the knowledge becomes useless no less than to the incontinent. To those, however, who regulate their appetites, and who act according to rea-

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[1] Dorner, art. "Ethik" in Herzog's *Real-Encyclopädie für Prot. Theol. und Kirche*. Compare also Harless, *Christliche Ethik*, p. 5, 4th ed.

[2] See Hagenbach, *Encyclopädie und Methodologie der Theol. Wissenschaften*, p. 291.

[3] *Natural Theology*, Works, vol. i., p. 23.

[4] Gilbert, *Life of Dr Edward Williams*, p. 589.

[5] Plato, *Protagoras*, p. 314, A.; in Stallbaum's edit. of his works, vol. ii., 33, 34.

[6] *Nicom. Eth.*, b. vi., c. vii., § 3 (ch. ix., near the beginning, by the Pacian division).

Introduction.

son, it is most useful to know about these things."[1] To the same effect Burgersdyk writes, "Actiones civiles versantur circa singularia, de quibus non secundum præcepta sed secundum occasionem judicandum est. Quod certe fieri non potest, nisi ab eo qui longo rerum usu atque experientia prudentiam sibi comparavit; quæ in juvenibus admodum rara est."[2] To these testimonies may be added those of Stewart, and Hume as quoted by Stewart.[3]

14. In attempting to discuss a subject of so much importance, of such compass, and of such difficulty within such limits as this article must necessarily be confined to, we feel that we have imposed on us no easy task. Our aim chiefly shall be to present such a view of the subject as shall meet the wants of the learner and the general reader.

15. No attempt is here made to trace the History of Moral Philosophy, partly because the space allotted to this article renders it impossible to do anything like justice to such a theme; partly because the Preliminary Dissertations of Mr Stewart and Sir James Mackintosh to a great extent supersede the necessity of making the attempt. In lieu of this we shall content ourselves with laying before our readers a survey of the literature of the subject:—

PLATO. All the treatises of Plato are more or less ethical in their character and drift; of those specially devoted to this science the most important are,—the *Phaedo*, the *Crito*, the *Gorgias*, the *Philebus*, the *Meno*, the *De Republica*, the *Politicus*, and the *De Legibus*. The most useful edition of his works is that of Stallbaum, of which only nine volumes have yet appeared. Gotha, 1837-1841. Other editions, with critical apparatus and notes, are those of Ast, 10 vols. 8vo, Leipsic, 1819-29; and of Bekker, 10 vols. 8vo, Berol. 1816-23. The Latin translation by Marsilius Ficinus (edited by Grynæus, Basil, 1534, fol.), the German by Schleiermacher, and the French by Victor Cousin, are worthy of careful consultation. The standard English translation is that of Sydenham.

ARISTOTLE, *Ethica Nicomachea, Ethica Eudemea Magna Moralia, Politica, et Œconomica*, and a [spurious] treatise, *De Virtutibus et Vitiis*. Of the Nicomachean Ethics, the best separate editions are those of Zell (Heidelberg, 1820, 2 vols. 8vo), Cardwell (Oxon. 1828–30, 2 vols. 8vo), and Michelet (Berol. 1819–35, 2 vols. 8vo). Very useful editions are those of Lancaster (Oxf. 1834), and Brewer (Oxf. 1836); the latter has English notes. Of the *Politica*, the editions of Schneider (Francf. 1809, 2 vols. 8vo), and Goettling (Jenæ, 1824), are reputed the best. The editions of his whole works most in repute are those of Pacius, 2 vols. 8vo, Genev. 1597; of Du Val, 2 vols. fol., Par., 1619; 4 vols., 1654; of Bekker and Brandis, 4 vols. 4to, Berol. 1831–36. Bekker's text was reprinted at Oxford, in 11 vols. 8vo, in 1837.

XENOPHON, *Memorabilia Socratis*, ed. Schneider. 8vo. Oxon. 1826.—Ed. Greenwood. 8vo. Lond. 1823.

THEOPHRASTUS, *Characteres Ethici*, ed. Ast. 8vo. Lips. 1816.

PLUTARCH, *Moralia*, Gr. et Lat., ed. D. Wyttenbach. 15 vols. 8vo. Oxon. 1795–1830. 6 vols. 18mo. Lips. 1820.

EPICTETUS, *Encheiridion et Fragmenta*, Gr. et Lat., ed. Uptonus. 2 vols. 4to. 1741. *Opera Omnia et Simplicii Comment*, Gr. et Lat., ed. Schweighæuser. 5 vols. 8vo. 1799.

ANTONINUS (Marcus Aurel.), *De Rebus Suis*, Libri xii., Gr. et Lat., ed. Gataker. 4to. 1652, 1697.

MAXIMUS (the Tyrian), *Dissertationes* xxxi., Gr. et Lat., ed. J. Davis. Best edit., Lond. 1740. 4to.

DIOGENES (of Laërte), *De Vitis, Dogmatibus et Apophthegmatibus Clarorum Philosophorum*, Libri x., ed. Meibomius. 2 vols. 4to. 1692. Very convenient editions are those of Kraus, 8vo, 1759, and Huebner, 2 vols. 8vo, 1828-31.

SEXTUS (Empiricus), *Opera Omnia*, Gr. et Lat., ed. Stephanus. Fol. 1621.—Ed. Fabricius. Fol. 1718.

CICERO, *Opera Omnia*, ed. Ernesti. 8 vols. 8vo. Hal. Sax. 1774-77.—Ed. Oliveti. 11 vols. 4to. Oxon. 1783.—Ed. Schütz. 20 vols. 8vo. Lips. 1814–23. *Opera Philosophica*, ed. Davis et Rath. 6 vols. 8vo. Hal. Sax. 1804-19.

SENECA, *Opera Omnia*; a Justo Lipsio Scholiis Illustrata. Fol. Antv. 1605.—Ed. Ruhkoff. 5 vols. 8vo. Lips. 1797-1811.

BOETHIUS, *De Consolatione Philosophiæ*, ed. Bernart. 8vo. Lugd. Bat. 1671.

BASILIUS (S^tus), *Ethica et Ascetica*. Works, best ed., 3 vols. fol. Paris, 1721-30.

AMBROSIUS (S^tus), *De Officiis*, Libri iii. Works, best ed., 2 vols. fol. Paris, 1689–90.

AUGUSTINUS (S^tus) Best edition of his works, 12 vols. fol. Antv. 1700–3, a reprint of the Benedictine of 1679.

HILDEBERT (of Tours), *Philosophia Moralis de Honesto et Utili*, in his collected works, by Beaugendre, pp. 961-998. fol. Paris, 1708.

ABAELARD (P.), *Ethica sive Liber dictus Nosce teipsum*, in vol. iii., pt. ii., from p. 627 of the Thes. Anecdot. Nov. of Pez. 7 vols. fol., 1721–9.

THOMAS (of Aquino), *Summa Theologiæ*; Prima Secundæ Partis, *De Virtutibus et Vitiis*, &c. Fol. Many editions.

WILLIAM (of Ockham), *Quæstiones et Decisiones in iv. Libb. Sententiarum*. Fol. Lugd. 1495.

PETRARCHA (Fr.), *De remediis utriusque fortunæ*; *De vera sapientia*; *De Contemptu Mundi*, &c., in his collected Latin works. Fol. 1554.

VALLA (L.), *De Voluptate et vero bono*. Bas. 1519. *De Libero arbitrio*. Bas. 1518.

MELANCTHON (Ph.), *Ethicæ Doct. Elementa*, &c. Viteb. 1550.

PICCOLOMINI (Fr.), *Universa Phil. de Moribus*, &c. Venet. 1583.

MONTAIGNE (M. de), *Essais*. Bordeaux, 1580.

CHARRON, (P.), *De la Sagesse*. Bord. 1601.

HORNEIUS, *Ethicæ sive civilis Doctrinæ de Moribus*, Libb. iv. Francof. 1625.

GROTIUS (H.), *De Jure Belli ac Pacis*, Libb. iii. Paris, 1625. The annotated edition published at Amsterdam in 1712 is the most useful.

HOBBES (Th.), *Elementa Philosophica de Cive*. Par. 1647. *Leviathan; or, the Matter, Form, and Authority of Government*. Fol. Lond. 1651. Collected works edited by Sir W. Molesworth. 16 vols. Lond. 1839–46.

CUMBERLAND (R.), *De Legibus naturalibus disquisitio Philosophica*, &c., 1671. Translated into English by John Maxwell, M.A. Lond. 1726.

GEULINX (A.), *Γνῶθι σεαυτόν, sive Ethica*. Amst. 1665.

PUFFENDORF (S.), *De officio hominis et civis juxta legem naturalem*, Libb. ii. Francof. 1673. Edited, with notes and additions, by Gershom Carmichael. Edinb. 1724, sec. ed.

SPINOZA (B.), *Ethica*; in his *Opera Posthuma*. Amst. 1716.

MORE (H.), *Enchiridion Ethicum, præcipua Phil. Mor. Rudimenta complectens*, &c. Lond. 1679.

CUDWORTH (R.), *The True Intellectual System of the Universe*. Lond. 1678. Translated into Latin by Mosheim, 2 vols. 4to. Jenæ, 1733. *Treatise concerning Eternal and Immutable Morality*. Lond. 1731. Appended to the 2d ed. of Mosheim's translation of the former work is a translation of this.

CRELLIUS (J.), *Ethica Aristotelica ad Sacr. Litt. normam emendata*. Cosm. 1681.

[1] *Nicom. Eth.*, b. i., c. i., § 11 (c. iii., near the end, according to the Pacian division).

[2] *Idea Philos. Moralis*, &c., ed. 1644, p. 24. This is the "Dutch Burgersdyck" of the *Dunciad*, b. iv., l. 298.

"Each staunch polemic, stubborn as a rock,
Each fierce logician still expelling Locke,
Came whip and spur, and dash'd through thin and thick,
On German Crousaz and Dutch Burgersdyck."

Poets are not the best judges of the merits of writers on Logic and Metaphysics; and in these lines Pope has thrown an air of ridicule over two men who, as Hallam says (*Hist. of Lit.*, ii., 372), were famous in their generation, and may yet be listened to with advantage. Gibbon has owned his obligations to Crousaz (*Life*, p. 93 of Milman's ed.); and of Burgersdyk we may say, that in the departments of Logic and Ethics the incipient polemic or logician may spur many a less willing and useful steed.

[3] *Active and Moral Powers*, Introduction, vol. i., p. 8.

THOMASIUS (Chr.), *Institt. Jurisprudentiæ Div.*, Libb. iii. Lips. 1688. *Introductio in Phil. Mor.* Hal. 1706.

MALEBRANCHE (Nic.), *Traité de Morale.* 2 vols. Lyons, 1697.

ROCHEFOUCAULT (Fr. de la), *Reflexions ou Sentences et Maximes Morales.* Par. 1690.

WOLF (Chr.), *Philosophia Practica Universalis.* Lips. 1703. A greatly enlarged edition and more perfect work appeared in 2 vols. at Leipzig in 1738.

MANDEVILLE (Ber.), &c., *The Fable of the Bees; or, Private Vices Public Benefits.* Lond. 1714. Part II. Lond. 1729.

LAW (Wm.), *Remarks on the Fable of the Bees.* Lond. 1726.

CLARKE (Sam.), *Discourse concerning the Unchangeable Obligations of Natural Religion*, &c. Lond. 1706.

WHITBY (Dan.), *Ethices Compendium, in usum Academ. Juventutis.* 3d ed. Lond. 1713.

WOLLASTON (Wm.), *The Religion of Nature Delineated.* Lond. 1723.

INNES (Alex.), *Aretologia; or, An Enquiry into the Original of Moral Virtue.* Lond. 1728.

SHAFTESBURY (Earl of), *An Inquiry concerning Virtue and Merit.* Lond. 1699. *Characteristics of Men, Manners, Opinions, Times.* 3 vols. Lond. 1710.

FIDDES (R.), *A General Treatise of Morality formed on the Principles of Natural Reason only.* Lond. 1724.

BUTLER (Jos.), *Sermons.* Lond. 1729. *Analogy of Religion*, &c. 1736. Best edit. by Fitzgerald. Dub. 1849.

BERKELEY (G.), *Alciphron; or the Minute Philosopher*, 2 vols. Lond. 1732.

HUTCHESON (Fr.), *An Inquiry into the Original of our Ideas of Beauty and Virtue.* Lond. 1725. *An Essay on the Nature and Conduct of the Passions and Affections, with Illustrations on the Moral Sense.* Lond. 1728. *Phil. Mor. Instit. Compend., in libris iii. Ethices et Jurisp. Nat. principia continens.* Glasg. 1745. Translated into English. Glasg. 1747. *System of Mor. Phil.*, in three books, &c. Edited, with Life of the Author, by W. Leechman. 2 vols. 4to. Lond. 1755.

BALGUY (J.), *Collection of Tracts Moral and Theological.* Lond. 1734.

MURATORI, (L. A.), *La Filosofia Morale.* 2d ed. Verona, 1737.

GROVE (Hen.), *A System of Moral Philosophy.* 2 vols. Lond. 1747.

BURLAMAQUI (J. J.), *Juris Naturalis Elementa.* Geneva, 1754.

PRICE (R.), *A Review of the Principal Questions and Difficulties in Morals*, &c. Lond. 1758.

SMITH (Ad.), *The Theory of Moral Sentiments*, &c. Lond. 1759.

TUCKER (Abr.), *Light of Nature Pursued.* 9 vols. 8vo. 1768–77.

BASEDOW, (J. B.), *Praktische Philos. für alle Stände*, 2 vols. Dessau, 1777.

HUME (D.), *Enquiry concerning the Principles of Morals.* Lond. 1751. Afterwards included in his *Essays and Treatises on several Subjects* (Lond. 1784), and of which there have been many editions. *Philosophical Works.* 4 vols. Edinb. 1826.

REID (Th.), *Essays on the Active Powers of Man.* Edinb. 1788.

EDWARDS (Jon.), *Dissert. concerning the Nature of Virtue.* Boston, U.S., 1788.

BENTHAM (Jr.), *Introduction to the Principles of Morals and Politics.* Lond. 1789. *Deontology, or the Science of Morality*, &c. Compiled from his MSS. by J. Bowring. 2 vols. Lond. 1834.

KANT (Im.), *Grundlegung zur Metaphysik der Sitten.* Riga, 1785. *Kritik der Praktischen Vernunft.* Riga, 1788. *Metaphysische Anfangsgründe der Rechtslehre.* Königsberg, 1797. *Met. Anf. der Tugendlehre.* Kön. 1797. These treatises occupy vols. viii. and ix. of Kant's *Sämmtliche Werke herausgegeben von Rosenkrantz und Schubert.*

FICHTE (J. G.), *Das System der Sittenlehre nach den Principien der Wissenschaftslehre.* Jena, 1798. *Das System der Rechtslehre, und der Sittenlehre* in his *Nachgelassene Werke*, edited by his son. vols. ii. and iii.

FERGUSON (Ad.), *Institutes of Mor. Phil.* Lond. 1769. *Principles of Mor. and Pol. Science.* 2 vols. 4to. Edinb. 1792.

BEATTIE (J.), *Elements of Moral Science.* Vol. i., Ed. 1790; vol. ii., 1793.

PALEY (Wm.), *Principles of Morality and Politics.* Lond. 1785. In the 2d ed. the title was altered to *Principles of Moral and Political Philosophy.*

SCHLEIERMACHER (Fr.), *Grundlinien einer Kritik der bisherig. Sittenlehre.* Berl. 1803. *Entwurf einer Syst. der Sittenlehre*, forming vol. v. of div. iii. of his *Sämmtliche Werke.* Berl. 1834-48.

SALAT (J.), *Die Moral Philosophie.* Landshut, 1810. 3d ed. Munchen, 1821.

WYNPERSSE (S. J. van de), *Institt. Philos. Mor.* Ludg. Bat. 1808.

HERBART (J. F.), *Allgemeine Prakt. Philosophie.* Gött. 1808.

STAEUDLIN (C. T.), *Neues Lehrbuch der Moral.* Gott. 1817. 2d ed.

KRUG (W. Tr.), *System d. Prakt. Philosophie.* Königs. 1818.

FRIES (J. Fr.), *Ethik oder die Lehren der Lebensweisheit.* Heidelb. 1810.

DE WETTE (W. M. L.), *Vorlesungen über die Sittenlehre.* 4 vols. Berl. 1823-4.

BROWN (Th.), *Lectures on the Philosophy of the Human Mind.* 4 vols., ed. 1820. The ethical portion of these lectures was published separately in 1846, 8vo, with a preface by Dr Chalmers.

MICHELET (C. L.), *Das System der Philos. Moral.* Berl. 1828.

STEWART (D.), *The Philosophy of the Active and Moral Powers of Man.* 2 vols. Edinb. 1828.

PAYNE (G.), *Elements of Mental and Moral Science*, &c. Lond. 1828. 4th ed. 1857.

WARDLAW (R.), *Christian Ethics; or Moral Philosophy on the Principles of Divine Revelation.* Lond. 1833. 5th ed. 1852.

CHALMERS (Th.), *Sketches of Mental and Moral Philosophy*, forming vol. v. of his *Collected Works.* Glasg. 1836. ff.

SMITH (Alex.), *Philosophy of Morals.* 2 vols. 8vo. Lond. 1835.

COUSIN (V.), *Œuvres Philosophiques.* 20 vols. Par. 1846-50.

DAMIRON (Ph.), *Cours de Philosophie*; tom. iii. and iv. Morale. 2d. ed. Par. 1842.

TISSOT (J.), *Ethique ou Science des Mœurs.* Par. 1840.

BAUTAIN (Abbé), *Philosophie Morale.* 2 vols. Par. 1842.

HARLESS (G. C. A.), *Christliche Ethik.* Stuttgart, 1842. 4th ed. 1849.

ROTHE (R.), *Theologische Ethik*, 1st and 2d vol. Wittemberg, 1845.

WHEWELL (W.), *Elements of Morality, including Polity.* 2 vols. Lond. 1845. *Lectures on Systematic Morality.* Lond. 1846.

WAYLAND (Fr.), *Elements of Moral Science.* Edinb. (reprinted from American ed.) 1847.

M'COSH (Jam.), *The Method of the Divine Government, Physical and Moral.* Edinb. 1850. 6th edit. 1857.

MÜLLER (Jul.), *Die Christliche Lehre von d. Sünde.* 2 vols. Breslau, 1849. Translated by W. Pulsford. 2 vols. Edinb. 1852-53.

CHALYBÆUS (H. M.), *System der Speculativen Ethik.* 2 vols. 1850.

ALEXANDER (Ar.), *Outlines of Moral Science.* New York, 1852.

(For the history of Moral Philosophy, besides the general histories of Brucker, Buhle, Tennemann, Rixner, Ritter, Erdmann, Chalybæus, Morell, Lewes, and Schwegler, the following special histories may be named:—MEINERS (Chr.), *Allgemeine Kritische Gesch. der älteren und neueren Ethik*, 2 vols., Gött. 1800-1. STAEUDLIN (C. F.), *Gesch. der Moral Philosophie*, Hanover, 1823. BLAKEY (R.), *History of Moral Science*, 2 vols. 8vo, Lond. 1848. *Whewell's History of Moral Philosophy in England.* 8vo, Lond. 1852.)

PART I.—OF RECTITUDE.

SECT. I.—RECTITUDE DEFINED.

Rectitude. Rectitude is the conformity of actions to an acknowledged standard of right.

In all ages, and among all nations, a distinction has been recognised between right and wrong; and these qualities have been discriminated from other qualities with which they may frequently be closely associated, such as pleasant and painful, agreeable and repulsive, beneficial and noxious, &c. The proposition, "This is right," and the proposition, "This is agreeable," may be translated into all languages under the sun by appropriate synonyms; and by no people would they be accepted as conveying exactly the same concept. When Horace says of Homer,—

> "Qui quid sit *pulchrum* quid *turpe*, quid *utile*, quid non,
> Planius ac melius Chrysippo et Crantore dicit,"[1]

it would be but a blundering translation which should confound the distinction expressed by the author between the *pulchrum* and the *utile*,—the morally fair or right (*τὸ καλόν*), and the useful (*τὸ χρήσιμον*). So also when Aristotle says of speech, that it is *ἐπὶ τῷ δηλοῦν τὸ συμφέρον καὶ τὸ βλαβερόν· ὥστε καὶ τὸ δίκαιον καὶ τὸ ἄδικον*,[2] no person who understands his words will fail to make a clear distinction between the qualities contrasted in the first clause, and the qualities contrasted in the second,—between the profitable as opposed to the hurtful, and the just as opposed to the unjust.

In the words immediately following those just quoted Aristotle goes on to say, that man is the only animal to whom the perception of the distinction between good and bad, just and unjust, has been given. What man thus alone of all animals perceives, it has always been thought important by mankind prominently to enunciate; and hence among all nations we find this distinction expressed in the form of rules or maxims more or less precise and comprehensive; the sum of which constitutes for any community or body of persons the *standard* of right by which they measure the rectitude of actions. Hence rectitude is virtually what some of the ancients called it, *νόμου πρόσταγμα*, what the law prescribes, meaning by "the law" not any particular enactment, either by the state or by any corporate portion of it, but what the community at large regards as the standard of right and wrong; and what Mr Horne Tooke has said, with questionable correctness of right as an abstract quality, that the *word* "is no other than RECT-*um* (*regitum*), the past participle of the Latin verb *regere*," and that the *thing* means simply "that which is ordered,"[3] may be accepted as not an inapt description of rectitude as a quality of actions. We may detect an analogous conviction in the use of the same words to designate the concept of *straightness* and the concept of *moral rectitude*,—a usage which is found to pervade all languages. When, in fine, we find the Hebrews denoting *sin* by such a word as חטאה, and the Greeks by such a word as *ἁμάρτημα*, both derived from roots which signify primarily to miss a mark, and both used to denote the physical act of missing or swerving, we see a further evidence of how generally mankind have identified the idea of rectitude with that of conformity to some acknowledged norm or standard of right.

SECT. II.—RECTITUDE A REAL QUALITY.

Rectitude in actions presupposes and depends on a distinction between right and wrong *per se*; and the question, whether the quality so predicated of actions is to be regarded as a *real* quality will be determined by the answer given to the question, whether this distinction is an essential and permanent, or only an accidental and variable distinction. That it is the former and not the latter, the following considerations render probable *in limine*:— Rectitude.

(i.) The recognition of the distinction by all peoples and in all times, as the appropriation of words to express it in all languages sufficiently indicates. A universal belief like this can be traced only to some common source of authority, the lessons of which the whole race has preserved from its cradle, or to convictions arising out of the nature of the case, and addressing themselves to every man's judgment. In the case before us the former hypothesis must be excluded as irrelevant (for however authority may attest a *fact* or establish a *principle*, it never can originate a subjective conviction); so that there remains only the latter hypothesis. But if the recognition of a distinction between right and wrong is to be traced to convictions springing into the minds of all men out of the nature of the case, this distinction must be one founded in nature, and therefore essential and permanent.

(ii.) The early period at which this distinction is recognised by children accords with the belief that it is a real and essential distinction. Anterior to education and experience a child will indicate, in the most unmistakable manner, its perception of the difference between what it thinks right and what it thinks wrong. This shows that the moral judgment is coeval with intelligence,—a fact which could not exist were the distinction on which that judgment proceeds one of an artificial or accidental kind.

(iii.) We find it impossible to conceive of right and wrong changing places, so that what is now right should become wrong, and *vice versa*. There is in this respect a rigidity which is peculiar to moral distinctions; for not only is it metaphysically impossible that rightness should become wrongness, just as it is metaphysically impossible that blackness should become whiteness, or crookedness straightness, but it is also physically impossible that the same object should become successively possessed of these opposite qualities. An object now black may become white, an object now crooked may become straight; but we cannot conceive of even omnipotence making that which is now right to become wrong. This, then, must be regarded as a distinction lying in nature, and immutable,—*φύσει ἀκίνητον καὶ πανταχοῦ τὴν αὐτὴν ἔχον δύναμιν*, as Aristotle expresses it.[4]

An ancient and favourite objection to this conclusion is drawn from the diversities that have obtained, at different times and among different nations, as to what is right and what is wrong. "Now to some," says Aristotle, "it appears that *all* are such (*i.e.*, made binding by arbitrary enactment); because what is by nature is immovable, and has everywhere the same power, just as fire burns as well here as in Persia; whereas they see that just things vary."[5] "In the state of nature," says Hobbes, "nothing can be unjust; the notions of right and wrong, justice and injustice, have there no place;" and again, "The nature of good and evil varies according to the will of individuals in a state of nature, and of princes in every state."[6] Locke has written to the same effect. "He that will carefully peruse," says he, "the history of mankind, and look abroad into the several tribes of men, and with indifferency survey their actions, will be able to satisfy himself that there is scarce that principle of morality to be named, or rule of virtue to be thought on (those only excepted that are absolutely necessary to hold society together, which commonly, too,

[1] *Epist.*, i., 2, 3.
[2] *Polit.*, b. i., c. i.
[3] *Diversions of Purley*, pp. 304, 306, Taylor's ed., 1840.
[4] *Nic. Eth.*, b. v., c. vii., § 5, Lancaster's ed. (c. x. of the Pacian division).
[5] Same place. See also b. i., c. i., § 9.
[6] *Leviathan*, c. vi.

Rectitude.

are neglected betwixt distinct societies) which is not somewhere or other slighted and condemned by the general fashion of *whole societies* of men, governed by practical opinions and rules of living quite opposite to others."[1]

On these statements it may be observed—

(i.) That whilst there is undoubtedly ground for the fact alleged, the extent to which such variety of moral judgment prevails is apt to be greatly exaggerated by those who use it as an argument against the reality of the distinction between right and wrong. It may be questioned whether, if the whole human race were assembled, the variations of their judgments on questions of ordinary morality would exceed the ratio of one in a hundred; and as for Locke's assertion, that there is scarcely a single principle of morality or rule of virtue that is not slighted or condemned by whole communities somewhere, it can only be set down to the author's excessive zeal for the cause he had set himself to maintain. "But what nation," we may ask with Cicero, "loves not courteousness, benignity, a grateful mind, and one that remembers a benefit? What nation does not hate and spurn the proud, the maleficent, the cruel, the ungrateful?"[2] But if the mass of mankind agree in their moral judgments,—if the agreement be anything like that above suggested, in the ratio of one to a hundred,—it follows, that if the common consent of mankind proves anything in a case of this sort, it must be held as proving the reality and fixedness of moral distinctions. Surely a few exceptional cases are not to be allowed to nullify the general testimony of the race; nor are those minds to be envied that, from contemplating this, "can turn away to seek, in some savage island, a few indistinct murmurs that may seem to be discordant with the whole great harmony of mankind."[3]

(ii.) Even admitting the fact to the full extent alleged, it would by no means prove what it is adduced to prove. A principle may be universally recognised, though variably applied, and men may agree in holding a distinction to be real, though they may differ as to the objects by which that distinction is exemplified. In affirming the universal consent of the race to moral distinctions, it is not intended to maintain that all men apply these with infallible and unvarying accuracy. It is simply affirmed, that to the unbiassed judgment of men right appears right, and wrong appears wrong, and that this obtains always and everywhere. The variations which occur may be accounted for by accidental or partial influences. 1. Excessive emotion often tends to pervert the moral judgment. Under the irritation of violent passion acts frequently appear lawful and proper which, in more quiet moments, the party who is hurried into them cannot but condemn. Smarting from the sting of mortified vanity or disappointed ambition, even a good man may think he "does well to be angry." Blinded by prejudice and infuriated by hatred, the persecutor who hales innocent men and women to prison or to the stake, "thinks he does God service," and may even piously give thanks to God for the doom inflicted on those whom he deems in error; as Laud did when he "pulled off his cap, and, holding up his hands, gave thanks to God" when the barbarous sentence endured by Leighton was pronounced.[4] In these and similar cases there is no perversion of the moral judgment properly speaking; there is simply a momentary suspension of the moral faculty, owing to the influence of something analogous to disease in the physical frame. 2. Some actions, in themselves indifferent, acquire a moral character only when they are performed under certain conditions; and consequently, in estimating the moral sentiments of the people by whom such acts are performed, we must be careful to see that the requisite conditions exist. For example, to appropriate any article is an act which comes to possess a moral character only on the supposition that it is *property;* so long as it belongs to no one, to take it implies no wrong. In a country, therefore, where the distinctions of property do not exist, the natives may be found attaching no sense of impropriety to what, in the estimation of more civilized nations, would be regarded as stealing. But this does not prove that by these people dishonesty is not considered wrong; it only proves that they did not consider the act of helping themselves to what they did not regard as property to be dishonesty. Establish in their minds the conviction that the article they have appropriated belonged rightfully as property to another, and they will at once see the moral impropriety of depriving him of it.[5] 3. It is seldom that acts can be contemplated under one simple aspect. Their aspects are generally numerous; and as under some of these aspects they may possess a different moral character from what belongs to them under others, it often happens that different persons or communities, from fixing their attention exclusively on different aspects of the same act, come to pronounce different moral judgments upon it. An act which under a certain aspect is wrong, may under another aspect be right, and *vice versa;* and hence may be tolerated, or even commended, by some, whilst denounced and condemned by others. Thus the slaughtering of innocent animals, if viewed under the aspect of an amusement, must be pronounced wrong; whereas, if viewed as necessary for the providing of food for man, it may be regarded as permitted; and if viewed as a sacrificial act, it may be commended as praiseworthy; so that three persons, viewing this one act from these three different points of view, might pronounce on its moral character three different judgments. This, however, would no more prove that the moral constitution or principles of these persons differed in each case than, in the famous shield case, the judgment of the one knight that it was black, and the judgment of the other that it was white, proved that their eyes were differently constituted, or that their notions of blackness and whiteness were not the same. This may serve to account for the fact, that many actions, in themselves of doubtful propriety, and many undoubtedly wrong, come to be regarded with approbation or indifference by individuals and communities: the actions have an aspect that is really or apparently harmless, and the parties fixing their attention only on that, and entirely overlooking the essential and primary aspect of the action, come to pronounce upon it an erroneous or defective moral judgment. It is upon this ground that Dr Chalmers so eloquently and forcibly accounts for the various cruelties which are practised, even in civilized society, upon the lower animals, whilst he denies that "even in the lowest walks of blackguardism," there is "such a thing as delight in suffering for its own sake."[6] On this ground, also, may we account for the unnatural practices of infanticide and parricide, on which Locke lays so much stress in the context of the passage above cited from his *Essay*. No man, no people, but would condemn the slaying of a helpless babe, viewed simply in itself; but the slaughter of that babe may come to be regarded as a necessity imposed by the scarcity of provisions, or as the fittest means of averting some terrible calamity, or as upon the whole a kinder thing to the babe than to suffer it to grow up amidst pain, shame, or slavery; and in such cases the act, which in itself all would abhor, may come to be by some regarded as not only permissible, but even to a certain extent praiseworthy. It is the same where

[1] *Essay*, b. i., c. iii., § 10, Works, vol. i., p. 16, fol. ed. [2] *De Legibus*, i. 11. [3] Brown, *Lectures*, vol. iii., p. 592.
[4] See Price's *Hist. of Protestant Nonconformity*, vol. ii., p. 69.
[5] See the instances given by Mr Stewart, *Active and Moral Powers*, vol. i., p. 178.
[6] *Sermon on Cruelty to Animals*, Works, vol. xi., p. 249 ff.

parricide is tolerated; the attention is withdrawn from the act in itself to certain concomitant or consequent effects which are desirable or commendable; and thus what no man would fail to pronounce wrong, if done apart from these effects, may come to be regarded as right when done for the sake of these. In all such cases there is no doubt perversion of moral judgment. But whence arises this perversion? Not from men regarding right and wrong as transferable qualities, but simply from their not viewing the act under that aspect under which alone its true moral character could be estimated. 4. The effect of education and custom must not be overlooked in reference to the variety of men's judgments as to the rectitude of actions. As the organs of taste may be taught to relish what to the uneducated palate is utterly nauseous, so may the moral faculty be educated to regard as lawful or good what the natural conscience would recoil from as sinful. Fashion, which can reconcile the æsthetic taste to the most inelegant costumes or the most grotesque combinations, is also sufficiently potent to reconcile the moral taste to practices altogether inconsistent with propriety and decency. "Who would believe," exclaims Charron, "how great and imperious is the authority of custom? To say that it is a second nature does not express all the truth; for it does more than nature—it conquers nature. . . . . It dominates over our souls and our judgments with a very unjust and tyrannical authority. It does and undoes, authorizes and forbids, what it pleases, without rhyme or reason,—nay, oftentimes contrary to all reason; it makes valid and establishes throughout the world, against reason and judgment, the most fantastic and barbarous opinions, religions, beliefs, observances, manners, and modes of living; and, on the other hand, it injuriously degrades and vilifies things truly great and admirable, robs them of their worth and estimation, and renders them contemptible."[1] To the influence of this tyrannical power many of the differences which prevail among men, and which might at first sight seem to indicate a diversity of moral principle and judgment, may be traced. A practice is held innocent by some which all others hold wrong, simply because the tyranny of custom has in this one instance obscured their perception of right and wrong.[2] The influence, however, thus exerted by education and custom on the moral perceptions of men, though imperious, is partial and transient; were it otherwise, society could not be held together.[3]

SECT. III.—FOUNDATION OF RECTITUDE.

The considerations adduced render it probable that the distinction between right and wrong is a real and permanent distinction. But to determine this more precisely, it will be necessary to inquire into the *foundation* of this distinction.

On this point the conclusions at which inquirers have arrived are very different. These conclusions may be arranged under two distinct classifications; the former of which is determined by their relation to the question whether the distinction between right and wrong be a real one, the latter by their relation to the question whether this distinction is perceived by a judgment of the intellect or felt by an emotion,—in other words, whether the foundation of this distinction lies without us or within us. Compounding these two classifications, we may present the following scheme of opinion on the point at issue:—

I.—EMOTIONAL OR SUBJECTIVE THEORIES.

A.—Affirming the Mutability of Moral Distinctions.
1. That right is what accords with desire; wrong what thwarts it.
2. That right is determined by a special principle implanted in the elect.

B.—Affirming the Reality and Permanency of Moral Distinctions.
1. The theory of a Moral Sense.
2. The theory of Conscience.
3. The theory of Sympathy.
4. The theory of Approbation.

II.—INTELLECTUAL OR OBJECTIVE THEORIES.

C.—Affirming Moral Distinctions to be Accidental and Mutable.
1. That they are created by human law.
2. That they are determined by the Divine will.
3. That they are determined by the consequences of actions.

D.—Affirming Moral Distinctions to be Essential and Immutable.
1. That they arise out of the fitnesses of things.
2. That they are determined by the truth of things.
3. That they are determined by the nature of things.
4. That they lie in the essential nature of God.

Analysis may resolve some of these theories into a common principle; but as they have all been advocated by different writers, it may be proper, in the first instance, to consider them apart.

I.—*Emotional or Subjective Theories.*

A. 1 and *A.* 2.—On the first two theories in this scheme it is not necessary that we should dwell. They are, properly speaking, not so much attempts to account for the distinction between right and wrong, as attempts to set aside that distinction entirely. The former (*A.* 1) proceeds on the assumption that man is the slave of circumstances—that his desires are excited by extraneous objects, and that he must act as his desires prompt. The only good for man, then, is to have these desires gratified, and the only evil is to have them thwarted. What men call right and wrong is really tantamount to gratification and disappointment; or it is a distinction existing only in words, and meaning nothing in reality. The latter theory (*A.* 2), is that of the Antinomians, who maintain that the elect are endowed with a principle of action far beyond any law, and that as this principle always operates necessarily according to the Divine predestination, it invariably conducts to what is right, even though it may prompt to what, on the lower ground of legal morality, would be pronounced sinful or vicious. Such doctrines are chiefly worth noticing because they show the extremes to which men will go in devising theories when they wish to sustain some "foregone conclusion;" and also because, as compared with each other, these theories illustrate the tendency of extremes to meet, and show how the ultraism of theological speculation and the ultraism of infidelity may meet together and erect a common trophy on the ruins of morality.[4] It is needless to linger on the refutation of either theory. The former is sufficiently refuted by the common consciousness and experience of the race, which loudly attest that man is not the slave of circumstances, that desire is not irresistible, that we have a conception of goodness and rectitude wholly distinct from that of desirableness, and that it is according as the one or the other of these

[1] *De la Sagesse*, b. ii., c. viii., § 6.

[2] "Tanta est corruptela malæ consuetudinis," exclaims Cicero, "ut ab ea tanquam igniculi exstinguantur a natura dati, exorianturque et confirmentur vitia contraria." (*De Leg.*, i. 12.)

[3] See Smith's *Theory of Moral Sentiments*, part v.; Stewart's *Phil. of the Active and Moral Powers*, vol. i., p. 152, ff.; Brown's *Lectures*, vol. iii., p. 592, ff.

[4] "If our Antinomians could pay a visit to the heathens of Hindustan, they would find millions on millions of their way of thinking. Nor need they go so far from home; among the apostles of modern infidelity the same thing may be found in substance. The doctrine of necessity, as embraced by them, reduces man to a machine, destroys his accountableness, and casts the blame of sin on the Creator. The body of these systems may be diverse, but the spirit that animates them is the same." (A. Fuller, *Works*, vol. ii., p. 599.)

predominantly regulates conduct that an individual is, in the common judgment of mankind, esteemed or despised. Of the latter theory, it may be enough to say that it is repudiated by the very authority on which its advocates base their entire scheme of speculation,—the language of Holy Scripture; for whatever ground Scripture may give for the belief that the elect are endowed with a special privilege of spiritual life, it most distinctly teaches that nothing can supersede the grand distinction between right and wrong, that the conduct of all men is amenable to the law of morality, and that those who boast of privilege, while they come short of rectitude, do but deceive themselves.

The theories forming sub-division *B.* of class I. are deserving of more careful examination. Though differing in detail from each other, they have this in common, that they propose to base rectitude on the existing constitution of the human mind. They differ as to the part of our mental nature which they select as furnishing the proposed basis, but they all agree in finding that basis among the facts given to us in consciousness. In proceeding to examine them, it is important to bear in mind, that with the psychological part of the theory we have here nothing to do directly; our whole concern at present is, conceding the alleged fact, to inquire whether in it a sufficient basis of moral distinctions is supplied.

B. 1. The first of these theories is that advocated in the writings of Professor Francis Hutcheson. We shall best explain it by citing the author's own words. "As the Author of Nature," says he, "has determined us to receive, by our external senses, pleasant or disagreeable ideas of objects, according as they are useful or hurtful to our bodies; and to receive from uniform objects the pleasures of beauty and harmony, to excite us to the pursuit of knowledge, and to reward us for it; or to be an argument to us of his goodness, as the uniformity itself proves his existence, whether we had a sense of beauty in uniformity or not; in the same manner he has given us a *moral sense*, to direct our actions, and to give us still nobler pleasures: so that, while we are only intending the good of others, we undesignedly promote our own greatest private good. We are not to imagine," he continues, "that this moral sense, more than the other senses, supposes any innate ideas, knowledge, or practical proposition: we mean by it only a determination of our minds to receive the simple ideas of approbation or condemnation from actions observed, antecedent to any opinions of advantage or loss to redound to ourselves from them; even as we are pleased with a regular form or a harmonious composition, without having any knowledge of mathematics or seeing any advantage in that form or composition different from the immediate pleasure."[1] In another work the author expounds his theory in the following terms:—"To regulate the highest powers of our nature, our affections, and deliberate designs of action in important affairs, there is implanted by nature the noblest and most divine of all our senses, that *conscience* by which we discern what is graceful, becoming, beautiful, and honourable in the affections of the soul, in our conduct of life, our words and actions. By this sense, a certain turn of mind or temper, a certain course of action and plan of life, is plainly recommended to us by nature; and the mind finds the most joyful feelings in performing and reflecting upon such offices as this sense recommends, but is uneasy and ashamed in reflecting on a contrary course. Upon observing the like honourable actions or designs in others, we naturally favour and praise them, and have a high esteem and goodwill and endearment towards all in whom we discern such excellent dispositions; and condemn and detest those who take a contrary course. What is approved by this sense we count *right* and *beautiful*, and call it virtue; what is condemned we count base and deformed and vicious."[2] From these extracts the author's theory may be clearly ascertained. He teaches, that as our bodily senses convey to us "certain feelings, ideas, or perceptions, raised upon certain objects presented" of an external and material kind, and as our sense of beauty conveys to us certain pleasurable emotions raised by the perception of proportion or harmony; so our moral sense or conscience awakens in us certain emotions of satisfaction with what is becoming in conduct, and of displeasure with what is the opposite. Thus far the author has been only analyzing certain phenomena of a psychological character; and thus far his sentiments will probably be in substance assented to by all. But when he goes beyond this, and, as a moralist, refers our perception of moral distinctions to this moral sense or conscience, and still more, when he finds the basis of these distinctions in the feelings excited by this sense, he advances doctrines which are subject to the gravest objection.

It is with the latter of these doctrines only that we have at present to do; and on this it may suffice to remark, that in it the author has either wholly evaded the question at issue, or he has answered it by a *petitio principii*. It may be quite true that the perception of moral goodness excites in us a feeling of approbation, whilst the perception of moral evil excites in us a feeling of disapprobation; but by this statement the question, What *constitutes* moral goodness, on the one hand, and what moral evil, on the other? remains wholly unanswered; or it is answered by first assuming moral goodness to exist independent of the moral sense, so as to become the *object* of it, and then accounting for this existence by tracing it to the operation of the moral sense. In this latter case the fallacy is the same as if one were to affirm that it is the sense of smell which causes differences of odour, or the sense of hearing which causes differences of sound.

B. 2. The theory of Hutcheson differs very slightly from that usually ascribed to his distinguished contemporary Bishop Butler. According to this theory, man's actions are determined by various natural impulses and propensities, over which conscience is placed as the supreme and directing authority. Conscience is the faculty by which we discern the moral qualities of actions, and approve or disapprove them as such; and the authority assigned to it over the active faculties of our nature is its prerogative, secured to it by the Creator when he gave man his peculiar constitution. Were the power of conscience equal to its right, all our actions would be controlled by it; and were conscience itself always duly enlightened, our actions would be so controlled by it as to be always consistent with rectitude. "Acting, conduct, behaviour abstracted from all regard to what is in fact and event the consequence of it, is itself the natural object of the moral discernment, as speculative truth and falsehood is of speculative reason."[3] "This moral discernment implies in the notion of it a rule of action, and a rule of a very peculiar kind; for it carries in it authority and a right of direction,—authority in such a sense as that we cannot depart from it without being self-condemned."[4] "There is a principle of reflection in men by which they distinguish between, and approve and disapprove, their own actions. We are plainly constituted such sort of creatures as to reflect upon our own nature. The mind can take a view of what passes within itself, its propensions, aversions,

[1] *Inquiry*, p. 129, 5th ed., 1753.
[2] *A Short Introduction to Moral Philosophy*, &c., translated from the Latin. Glasgow, 1747. P. 16.
[3] Dissertation on the Nature of Virtue, appended to the *Analogy of Religion*, &c., p. 321, Fitzgerald's ed.
[4] *Analogy*, part i., c. vi., p. 124.

Rectitude. passions, affections, as respecting such objects, and in such degrees; and of the several actions consequent thereupon. In this survey it approves of one, disapproves of another, and towards a third is affected in neither of these ways, but is quite indifferent. This principle in man, by which he approves or disapproves his heart, temper, and actions, is *conscience*."[1] "That principle by which we survey, and either approve or disapprove our own heart, temper, and actions, is not only to be considered as what is in its turn to have some influence; which may be said of every passion, of the lowest appetites: but likewise as being superior; as, from its very nature, manifestly claiming superiority over all others, insomuch that you cannot form a notion of this faculty, conscience, without taking in judgment, direction, superintendency. This is a constituent part of the idea, that is of the faculty itself; and to preside and to govern, from the very economy and constitution of man belongs to it. Had it strength as it had right, had it power as it had manifest authority, it would absolutely govern the world."[2] Such, in Butler's own words, is the substance of his theory of conscience; and this, so far as his words go, is unimpeachably correct. But if it be viewed as intended to furnish a theory of rectitude, it must be pronounced deficient; for, as Mackintosh observes, if to the question, What is the distinguishing quality common to all right actions? "it were answered, 'Their criterion is, that they are approved and commended by conscience,' the answerer would find that he was involved in a vicious circle; for conscience itself could be no otherwise defined than as the faculty which approves and commends right actions."[3] It may be questioned, however, whether Butler be justly amenable to the charge of having offered so defective a theory. Though, with that preference for the actual to the speculative, which is characteristic of him, he chooses rather to vindicate moral truth by showing how it accords with, and is enforced by, the constitution of man, than to investigate its abstract foundation, he by no means overlooks the latter inquiry, still less does he offer his own conclusions as tending to supersede it. On the contrary, he distinctly states that the method "which begins from inquiring into the abstract relations of things" affords "the most direct formal proof," and that it and the method he has followed "exceedingly strengthen and enforce each other."[4] From casual statements in different parts of his writings it would appear that Butler held the foundation of morals to lie in the nature of things, as understood by him (of which more hereafter), and so really belonged to the class of intellectualists on this question.[5]

B. 3. The theory which bases rectitude on sympathy stands associated with the name of Dr Adam Smith. In his charming and instructive book entitled *The Theory of Moral Sentiments; or, an Essay towards an Analysis of the Principles by which men naturally judge concerning the conduct and character first of their neighbours and afterwards of themselves*, he has developed this theory with all his wonted clearness, grace, and genius. The following sentences will suffice to place it in substance before the reader:—"To approve of another man's opinions is to adopt those opinions, and to adopt them is to approve of them. . . . . But this is equally the case with regard to our approbation or disapprobation of the sentiments or passions of others." "In the suitableness or unsuitableness, in the proportion or disproportion, which the affection seems to bear to the cause or object which excites it, consists the propriety or impropriety, the decency or ungracefulness, of the consequent action." "When we judge of any affection as proportioned or disproportioned to the cause which excites it, it is scarce possible that we should make use of any other rule or canon but the correspondent affection in ourselves. If, upon bringing the case home to our own heart, we find that the sentiments which it gives occasion to, coincide and tally with our own, we necessarily approve of them as proportioned and suitable to their objects; if otherwise, we necessarily disapprove of them as extravagant and out of proportion." "Originally we approve of another man's judgment, not as something useful, but as right, as accurate, as agreeable to truth and reality; and it is evident we attribute these qualities to it for no other reason but because we find that it agrees with our own."[6] "When I endeavour to examine my own conduct—when I endeavour to pass sentence upon it, and either approve or condemn it, it is evident that, in all such cases, I divide myself, as it were, into two persons, and that I, the examiner and judge, represent a different character from that other I, the person whose conduct is examined into and judged of. The first is the spectator, whose sentiments with regard to my own conduct I endeavour to enter into by placing myself in his situation, and by considering how it would appear to me when seen from that particular point of view. The second is the agent—the person whom I properly call myself, and of whose conduct, under the character of a spectator, I was endeavouring to form some opinion."[7] From these statements it appears that the following constitute the integral elements of Dr Smith's system:—1. That to approve of any man's sentiments or conduct is tantamount to believing that, under similar circumstances, we ourselves would have felt or acted as he has done. 2. That the propriety of affections depends upon their suitableness, as measured by the proportion borne by them to their exciting cause. 3. That of this proportionateness the only rule or measure is our own sympathy with these affections; that is, our conviction that in similar circumstances we should have entertained them and no others. 4. That we pronounce the judgment of another right for no other reason but because it agrees with our own. 5. That in judging of our own affections and conduct we use, as a measure, the sentiment which they would excite in us if viewed from the stand-point of another; and pronounce them right or wrong accordingly.

In judging of this system with reference to the point at present before us, it is necessary to keep in mind that the question is not as to the existence and functions of sympathy as a psychological phenomenon; nor is it as to the advantage, in a practical point of view, of endeavouring to place ourselves in the position of others before we pronounce any judgment on their feelings or conduct; nor is it as to the influence which the presumed judgments of others have upon our own judgments and behaviour; nor is it as to the process by which the moral faculty is historically brought into active operation in the soul of man. The question is, Does the quality which constitutes an action *right* arise out of that sympathy on the part of the spectators to which Dr Smith appeals?

[1] *Sermons on Human Nature*, p. 11, Oxf. 1826. [2] Same book, p. 36. [3] *Diss.*, p. 363. [4] Preface to *Sermons*, p. vii.

[5] Compare such statements as the following:—"The moral faculty may be understood to have these two epithets, δοκιμαστικὴ and ἀποδοκιμαστικὴ, upon a double account; because, upon a survey of actions, whether before or after they are done, it determines them to be good or evil; and also because it determines itself to be the guide of action, of life, &c." (*Diss. on Virtue*, p. 319, note *a*.) "Conscience, ... whether considered as a sentiment of the understanding, or as a perception of the heart, or, *which seems the truth, as including both*." (p. 320.) "Moral precepts are precepts, the reasons of which we see; moral duties arise out of the nature of the case prior to external command." (*Anal.*, part ii., c. i.) "Vice is contrary to the *nature and reason of things*." (Pref. to *Sermons*, p. vii.)

[6] Part i., § i. c. 3 and 4. [7] Part III., c. 2.

Rectitude.

To this question it must be confessed that only a negative answer can be returned. Allowing to sympathy all the influence and force which Dr Smith ascribes to it, it must nevertheless be pronounced wholly inadequate to sustain the superstructure which he has sought to erect upon it. His theory stands exposed to the following among other objections:—1. It assumes a fact as given in consciousness which consciousness refuses to own. The process of transferring ourselves into the position of another, in order to judge of the rectitude of his affections by supposing them our own, or of placing ourselves in the position of a spectator, in order to judge of the rectitude of the affections we ourselves indulge, is one which could not go on without our being conscious of it. But in the multitudinous instances in which we pronounce moral judgment on others or on ourselves, how seldom is it that we are conscious of any approximation to such a process of reflection! The man who sees an unjust blow given, or who recoils from the suggestion of a tempter, passes instantaneously from the perception of the object to the moral judgment upon it; and no process of after reflection awakens in him the slightest consciousness that his *reason* for this judgment was furnished by such a transference of parties as Dr Smith supposes. Such utter unconsciousness of a process, upon which the entire validity of the judgment is assumed to rest, seems irreconcilable with the hypothesis of its existence. 2. Supposing the alleged process to take place, it affords no ground for the judgment pronounced. The conviction in the mind of A, that, if placed in the circumstances of B, he would have acted as B has acted, simply proves a similarity in his moral constitution with that of B; it proves nothing as to the rightness or the wrongness of the action itself. In order to reach this we must suppose A to approve the conduct of B as what in his own case he would have held to be *right*. But this presupposes a *previous* knowledge of the distinction between right and wrong; and, consequently, a foundation for this distinction different from, and prior to, our sympathy with the agent. In point of fact Dr Smith tacitly assumes this; and thereby lands himself in the same vicious circle as we have seen to be fatal to the theories already examined. "I cannot but regard the very celebrated theory of Dr Smith," says Dr T. Brown, "as involving, in morals, the same error that would be involved in a theory of the source of light, if an optician, after showing us many ingenious contrivances by which an image of some beautiful form may be made to pass from one visible place to another, were to contend that all the magnificent radiations of that more than ethereal splendour which does not merely adorn the day, but constitutes the day, had their primary origin in *reflection*, when reflection itself implies, and cannot be understood but as implying, the previous incidence, and therefore the previous existence, of the light which is reflected."[1] 3. Dr Smith's theory, in its primitive form, offers no account of the *imperativeness* which we invariably associate with the conception of right. That we approve the act of another as what we, if in his place, would have done, leaves altogether unaccounted for the conviction with which that approval is accompanied, that the act is such as *ought* to have been done. Dr Smith is far from overlooking this conviction; he repeatedly and emphatically asserts the imperativeness of moral rectitude. But in order to reconcile this with his theory of sympathy, he resorts to an expedient which virtually sets aside that theory. He says there is "a tribunal established in our own breasts which is the supreme arbiter of all our actions;" and this he ingeniously describes as the conception "of a person quite candid and equitable, of one who has no particular relation either to ourselves or to those whose interests are affected by our conduct, who is neither father nor brother nor friend to them or to us, but is merely a man in general, an impartial spectator, who considers our conduct with the same indifference with which we regard that of other people." From this it appears that it is not our sympathy with any of our fellow-men who may be supposed to witness our conduct, but our sympathy with this imaginary man, this "abstract man, the representative of mankind and substitute of the Deity," that determines the rectitude of our sentiments and actions. But what is this "man within" but some recognised standard of right and wrong existing independent of us, and recognised by us as the supreme arbiter of our actions—in reality something without us, but appearing to be within us, because realized as a conception of our mind? By this theory, then, of Dr Smith, as completed by himself, we are ultimately taken off the ground of emotionalism and conveyed to that of intellectualism for a basis of moral distinctions; so that its only advantage is, that it conducts us by a flowery and pleasant path, through a needless detour, to a conclusion more solid and sound than it promised. It is not without reason that the elaborate device of the author to save his peculiar theory, without renouncing the certainty or permanency of moral distinctions, has been compared to the expedients of the Ptolomaic astronomers who, "to save appearances," proposed to

> "Gird the sphere
> With centric and eccentric scribbled o'er
> Cycle and epicycle, orb in orb."[2]

B. 4. This theory will be found most ably developed in the Lectures of Dr Thomas Brown. According to him the basis of moral distinctions lies in the emotional constitution of the human mind,—in the feeling of approbation which a virtuous action awakens in us towards the agent. He denies that right and wrong are qualities of actions, and contends that they simply express a relation to the emotional part of our nature; that which we pronounce right being that which excites in us approbation, that which we pronounce wrong being that which excites in us censure or blame. "Right and wrong," says he, "signify nothing in the objects themselves. They are words expressive only of relation, and relations are not existing parts of objects, or taken from them. There is no right nor wrong, virtue nor vice, merit nor demerit, existing independently of the agents who are virtuous or vicious; and, in like manner, if there had been no moral emotions to arise on the contemplation of certain actions, there would have been no virtue or vice, merit or demerit, which express only relations to these emotions."[3] "If," says he in another lecture, "a particular action be meditated by us, and we feel, on considering it, that it is one of those which, if performed by us, will be followed in our own mind by the powerful feeling of self-reproach, and in the minds of others by similar disapprobation; if a different action be meditated by us, and we feel that our performance of it would be followed in our own mind and the minds of others by an opposite emotion of approbation, this view of the moral emotions that are consequences of the actions is that which I consider as forming what is termed *moral obligation*,—the moral inducement which we feel to the performance of certain actions, or to abstinence from certain other actions. . . . . Our action in the one case we term morally right, in the other case morally wrong; *right* and *wrong*, like virtue and vice, being only words that express briefly the actions which are attended with the feeling of moral approbation in the one case, of moral disapprobation in the other case."[4] On this

[1] *Lectures*, vol. iv., p. 139. [2] Milton, *Paradise Lost*, b. viii. [3] *Lect.* lxxxii., vol. iv., p. 175, 1st ed.
[4] *Lect.* lxxxi., vol. iv., p. 148. Compare also *Lect.* lxxiii., vol. iii., p. 567, ff.

theory of moral distinctions the following strictures may be offered:—

(i.) This theory is incompatible with the doctrine of the *reality* and *permanency* of moral distinctions. Of this doctrine Dr Brown is himself a zealous and eloquent advocate; but he appears to have forgotten it when constructing his own theory of the foundation of such distinctions. For if right and wrong be terms expressive of a mere relation of certain actions to the human mind, it follows that, the constitution of the human mind being altered, the relation would be disturbed, might even be reversed, so that what is now wrong might become right, and *vice versa*. That which is based on what is arbitrary and mutable can never be itself essential and permanent.

Dr Brown does not shrink from the avowal that, as the constitution of the mind might be altered, our moral judgments might be the reverse of what they now are; but he endeavours to defend his doctrine from the charge that it makes rectitude precarious and changeable, by affirming that the relations of morality are not more exposed to this objection than the relations of mathematics. "It is not to moral distinctions only that this objection, if it had any force, would be applicable. *Equality, proportion*, it might be said, in like manner, signify nothing in the objects themselves to which they are applied more than *vice* or *virtue*. They are as truly mere relations as the relations of morality." Now, in arguing thus, Dr Brown has either argued irrelevantly, or he has argued against himself. It is granted that equality is the concept of a relation; but the question arises, A relation of what, and to what? Is it of a certain object to the mind? Certainly not; but of the object to some other object. Either, then, the relations of morality are of the same kind as the relations of equality, or they are not. If they are not, Dr Brown's illustration, drawn from the latter to the former, is irrelevant; if they are, their rectitude is not the relation of an action to the mind, but the relation of the action to something else out of the mind, viz., to some standard of rectitude existing independently of the mind and its feelings. The confusion into which Dr Brown has been betrayed in this attempt to defend his theory from a fatal objection becomes still more manifest as he proceeds. "Though the three sides of a right-angled triangle," he continues, "exist in the triangle itself, and constitute it what it is, what we term the properties of such a triangle do not exist in it, but are results of a peculiar capacity of the comparing mind. It is man, or some thinking being like man, whose comparison gives birth to the very feeling that is termed by us a discovery of the equality of the square of one of the sides to the squares of the other two; that is to say,—for the discovery of this truth is nothing more,—it is man who, contemplating such a triangle, is impressed with this relation, and who feels afterwards that it would be impossible for him to contemplate it without such an impression. If this feeling of the relation had never arisen, and never were to arise, in any mind, though the squares themselves might still exist as separate figures, their equality would be nothing, exactly as justice and injustice would be nothing, where no relation of moral emotion had ever been felt."[1] This passage is full of errors, and one can account for its being found where it is only by remembering with what haste Dr Brown's lectures were composed, and how they were sent forth to the public without the benefit of his superintending and correcting hand. Had he ever carefully reviewed this passage he would not, we believe, have allowed himself to appear before the public as affirming that it is the three sides of a right-angled triangle that *constitute* it what it is,—that the mind may *discover* what has no existence,—that a discovery is a *feeling*,—that the mind, by comparing, may find out properties which do not exist,—and that two objects may be equal to each other, and yet their equality be "nothing" apart from a perceiving mind. But not to dwell on these incoherences, is it not evident that Dr Brown's illustration is altogether against his own theory? As the equality of the square of the hypothenuse to the sum of the squares of the sides of a right-angled triangle does not arise from their relation to the mind, as little does the rectitude of one action and the wrongness of another arise from the relation of such to the mind; and as the perception of the equality of objects is the result of the mind's comparing these objects with each other, so the perception of the rectitude of actions is the result of the mind's comparing these with some standard of right and wrong. From this it follows conclusively that the basis of this distinction cannot be in the mind itself.

(ii.) On Dr Brown's theory it is impossible to account for the existence in the mind of the judgment of right or wrong in reference to any action. By the hypothesis there is nothing in the action itself to originate such judgments; they arise simply and solely from the mind's feeling approbation or disapprobation on perceiving the action. But what originates this feeling in the mind? It cannot be self-caused; and if not self-caused, what is there to cause it but something in the action itself? Dr Brown's system thus leads to a contradiction. Had his position been, that rectitude is a quality of actions which the mind is adapted to approve, and that on the perception of that quality in any action a feeling of approbation arises within us in reference to the agent, all would have been clear and intelligible; but when we are told that rectitude is only a relation between a certain action and an emotion of the mind, which emotion must exist before the rectitude can be perceived, all is thrown into inextricable confusion. We have the mind approving where there is nothing to approve; an emotion arising which there is nothing to excite; and a conception formed, as the *result* of an emotion, which can only exist where that conception is presupposed.

(iii.) Dr Brown's theory obliterates the distinction between Ethics and Psychology, by identifying what *is* with what *ought to be*. No writer has more distinctly than he enunciated the necessity of keeping these two questions separate. "When we know," says he, "that man has certain affections and passions, there still remains the great inquiry as to the propriety or impropriety of those passions, and of the conduct to which they lead. We have to consider not only *how* he is capable of acting, but also whether, acting in the manner supposed, he would be fulfilling a duty or perpetrating a crime."[2] In pursuance of this distinction, Dr Brown has considered the emotions of moral approbation and disapprobation, viewed as affections of the mind, as falling within the psychological (or, as he chooses to designate it, the physiological) department of his course. Here he analyzes these emotions as they are, and this is all with which Psychology has to do. But when he comes to Ethics he has further to inquire into the moral propriety or impropriety of these emotions. This inquiry, however, he very inconsistently waives in reference to these emotions, and sets out with the assumption that these are what they ought to be simply because they are,—nay, are themselves the source and criterion of the propriety or impropriety of actions. If any other emotion arise in the mind, we may ask concerning it, Is it right or wrong? and to answer this we must appeal to our emotion of moral approbation or disapprobation: but when this emotion itself arises we may not ask such a question concerning it; the mere existence of it determines that it is as it ought to be. Now, why this departure in this one instance from a principle recognised and pleaded for in every other? Why

[1] *Lect.* lxxxii., vol. ii., p. 177.

[2] *Lect.* i., vol. i., p. 9.

Rectitude.

is one affection of the mind to be assumed to be always right simply because it exists, while other affections of the mind must depend upon it for their moral character? Why, above all things, should that by which other affections are to be proved right or wrong, be *assumed* to be itself certainly right without any proof? "It is obvious," as has been justly observed, "that Dr Brown takes for granted the propriety of the feelings of approbation; and indeed he must do so. And taking this for granted, the system supplies us with no certain measure of the rectitude of any action, or of any affection of mind whatever. The correctness of the rule not being verified, we can have no confidence in relation to the correctness of anything that is measured by it. The whole system of morals is thus involved in doubt and uncertainty; and it is impossible, on this scheme, for any man to know whether he deserves the vengeance or the love of his fellow-men."[1]

(iv.) It is impossible to understand, on Dr Brown's theory, in what sense rectitude can be ascribed to God. That God is right in all his ways is a dictate of all religions, as well of nature as of Scripture. But if rectitude be a mere relation of actions to the mind, in what sense can the actions of God be pronounced right? *Whose* mind is it, by their relation to which the rectitude of these actions is determined? Not, of course, that of any of God's creatures; for this were to make the character of God and his ways dependent on the feelings of a finite and perhaps erring being. Not his own mind; for we cannot without absurdity say that God's actions are right because, when He has done them, they are approved by Him, or were so when he foresaw that he would do them. Dr Brown's system seems here wholly at fault. Reason and piety alike constrain us to say that God's actions are right, because they are all perfectly conformed to an absolutely perfect standard of rectitude.

(v.) Experience teaches us that men may very sincerely and conscientiously approve actions which other men see to be wrong, and which they themselves afterwards as sincerely and conscientiously pronounce blameworthy. In such a case, according to Dr Brown's theory, the same action would be both right and wrong at the same time to different persons, and at different times to the same person. Does not such a conclusion go entirely to unsettle the foundations of morality? What confidence can one have in moral distinctions, if the mere fact that our contemplating a certain action with approbation makes it right for us to do it, and that when we change our feeling with regard to it, we become bound not to do it? Besides, does not the fact that we may change our moral estimate of actions in consequence of greater knowledge or greater mental purity, show of itself that the rectitude of actions depends upon something out of ourselves,—something appertaining to the action which we require justly to apprehend before we can feel approbation of it or of the doer of it?

On these grounds the theory of Dr Brown, ingeniously as he has illustrated it, appears altogether untenable.

Before leaving the emotional theories of rectitude, there are one or two observations of a general nature which may be hazarded in reference to certain particulars which affect them in common.

(i.) They all agree in founding moral distinctions on the existing constitution of the human mind. Dr Brown expressly avows this with reference to his theory;[2] and it is no less true with reference to the others. Whether we resolve rectitude into a dictate of conscience, a result of sympathy, or a perception of the moral sense, we alike base it upon something in man's existing mental constitution.

(ii.) Though the authors of these theories all agree in repudiating the doctrine which finds the basis of rectitude in the will of God, the ground they have assumed in common is one which conducts ultimately to this doctrine. For as man is God's creature, his constitution, bodily and mental, is simply that which God willed him to have; and thus, as his constitution depends entirely on the Divine will, whatever depends upon his constitution must be resolved ultimately into that will. We may, indeed, ask why God willed man to possess such a moral constitution as He has given him; and we may find an answer to this in the position, that God ever does that which is right and best; but from such an inquiry and such an answer those who place the foundation of rectitude and goodness in certain emotions of the human soul, preclude themselves by the ground they have assumed.

(iii.) All these theories proceed upon the assumption, that the moral constitution of man remains in its normal state. This is essential to the validity of their appeal; for if man's moral constitution be in a state of disorder or disease, we can no more trust to its decisions in matters of right and wrong, as an independent and original source of moral distinctions, than we could to the reflections of an ill-polished mirror or to the sensations of a jaundiced eye. In making this assumption, however, they have overlooked a fact to which all experience, no less than Divine revelation, gives testimony, that man's moral constitution, so far from being in the state in which it ought to be, is in a condition wholly abnormal and disordered. It is true that this state does not amount to a destruction of man's moral constitution; he is still susceptible of moral impressions, still capable of moral judgments; and enough remains to enable us to determine what the order of his moral nature originally was. But with all this there is so much of perversion, confusion, and disorder, that we can have no security that what his moral tastes or affections may approve shall be on that account right and proper.

II.—*Intellectual or Objective Theories.*

We proceed to the consideration of these with a presumption that, in this department of speculation, we shall find the object of which we are in search. This presumption is founded not only on the fact that we have failed to find it in the emotional part of our nature, but also because of the intellectual character of our moral cognitions. When we say, "This is right," we do not give expression to an emotion; nor do we utter a wish; nor do we express a resolution: we pronounce a judgment. Now, as a judgment is an intellectual act, the presumption is, that the basis on which this judgment rests will be some datum or discovery of the intellect.

C. 1. This theory, according to which rectitude depends on civil enactment, is generally cited as owning for its principal exponent and advocate "the philosopher of Malmesbury," Thomas Hobbes. To this dubious honour Hobbes has contributed to raise himself by the manner in which he has repeatedly expressed his views; but it is more than doubtful whether such a doctrine can be justly fixed upon him. Mr Stewart has remarked, that "the ethical principles of Hobbes are completely interwoven with his political system;"[3] and this must ever be borne in mind in estimating his views. The great problem which he has set himself to solve is apparently this:—Given a community, composed of men such as men usually are, how may peace and order be best secured in the administration of its affairs? And of the solution which he offers part is this, that men in such a community must not be allowed to judge each one for himself what is good and what is bad, what is *meum* and what is *tuum*, what is just and what is unjust; but all this must be determined by the enactment of the ruling power Hence his writings contain such startling assertions as the

[1] Payne, *Elements of Mental and Moral Science*, p. 485, 1st ed.

[2] See *Lecture* lxxiv., vol. iii., p. 598.

[3] *Diss.*, p. 42, col. 1.

following:—"Quod legislator præceperit, id pro *bono*, quod vetuerit, id pro *malo* habendum esse. . . . Ante imperia *justum* et *injustum* non extitere; ut quorum natura ad mandatum sit relativa; actioque omnis sua natura adiaphora est; quod justa vel injusta sit a jure imperantis provenit. Reges igitur legitimi quæ imperant justa faciunt imperando, quæ vetant vetando injusta. Privati autem homines dum cognitionem boni et mali ad se trahunt cupiunt esse sicut reges; quod salva civitate non potest."[1] "Culpa, hoc est peccatum, est quod quis fecerit, omiserit, dixerit, vel voluerit contra rationem civitatis, id est contra leges."[2] "In a state of nature nothing can be unjust; the notions of right and wrong, justice and injustice, have there no place; where there is no common power, there is no law,—where no law, no transgressions."[3] "No law can be unjust."[4] Many similar statements might be adduced from the two works from which these sentences are taken; and such statements, it cannot be denied, if taken by themselves, would fully justify the imputation to Hobbes of the opinion, that it is by the authority of political enactment that justice and injustice, right and wrong, are produced. All, however, that he appears to have intended by them is, that in a state the governing power must settle the conditions of property; and by its enactment, and not by the opinions of each individual, must the duty and the right of each, as a member of the body politic, be determined. That he did not consider his inquiry as directed to the settling of general principles of morals, but only to the determining of the authority by which, in a state, the boundaries of good and evil should, for governmental purposes, be fixed; and that he held moral distinctions to be in themselves independent of civil enactment, may be clearly shown from many parts of his treatise *De Cive*. Thus, in reference to theft, he says, —"Non quærimus an furtum sit peccatum; *quærimus quid furtum dicendum sit, et sic de cæteris similibus*."[5] According to this, his design is not to determine the moral virtues, but only to ascertain by what authority such and such acts are to be held breaches of these virtues. This obviously implies that these virtues themselves rest on something else than, and anterior to, civil enactment for their basis. Still more explicitly and fully is this stated in the following passage:—"Doctrinarum quæ ad seditionem disponunt una et prima hæc est; cognitionem de bono et malo pertinere ad singulos. In statu quidem naturali ubi jure æquali singuli vivunt, nec se per pacta sua aliorum imperio submiserunt veram eam esse concedimus, imo cap. i., art. 9, probavimus. Sed in statu civili falsa est. Ostensum enim est, cap. vi., art. 9, Regulas boni et mali, justi et injusti, honesti et inhonesti esse leges civiles, ideoque quod legislator præceperit id pro bono, quod vetuerit et pro malo habendum esse."[6] Here the author distinctly states, that in a state of nature every man can and may judge for himself what is right or wrong; and that it is only when he has entered into a civil compact that he becomes bound to allow the state to fix the rules of rectitude for him. Such a doctrine may be very unsound politically, but it does not amount to anything like an affirmation that moral distinctions, as such, have their origin in civil enactment. On the contrary, in that part of his work to which he here refers (the first chapter), Hobbes shows at length that there are natural laws prescribing to man what he ought to do; that these laws are immutable and eternal; that they bind man *in foro conscientiæ*; that they are nothing else than certain conclusions understood by reason concerning things to be done and things to be omitted; that they are identical with the moral law; and that they may justly be called *divine*, "not only because reason, which is itself the law of nature, has been given immediately by God to each man as the rule of his actions, but also because the precepts of living thence derived are the same as those which have been promulgated by the Divine Majesty as laws of the heavenly kingdom, through our Lord Jesus Christ and the holy prophets and apostles."[7] These sentiments appear altogether incompatible with the theory of moral distinctions usually imputed to Hobbes. It belongs to another department to examine the soundness of Hobbes's doctrine concerning the relation of subjects to their governors.

The opinion which has been thus injuriously imputed to Hobbes was certainly, however, held by some ancient philosophers, as Cudworth has showed in his learned way by numerous citations.[8] Unfortunately, these are for the most part given in such a way, that we have been unable to verify them all; and of those we have succeeded in tracing, all do not appear apposite to the purpose for which they are cited. When every deduction, however, has been made on these accounts, there still remains enough to prove that there were philosophers in ancient times who not only affirmed what Hobbes has affirmed as to justice and injustice, good and evil, being determined by law, but who affirmed also what Hobbes has denied, viz., that such distinctions are not also by nature.[9] Now to all such doctrines the answer is sufficiently obvious. A law, as law, is the mere expression of the supreme will in a community, and can never confer a moral character on any act to which it relates. The utmost law can do is to indicate that a given course will be followed by a given punishment, and so to affix a character of imprudence or folly to the pursuing of that course. It can never *per se* make that which was before right to become wrong, nor that which was before wrong to become right. "A sovereign," as has been truly said, "may enact and rescind laws, but he cannot create or rescind a single virtue;" nor can any mere expression of his will, or any penalty he may attach to the violation of it, awaken one feeling of remorse or self-condemnation in the bosom of the man who transgresses the law under a clear and firm conviction that it enjoins what a regard to a higher law—the law of rectitude or of God—forbids. The mere utterance of will can never of itself add moral qualities to an act, or bring one under an obligation to perform it; and it matters not whether this will be that of an individual or of a community, for mere numbers in a case of this sort go for nothing: where $x=0$, $100x$ or $10{,}000{,}000x$ amount to no more. As Dr Brown puts it (though he erroneously ascribes this argument to Cudworth), "it must either be right to obey the law, and wrong to disobey it, or indifferent whether we obey it or not. If it be morally indifferent whether we obey it or not, the law which may or may not be obeyed with equal virtue cannot be a source of virtue; and if it be right to obey it, the very supposition that it is right to obey it implies a notion of right and wrong that *is antecedent to the law*, and gives it its moral efficacy."[10] It is not easy to conceive what could be said in reply to this.

Rectitude.

[1] *De Cive*, cap. xii., § 1. [2] Same book, cap. xiv., § 17. [3] *Leviathan*, p. 63. [4] Same book, p. 182.
[5] *De Cive*, cap. xiv., § 17. [6] Same book, cap. xii., § 1. [7] Same book, cap. iii., §§ 27, 29, 31, 33; cap. iv., § 1.
[8] *Treatise concerning Eternal and Immutable Morality*, pp. 2–7.
[9] See Plato's *Theætetus*, p. 172, B.; Opp. ed. Stallbaum, vol. viii., sect. 1, p. 149; *De Legibus*, b. x., near the beginning; Aristotle, *Nicom. Ethic.*, b. v., c. vii., §§ 4, 5, Lancaster's ed.; Archelaus, in Diogenes Laertius, *De Vitis*, &c., *Philosophorum*, says, καὶ τὸ δίκαιον εἶναι καὶ τὸ αἰσχρὸν οὐ φύσει, ἀλλὰ νόμῳ, b. ii., cap. iv., § 3; Aristippus, μηδὲν εἶναι φύσει δίκαιον ἢ καλὸν ἢ αἰσχρὸν ἀλλὰ νόμῳ καὶ ἔθει, b. ii., c. viii., § 8; Pyrrho, b. ix., c. xi., § 3; Carneades as reported by Lactantius, *Div. Institt.*, b. v., c. 16, ed. Sparke.
[10] *Lectures*, vol. iii., p. 632. It is worthy of notice that Stewart as well as Brown imputes this dilemmatical reasoning to Cudworth. See *Active and Moral Powers*, vol. i., p. 240. Both were led into the mistake by Dr Adam Smith; see his *Theory of Moral Sentiments*, part vi., § 3, c. 2.

Rectitude.

In the minds of many, however, there is a confused impression, that because it is morally right for subjects to obey their rulers; therefore whatever the ruler may prescribe becomes *ipso facto* right, and consequently, that it is into the will of the ruler that rectitude is ultimately to be resolved. Now a very little reflection will suffice to show, that even assuming this reasoning to be well founded, it will apply to only a very small part of what concerns man as a moral agent; by far the greater part of his moral obligations relating to a sphere within which no legislation of his fellow-men can penetrate. It will occur also to the inquirer to ask,—If the will of the ruler determine the moral obligations of his subjects, what is it that determines the moral obligations of the ruler? He is not free from these; for this would be to deny to him the attributes of an intelligent creature; and if these have come upon him from some source superior to his own will, and anterior to the exercise of it, then moral distinctions cannot be *created* by him, and consequently conduct cannot become right simply because he commands it. Further, the question will arise,—On what rests the obligation incumbent on subjects to obey their rulers? Not surely on law; for mere law can never create an obligation: it can only prescribe how a previously existing obligation is to be followed. But if not on law, then on something anterior to law and above it; so that we are again brought to the conclusion, from the very relation of governor and subject, that there is a foundation for rectitude wholly independent of any legislation or utterance of rectoral will. "It was never heard of," says Cudworth, "that one founded all his authority of commanding others, and others' obligation or duty to obey his commands, in a law of his own making, that men should be required, obliged, or bound to obey him. Wherefore, since the thing willed in all laws is not that men should be bound or obliged to obey, this thing cannot be the product of the mere will of the commander; but it must proceed from something else, namely, the right or authority of the commander, which is founded in natural justice and equity, and an antecedent obligation to obedience in the subject which things are not made by laws, but presupposed before all laws to make them valid. And if it should be imagined that any one should make a positive law to require that others should be obliged or bound to obey him, every one would think such a law ridiculous and absurd; for if they were obliged before, then this law would be vain and to no purpose; and if they were not before obliged, then they could not be obliged by any positive law, because they were not previously bound to obey such a person's commands; so that obligation to obey all positive laws is older than all laws, and previous or antecedent to them."[1] In fine, it will occur to the thoughtful inquirer, that as the obligations lying on subjects to obey their rulers is thus imposed by an authority above and anterior to that of any ruler, so the limits of this obedience must be determined by a regard to this higher authority. His authority can never ascend beyond its own source; and if, consequently, he shall command what the source of his own authority forbids, the obligation resting on his subjects to obey him necessarily terminates *quoad hoc*. This leads to the conclusion, on the one hand, that a ruler is to be obeyed only so far as he enjoins what is morally right; and, on the other, that so far from his law creating the rectitude of actions, it is by the standard of rectitude that the moral validity of his own law is to be tried.

C. 2. Closely connected in principle with the doctrine just examined, though proceeding from very different parties, and urged with very different views, is the opinion that rectitude is to be resolved into the sovereign will of God. Cudworth traces this opinion to Ockham, from whom he quotes the statement, "That there is no act evil but as it is prohibited by God, and which cannot be made good if it be commanded by God; and conversely."[2] But it is certain that, in holding this opinion, Ockham only followed his master, Duns Scotus, as did many others of the Scotists.[3] The opinion has found many advocates in more recent times, some of whom have not shrunk from following it to the extreme consequence, that God may enjoin on us what we now regard as the greatest crimes, but which would then become as great virtues. Descartes, as Cudworth shows, throws himself so energetically into the defence of this opinion, that he does not hesitate to affirm "that God did not will the three angles of a triangle to be equal to two right angles because he knew it could not be otherwise, but because he willed the three angles of a triangle to be necessarily equal to two right angles,—therefore this is true, and cannot be otherwise;" thus resolving all truth, necessary as well as contingent, into the mere sovereign will of God. A leaning to this view may also be found in Bishop Taylor, and in several of the casuistical and mystical theologians. In judging of opinions on this subject, however, we have ever carefully to keep in view the distinction between the will of God as a rule and directory of conscience, and the will of God as a source of moral distinctions. The former opinion may be held where the latter is repudiated, as it is, for instance, by Suarez, who says, "Hæc Dei voluntas, prohibitio aut præceptio, non est tota ratio bonitatis et malitiæ quæ est in observatione vel transgressione legis naturalis, sed supponit in ipsis actubus necessariam quandam honestatem vel turpitudinem, et illis adjungit specialem legis divinæ obligationem."[4]

There can be no doubt that many who have given in to the opinion now under consideration, have done so from a pious desire to uphold the majesty and authority of God as the moral governor of the universe. Such motives are to be respected; but this must not prevent our pronouncing the opinion to which they have given currency not only unsound in principle, but most pernicious in tendency. It is at once, indeed, admitted that God can never enjoin anything but what is right and good; that whatever He enjoins, it is the duty of his creatures on whom it is enjoined to obey; that His law is the safest and surest rule by which any man can direct his conduct; and that, in actual practice, no man needs any other or higher reason for doing what God enjoins than is furnished by the simple fact that He has enjoined it. But, after all this has been conceded, the question arises: Does the mere utterance of the Divine will, pronouncing any course of conduct to be right, *create* and *constitute* the absolute rectitude of that conduct? In other words—would that which we now feel and believe to be right cease to be so, could it be shown that God has never commanded it? Or, in other words still,—would the Divine command (supposing it possible for such a thing to occur) be sufficient of itself to alter all our present moral convictions and relations, so as to make that which it is now right for us to do, wrong, and conversely? These questions the theory now under consideration would answer in the affirmative; and such answer we hold to be unsound and mischievous. In proof of this, the following observations may be adduced:—

(i.) This theory asserts that the distinction between vice and virtue is purely arbitrary; and that, consequently, there is no intrinsic excellence in virtue, no intrinsic turpitude in vice. All this is purely matter of appointment, and the

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[1] *Treatise*, &c., p. 19.

[2] Nullum actum malum esse nisi quatenus a Deo prohibitum, et qui non possit fieri bonus si a Deo præcipitur et e converso.

[3] See Tennemann, *Grundriss d. Gesch. d. Philosophie*, pp. 284, 289, 5th ed.

[4] *Tractatus de Legibus ac Deo Legislatore*, &c., c. vi., § 11, quoted by Hallam, *Hist. of Literature*, vol. ii., p. 505, 2d ed.

emotions of approbation with which we regard the former, and of disapprobation with which we regard the latter, stand connected with a constitution which might have been so framed as to admire vice and abhor and condemn virtue. Had God so willed it, then, we might have been found contemplating such a character as that of Jesus Christ with aversion, and such a character as that of Judas Iscariot with admiration and rapture, as the noblest development of human excellence,—a conclusion against which our entire moral nature revolts, and which is as impious as it is immoral. It may, indeed, be said that it is impossible for God to will what is evil, and that consequently it is incompetent for us to reason on the supposition that he could. But if good and evil have no existence anterior to, or independent of, the expressed will of God, where is the impossibility of His reversing the distinctions between these which now exist? By the hypothesis, there is nothing right and nothing wrong apart from God's will; it is His command which imparts a moral character to what, apart from this, is neither good nor bad; what, then, is to render it impossible that He should will the one and not the other? If it be replied, that He must always will what is good, this gives up the theory, because in that case it is admitted that it is not because God wills it that any course is right, but because it is right that God wills it.

(ii.) This theory, whilst proffering homage to God, really dishonours Him. For it assumes that, in settling the most momentous relations of His intelligent creatures, He proceeded without reason, and left these to be determined by mere accident or caprice. If this be denied by the advocates of this theory, the question they will have to meet is, For what reason did God will His creatures to be virtuous? To this the only reply that can be given is, that He willed this because He saw it to be good and right. But this reply supposes that virtue, as seen by the eye of God, is good anterior to His willing it for His intelligent creatures; and consequently virtually renounces the theory now under consideration. If the theory be retained, the answer is precluded, and the alleged objection stands firm. It may be added, that this theory is dishonouring to God, further, by denying that there is any inherent excellence in the Divine character independent of God's will. For if the character of God be affirmed to be excellent in itself, it will follow that there is a foundation for rectitude and moral excellence independent of any act of the Divine will; and if, on the other hand, it be affirmed that the character of God is excellent simply because it is what He willed to have it, it follows that in that character there is no inherent, essential excellence, and that if God had so willed it, His character might have been marked by the very opposite qualities to those by which it is adorned. "According to this scheme, therefore," as has been justly remarked, "there is no original moral difference between the characters of an infinitely malevolent being and an infinitely benevolent one; because this difference depends on a mere arbitrary act of will, and not at all on the respective natures of the things themselves."[1]

(iii.) This theory confounds the distinction between moral duties and positive duties. Every person will admit that it is right to do what God enjoins; but every person must feel that there is an essential difference between the command to abstain from murder, falsehood, or theft, and the command to circumcise every male child when he is eight days old, or the prohibition to eat flesh with the blood in it. The former are moral laws, which carry their reason in themselves, and are enjoined because they are right; the latter are positive laws, which derive their reason from the authority which enacts them, and are right because they are enjoined. But if it be the Divine command which gives its moral character to any injunction, this distinction is baseless and fantastical. The only reason for any duty in that case is, that so it has been enjoined; and murder, falsehood, or theft, which would have been quite innocent had God not forbidden them, are not crimes to us in any other sense than a neglect to circumcise his child, or the eating of blood, would have been a crime to an Israelite. It is true that in the former case the law has existed since ever man existed, and is in force wherever man is found, while in the latter it was local and for a season; but if the rectitude of the acts in both cases be derived from the mere fact that they are enjoined by God, this difference does not seem to be of any moment.

C. 3. The general theory which derives the rectitude of actions from their consequences, divides itself into two sub-theories, according as these consequences are viewed either relatively to the agent himself alone, or relatively to other beings, or to being in general. In the former case rectitude is identified with what is advantageous or agreeable to the individual; in the latter it is identified with what is advantageous to the community or the race. In both cases it is assumed that there is no inherent, essential quality of rectitude in actions,—that happiness or advantage is the ultimate good, and that actions become right as they tend to promote this, and are wrong as they tend to hinder it. It may be of advantage to examine separately these modifications of the Utilitarian, or (to use the word suggested by Kant as more correct) Eudaimonistic theory of morals:—

(i.) The system which refers the rectitude of actions to their tendency to promote the advantage of the agent is commonly known as the Selfish System. It has found supporters both in ancient and more recent times; but it has never drawn to it any large amount of respectable support, and it may be questioned whether any one pretending to the name of philosopher would, in the present day, be found willing to appear as its formal defender. Still it exerts a sort of unacknowledged authority over the minds of very many; it is the form into which much of the popular and vague speculation at present afloat on morals among the masses would be reducible; and hence some remarks are required to show its unsoundness.

It is not to be denied, that with all right acts there is associated a certain amount of pleasure, and that the surest course to spend life happily is to spend it virtuously. The only question is, Does this gratification constitute the source of the rectitude? in other words, Is the tendency of certain actions to communicate pleasure to us the quality which confers on them the character of rectitude?

Now, in answer to this question, it is obvious to remark, that if it be the tendency of actions to convey pleasure to us which constitutes them right, the rectitude of actions will *vary* in proportion to the degree of this tendency, or the amount of pleasure which they are capable of yielding to us. Those actions, therefore, which afford us most gratification will, on that account, be most deserving of our moral approbation; and we shall be able at any time to increase the rectitude of an action by increasing its capacity of pleasing us, just as a cook may increase the excellence of a dish by augmenting its power of gratifying the palate. Nor is this all: it follows, further, from this doctrine, that what is right to one person may be wrong to another; nay, that what is now wrong to any one, because it makes him unhappy, may become right to him through some change of circumstances on his part, or by some modification of its qualities in relation to him. But are such conclusions in accordance with fact? Are they borne out by the moral sentiments of mankind? Do they find assent in the sincere convictions of any human being? On the contrary,

[1] Dwight, *System of Theology*, Serm. xcix.

Rectitude.

does not every one feel that, if conclusions like these were true, such words as *right* and *wrong*, *virtuous* and *vicious*, would be utterly superfluous, and calculated only to confuse and mislead.

We may apply another test to this doctrine. Were it true, it would follow that, in judging of the actions of others, we should approve those which conduce most to the advantage of the agent; for as we approve the actions of others in proportion as they are right, if rectitude depend on advantage, our approbation will necessarily be determined by our perception of such advantage as accruing to the individual. It would thus become proper for us to think well of the successful adventurer who had surrounded himself with the comforts of life by the violation of justice, and by trampling mercy under foot,—whose coffers were filled with gains collected by fraud and extortion, and who revelled in the fruits of deeds which had desolated many homes, broken many hearts, and sent many prematurely to the grave. There is, in fact, no sort of successful crime which, on this principle, we should not commend, our censure being reserved only for the unfortunate or the imprudent, who had failed to secure their own interest. On such a supposition, is it not idle to talk of moral distinctions, or to dignify man with the title of a moral agent?

Every person who reflects on the moral phenomena of his own nature must be aware that such perverted judgments are utterly impossible. Men, it is true, "will praise those that do well to themselves;"[1] for there is a certain feeling of admiration excited by all successful adventure, even when its end is purely selfish; but such praise is always limited by the condition, that in doing well to themselves men have not done ill to others; and it is excited, besides, not so much by the view of the advantage the individual has secured, as by the conviction that man owes a duty to himself in reference to the promotion of his own welfare, as well as to others. When it is evident that it is by the path of *crime* that men have passed to wealth, honour, or pleasure, there is in every human breast a sentiment of condemnation excited by their conduct, which no consideration of its successful result can mitigate. Nay, so certain and so strong is this sentiment, that even when we ourselves are made to reap the benefits of another's crime, we cannot but perceive and feel the evil of his conduct. The favourite of a despot who is enriched by his master's extortions, and whose passions are regaled by means of the license which his master's tyranny secures, has nevertheless within his bosom a sentiment condemnatory of his master's proceedings, which no sense of gratitude to his master can wholly obliterate, and which the degrading influences of a vile dependence can hardly blunt. "We can constrain our tongue to be false, our features to bend themselves to the resemblance of that passionate adoration which we wish to express, our knees to fall prostrate; but our heart we cannot constrain. There virtue must still have a voice, which is not to be drowned by hymns and acclamations; there the crimes which we laud as virtues are crimes still, and he whom we have made a god is the most contemptible of mankind, if indeed we do not feel, perhaps, that we are ourselves still more contemptible."[2] This description, though perhaps somewhat exaggerated, is substantially true; but if virtue lie in the tendency of any act to promote our individual benefit, why should it be so impossible for us to commend acts which directly minister to our advantage, or to approve of the character of one to whose agency we owe so much?

In reply to these strictures, it may be said that, in estimating the consequences of actions to ourselves, we must take into account the *whole* of our being, and that in this case it will be found that, as no vicious course is ultimately beneficial, and no virtuous course ultimately injurious, true wisdom would dictate to all men to avoid a vicious and pursue a virtuous career. This is the form in which the Eudaimonistic theory was advocated by Epicurus, who maintained that "virtues are to be preferred for the sake of pleasure, not for their own sake, just as medicine for the sake of health;" but at the same time contended "that virtue alone is inseparable from pleasure," and that "no man can live pleasantly unless he live prudently, honourably, and justly;" and hence he consistently taught that prudence (φρόνησις) is the prime virtue.[3] In this last assertion Epicurus avows what is sufficient to prove the inadequacy of the Eudaimonistic theory, even in this its improved form, to account for moral distinctions, or distinct moral judgments. After all, even on his own showing, the choice between right and wrong is a mere matter of *prudence;* there is nothing *morally* wrong in vice or right in virtue: the former is to be shunned simply because it leads to unpleasant consequences, and the latter to be followed simply because upon the whole it conduces to our happiness. On this theory it still remains inexplicable why men should censure vice and should commend virtue. If a man chooses to be vicious or selfish on the ground that that is the pleasanter course for him, we may pity him for the *mistake* he has made, but we have no right, on this theory, to blame him as having done wrong.

Besides, how on this theory are we to adjust the competing merits of a life of simple selfishness and a life of generous beneficence? Are these equally good? and, if not, why not? Let us take a case. Some person, writing in the name of Swift, says to the people of Ireland, "I have been bred in a careful way of life, and never ventured upon any project without consulting my pillow first how much I should be a gainer in the upshot."[4] These are not Swift's own words, for at the time they were written he was hastening to the grave in a state of hopeless imbecility; but they paint a character such as may sometimes be found, and therefore are sufficient for our present purpose. Now, some twenty years before the date of this production, Swift wrote to Lord Carteret as follows, of his illustrious friend and countryman Berkeley:—"He is an absolute philosopher with regard to money, titles, and power; and for three years past hath been struck with a notion of founding a university at Bermudas by a charter from the crown. . . . . He showed me a little tract which he designs to publish; and there your excellency will see his whole scheme of a life academico-philosophical—of a college founded for Indian missionaries, where he most exorbitantly proposeth a whole hundred a year for himself, forty pounds for a fellow, and ten for a student. His heart will break if his deanery be not taken from him and left to your excellency's disposal."[5] In these characteristic sentences the sarcastic Dean of St Patrick's seeks to assist his friend in the "romantic design," as he calls it,—but which he could not help feeling to be also "very noble and generous,"—of resigning wealthy preferment, great prospects, refined society, scholarly resources and associations, to go to a distant and semi-barbarous colony as a pioneer of civilization and a preacher of religion, amid poverty and privation of every kind. Here, again, we have a character painted to us—happily this time a real character, though one not so frequently encountered in actual life as the former. What shall we say of the two characters on the Eudaimonistic theory? On that theory the motive in both cases was the same—personal advantage and pleasure.

[1] Ps. xlix. 18.
[2] Brown, *Lectures*, vol. iv., p. 72.
[3] Diog. Laert., l. x., §§ 138, 140, &c.
[4] *The Drapier's Letters to the Good People of Ireland*, 1745, in Swift's Works, vol. xxvii., p. 160, ed. 1779.
[5] *Works*, vol. xvii., p. 153.

Were both, then, alike good? Is the pseudo-Swift, cautiously consulting his pillow before he committed himself to any project, that he might avoid all possible sources of personal loss and discomfort, to be equally commended and admired with the large-hearted and generous Berkeley, who, casting all personal considerations to the winds, is willing to endure penury, and toil, and trial, for a scheme which is to profit him nothing, even should it prove successful, but from which he hopes his fellow-men may reap benefit? Or if the latter is to be pronounced the better of the two, is his superiority to be determined by nothing else than a nicely-adjusted estimate of the superior amount of happiness which, in the upshot, the course he has selected is calculated to confer upon him?

But supposing we arrive at this conclusion, it may occur to one to ask, How did Dr Berkeley know, or how can any one know, *anterior to experience*, that the path of generous self-denial is productive of a larger amount of happiness than that of self-indulgence? Here the Eudaimonistic theory of human actions seems wholly at fault. For either the happiness which virtue confers is cognised by the mind previous to the virtuous action, or it is not. If it is not, then all acts of virtuous self-denial are performed either without any motive at all,—a position which the mind refuses to admit,—or they are performed for some other reason than the pleasure attendant on virtuous conduct. If, on the other hand, there is an attendant acquaintance with this pleasure, for the sake of which alone good deeds, it is supposed, are done, this can arise only from the generous desire being felt previous to the pleasure which the anticipated gratification of it yields. In either case, it is certain that it is not from selfish motives that the virtuous deed is done.

In fine, as Dr Brown has observed, "even if virtue were as selfish as it is most strangely said to be, it would be necessary to form two divisions of selfish actions: *one*, of those selfish actions of which self was the direct object; and *another*, of those very different selfish actions in which the selfish gratification was sought in the good of others. He who submitted to poverty, to ignominy, to death, for the sake of one who had been his friend and benefactor, would be still a very different being, and ought surely, therefore, to be classed still *differently* from him who robbed his friend of the scanty relics of a fortune which his credulous benevolence had before divided with him, and, not content with this additional plunder, calumniated, perhaps, the very kindness which had snatched him from ruin. By what perversion of language," he justly asks, "is the same term to be given to affections so different?"[1]

(ii.) The theory which refers the rectitude of actions to their tendency to promote the general good is commonly known as, by way of eminence, the Utilitarian theory. Though not unknown to the ancients, it is in more recent times that this theory has found its principal expounders and advocates. The first formally to develop it was Bishop Cumberland, in his elaborate treatise, *De Legibus Naturæ*, written in reply to Hobbes. It was subsequently embraced by Puffendorf, and has more recently been advocated by Hume, Paley, and Bentham. In substance it is the theory which lies at the basis of the ethical system of Edwards; and it has been avowed and defended by one of Edwards's ablest followers, Dr Timothy Dwight. To these writers must be added Mandeville; for though he teaches that virtue and vice are determined by enactment, and the sense of them acquired by education, yet he asserts that rulers, in fixing what shall be called virtue and what vice, have been guided solely by a regard to utility, making those actions virtuous which benefit the community, and those vicious which injure it.[2] All these writers agree in maintaining that the *utility* of actions (that is, their fitness to promote the welfare of being in general, of society at large, or to the greatest possible extent of the greatest possible number) constitutes their rectitude, and that the feeling of benevolence, or the desire so to act as to promote this utility, is the principle of virtue in an agent.

Now, it may be conceded that, in a sense, utility is inseparable from virtue and rectitude. By the gracious arrangement of the Almighty, all right actions are really useful; and it is not to be denied that to will the good of others, and to labour for that, is in itself good and right. But after all this is conceded, it still remains to be asked, Is the utility of an action that which, *per se* and *solely*, constitutes that action right? Those who would answer this question in the affirmative urge the consideration that, in a comparative view of human actions, our preference is always given to those which are most advantageous to the race, and that, apart from the tendency of virtue to make men happy, there seems no reason why it should be preferred to vice. Now, it may be granted that, in estimating the worth of virtuous actions, men usually prefer those which are most advantageous; but in order to judge of the bearing of this fact on our present inquiry, it will be needful to view it under two conditions: *first*, that the criterion of preference shall be moral rectitude, and not expediency; and, *second*, that the criterion being moral rectitude, it shall be ascertained that it is the utility of actions on which the mind fixes as the ground of its preference. If these conditions be enforced, we believe it will be found, not that the actions are preferred because they are most useful, but that those preferred, as morally best, are also found to be most useful because of the established connection between rectitude and utility; so that this fact determines nothing conclusively in favour of the Utilitarian theory. With regard to the other argument adduced, though it is one on which Dwight lays great stress,—asserting that "were sin, in its own proper tendency, to produce invariably the same good which it is the tendency of virtue to produce, ... no reason is apparent to me why it should not become excellent, commendable, and rewardable, the same as virtue now is,"[3]—we cannot but regard it as a mere *petitio principii*. Of course, if virtue have no quality of its own to distinguish it essentially from vice, and if the only difference between the two lie in their tendencies, it is clear enough that the foundation of the former is to be sought in its tendency to utility; but all that is here assumed happens to involve the very point in dispute, and to be just what is required to be proved.

The fundamental objection to the theory of utility lies, we think, in this, that it proposes to find the basis of moral distinctions in what is not directly a moral quality at all. Utility is a physical and not a moral excellence. The test of this is furnished by the fact, that utility is not a quality which awakens in us moral approbation. It may excite admiration, delight, gratitude; but of itself it never awakens moral approbation. When a benefactor confers on us a favour, it is not the value of the favour that excites our

[1] *Lectures*, vol. iv., p. 69.

[2] Stewart has animadverted on the inconsistency of this with the doctrine with which Mandeville's name is chiefly associated, "that private vices are public benefits." The inconsistency is manifest, if Mandeville be regarded as meaning to inculcate that what benefits the public is, in any sense, or under any circumstances, a vice. But there is grave reason to doubt whether Mandeville ever taught, otherwise than hypothetically, the doctrine imputed to him. His reasoning is:—If national wealth be a benefit, and if certain vices promote it, then, on the basis of utility, these vices ought to be introduced as virtues. He himself solemnly declares that his entire treatise is ironical, and that he wrote it to refute the enemies of virtue, by subjecting their views to a *reductio ad absurdum*. See Whately's *Lectures on Political Economy*, Lect. ii.

[3] *System of Theology*, Serm. xcix.

Rectitude. moral approval; that is reserved for some quality in the benefactor, with which the utility to us of his donation has nothing to do: were it otherwise, we should regard the benevolent act which relieves a starving family with exactly the same emotion with which we regard the coins given by the benefactor for the purpose of his benevolence. But if utility be not a quality that excites in us moral approbation, then it must be fallacious to make it the basis of moral excellence; for this would be to affirm an entire discordance between moral truth and man's moral nature,—in other words, to deny the possibility of morality altogether. Then, moreover, utility is a quality which belongs to many objects which are irrational, and many which are inanimate, to none of which we ever think of ascribing moral excellence. A horse is useful, a cow is useful, a chair is useful, food is useful, and so of a multitude of other things; yet who ever thinks of ascribing to these objects the quality of rectitude or moral worth because of their utility? But if mere utility were the basis of rectitude, why should it be so? why should we refuse to ascribe moral excellence to an object which possesses in a high degree the quality which is the differential and constitutive element of moral excellence? If utility and virtue be equivalent terms, why should it seem preposterous to speak of a virtuous horse, or ridiculous to commend the moral excellence of a mahogany table? This objection, though urged by Dr Adam Smith, Dr Thomas Brown, and other eminent philosophers, is treated with great contempt by Dr Dwight. "This objection," says he, "it is hardly necessary to answer. Voluntary usefulness is the only virtue. A smatterer in philosophy knows that understanding and will are necessary to the existence of virtue. He who informs us that if virtue is founded on utility, animals, vegetables, and minerals, the sun, the moon, and the stars, must be virtuous, so far as they are useful, is either disposed to trifle with mankind for their amusement, or supposes them to be triflers."[1] This is sufficiently strong; but is it just? An action is pronounced morally good, and the question is asked, Why? To this the utilitarian answers, "Simply because its tendency is useful." "No," replies the objector, "for there are many things useful which we cannot call morally good." "Oh," says Dr Dwight, "that is a trifling objection, because when I speak of virtue I speak of what belongs only to voluntary agents." But is not this a giving up of the whole question? From this it appears that what constitutes virtue is not mere utility, but utility *plus* a voluntary and intelligent choice; and as the former element in this equation must, for the reasons above assigned, be eliminated, the latter remains as the only substantial basis of virtue. But virtue cannot be placed in mere choice; it can be found only in the *reasons* which have guided that choice. It follows, that in these reasons, whatever they may be, and not in the mere utility of the act, the element of its virtuousness must be sought.

We conclude, then, that it is not in the tendency of actions to promote either our own happiness or the welfare of others that the basis of virtue is to be sought. It is true that virtuous actions will promote both, and it is true that no higher or nobler end can be proposed by any man to himself, as an active being, than the promoting of the happiness and honour of universal being as far as he can. But still, as has been justly remarked, "it remains a question how far conduciveness even to these is what properly *constitutes* virtue or moral rectitude. Instead of its conduciveness to good constituting its essential nature, from its essential nature may arise its conduciveness to good. . . . The inquiry will remain, whether virtue is good *because it conduces to these ends*, or whether it does not necessarily conduce to these ends *because it is good;* in other words, whether the system, even in the loftiest and most enlarged view of it, goes far enough back; whether there be not ultimate principles of moral rectitude necessary and eternal, existing previously to all possible trial and manifestation of their tendencies; and whether the actual evolution of the goodness of these tendencies, commencing of course with the earliest date of creation, instead of being what essentially constitutes moral rectitude itself, ought not rather to be regarded as the native and appropriate result of the principles of rectitude."[2]

Rectitude.

We may conclude this discussion by citing the words of Cicero:—"Sive honestum solum bonum est, ut Stoicis placet, sive quod honestum est id ita summum bonum est, quemadmodum Peripateticis nostris videtur, ut omnia ex altera parte collocata, vix minimi momenti instar habeant: dubitandum non est quin nunquam possit utilitas cum honestate contendere. Itaque accepimus Socratem exsecrari solitum eos qui primum hæc, natura cohærentia, opinione distraxissent. Cui quidem ita sunt Stoici assensi ut quidquid honestum esset id utile esse censerent, nec utile quidquam quod non honestum."[3]

D. 1. This theory is identified with the name of Dr Samuel Clarke. It is stated by him as follows:—"That there are *different relations* of things one towards another is as certain as that there are different things in the world. That from these different relations of different things there necessarily arises an *agreement* or *disagreement* of some things to others, or a fitness or unfitness of the application of different things or different relations one to another, is likewise as certain as that there is any difference in the nature of things, or that differences do exist. Further, that there is a *fitness* or *suitableness* of certain *circumstances* to certain *persons*, and an *unsuitableness* of others founded in the nature of things, and in the qualifications of persons antecedent to *will*, and to all *arbitrary* or *positive appointment* whatsoever, must unavoidably be acknowledged by every one who will not affirm that it is equally fit and suitable, in the nature and reason of things, that an innocent being should be extremely and eternally miserable, as that it should be free from such misery. There is therefore such a thing as *fitness* and unfitness, eternally, necessarily, and unchangeably, in the nature and reason of things. Now, what these relations absolutely and necessarily *are* in themselves, that also they *appear to be* to the understanding of all intelligent beings, except those who understand things to be what they are not,—that is, whose understandings are either very imperfect or very much depraved. And by this understanding or knowledge of the natural and necessary relations of things, the *actions* likewise of all intelligent beings are constantly directed (*which, by the way, is the true ground and foundation of all morality*), unless their will be corrupted by particular interest or affection, or swayed by some unreasonable and prevailing lust."[4] Again, he says, "The true ground and foundation of all eternal moral obligations is this, that the same reasons (viz., the forementioned necessary and eternal different relations which different things bear to each other, and the consequent fitness or unfitness of the application of different things or different relations one to another, unavoidably arising from that difference of the things themselves),—these very same reasons, I say, which always and necessarily *do* determine the will of God, *ought* also constantly to determine the will of all subordinate intelligent beings."[5] According to these statements, it appears that Dr Clarke placed the basis of rectitude ultimately in "the reason and nature of things," out of which have arisen certain essential differences in objects and their relations, which again have given birth to certain fitnesses or unfit-

[1] Serm. xcix.
[2] Wardlaw, *Christian Ethics*, p. 107, ff., 3d ed.
[3] *De Officiis*, b. iii., § 3.
[4] *Demonstration of the Being and Attributes of God*, vol. i., p. 106, 10th ed.
[5] Same book, p. 115.

Rectitude. nesses in the application of one thing to another, an intelligent conformity to which constitutes morality.

In judging of this theory it is important to bear in mind in what sense the author speaks of "the fitnesses of things." The word "fitness" is ambiguous; it may express the adaptation of one thing to another, or it may express the accordance of things with some standard by which they are judged. If we say "this is fitted to produce such or such an effect," we convey a very different conception by the word "fitted" from what is conveyed by the word "fit," when we say "it is fit that such or such an effect should be produced." Now, it is in the latter of these senses that Dr Clarke uses the term "fitness" when he speaks of the "fitnesses of things;" he intends by this phrase, not the adaptation of things in general to each other, but the accordance of things with the standard produced by their essential differences of nature and relation; in other words, congruity, or accordance with their relations. Had Dr Brown and Sir James Mackintosh sufficiently adverted to this, they would have spared some of the severest strictures they have offered on this theory.[1]

It is further to be borne in mind, in justice to Dr Clarke, that in making morality consist in conformity to relations, he had not in view *all* relations, but only such as belong to the sphere of moral agency. It might be presumed that this was his reference from the nature of the subject he is discussing in the part of his book where this theory is developed—the Moral Perfection of God; and the well-known acuteness of the author might have preserved him from being supposed to maintain a theory which would have placed the constructing of a machine on strictly mathematical principles on a par, in point of moral rectitude, with the performance of an act of eminent piety or benevolence; nay, which would make the murdering of a man by a scientific regard to the relations of poison to the human system, as virtuous an act as the saving of a starving man's life by a due regard to the relations of food to the body. Dr Samuel Clarke was not quite the man to fall into a gross mistake of this sort; and had due attention been paid to his own words in the passage we have quoted, such a mistake would not have been imputed to him.[2] The fitnesses of which he speaks, as lying at the basis of morality, are the congruities of the actions of moral agents with the relations in which they have been placed by God—relations which he holds to be not accidental or arbitrary, but flowing out of the nature and reason of things. Here again his critics have done him grievous wrong.

When fairly viewed, the doctrine of Clarke is rather to be pronounced defective than condemned as erroneous. That it is true so far as it goes it seems impossible to deny. There can be no doubt that in the sphere of moral agency there are essential differences, out of which arise fixed and unalterable relations, and that there is a fitness or propriety of actions, and the contrary, thence resulting. The only questions which we think can be fairly mooted in reference to the validity of Clarke's theory are, *first*, whether it does not leave us with too vague and indefinite an answer to the inquiry, "On what is rectitude founded?" and *second*, whether the author has not stopped short of a thorough exploration of the subject? It must be admitted that the phrases "fitnesses of things," "eternal and immutable relations," and even the phrase "nature and reason of things," are somewhat deficient in precision and clearness; but even were these phrases more distinctly intelligible than they are, it would still remain to inquire, Why is it that moral distinctions arise out of the nature and reason of things? We may say, morality is conformity to the fitnesses of things, and the fitnesses of things arise out of the fixed and unalterable relations of things; and these relations result from the essential differences of things; but still the question comes up, To what are these essential differences due? By "things" we are of course to understand here all beings with which moral agents have to do. Now of these "things," all, excepting God himself, are the creatures of His will, and have received their nature from Him. Shall we say, then, that in giving them each its peculiar nature He acted arbitrariously? No, replies Clarke; God was under no necessity to create; but having resolved to create, He must make things "so that they shall be disposed according to the exactest and most unchangeable laws of eternal justice, goodness, and truth." But is not this virtually to admit that the laws of justice, goodness, and truth—in short, moral laws generally—exist *antecedently* to the constitution of things, and regulate and determine that? and if so, must not a basis of moral truth be sought deeper down than in these relations or the fitnesses to which they give rise?

D. 2. This theory is advanced by Wollaston in his *Religion of Nature*. "Those propositions," says he, "are true which express things as they are; or truth is the conformity of those words or signs by which things are expressed to the things themselves." "A true proposition may be denied, or things may be denied to be what they are, by deeds as well as by express words, or another proposition. Every act of such a being as is before described (a being capable of distinguishing, choosing, and acting for himself), and all those omissions which interfere with truth (*i.e.*, deny any proposition to be true which is true, or suppose anything not to be what it is in any regard), are morally evil in some degree or other; the forbearing of such acts, and the acting in opposition to such omissions, are morally good; and when anything may be either done or not done, equally without the violation of truth, that thing is indifferent."[3] This theory is substantially identical with that of Clarke; indeed, it is offered by the author as an improvement on that of Clarke, inasmuch as it affords a more precise and intelligible statement of the truth. What Clarke calls the fixed relations of things Wollaston calls the truth of things; and when Wollaston pronounces immorality to consist in acting so as to suppose anything not to be what it really is, he only reiterates Clarke's statement, that blame-

[1] See the acute and able reply of Dr Wardlaw to these strictures in his *Christian Ethics*, note E, 3d ed.

[2] To this may be added the following:—"That there is a fitness or suitableness of certain circumstances to certain persons, and an unsuitableness of others, founded on the nature of things, and the qualifications [qualities] of persons antecedent to all positive appointment whatever; also, that from the different relations of different persons one to another, there necessarily arises a fitness or unfitness of certain manners of behaviour of some persons towards others, is as manifest as that the properties which flow from the essences of different mathematical figures have different congruities or incongruities between themselves. . . . . For instance, that God is infinitely superior to man is as clear as infinity is larger than a point, or eternity longer than a moment. And 'tis as certainly fit that men should honour and worship, obey and imitate God, rather than, on the contrary, in all their actions endeavour to dishonour and disobey Him, as 'tis certainly true that they have an entire dependence on Him," &c. (Vol. ii., p. 30.) These sentences leave no doubt that it was only in respect of the relations of moral agents that Clarke meant to predicate moral fitnesses. This passage is so worded also, that it ought to have preserved him from the charge of confounding moral and mathematical relations. It is evident he does not confound them, but simply states an analogy between them in their respective provinces. This charge is the more unjust, in that Clarke himself guards against it by articulately stating, that he did not, in making such comparisons, overlook the difference, "that assent to a plain speculative truth is not in a man's power to withhold; but to act according to the plain right and reason of things, this he may, by the natural liberty of his will, forbear." (Vol. ii., p. 40.)

[3] *The Religion of Nature Delineated*, 7th ed., 8vo, pp. 5, 6, 29.

Rectitude. worthiness consists in acting as if "the proportions of things in morality were what they are not."[1] There is little ground, however, for Wollaston's boast that his modification of the theory is the superior of the two. His phraseology is even more vague and loose than that of Clarke. Taking his own definition of truth, and comparing that with his emphatic declaration, that he "would have it to be minded well" that when he speaks of acts inconsistent with truth, he means "any truth, any true proposition whatsoever, whether containing matter of speculation or plain fact," we may venture to say that no simply immoral act has ever been committed, or ever can be committed, inasmuch as any act is prompted by regard to some fact or other. It is only when couched in Clarke's more cautious phraseology that the doctrine ceases to be absurd.

D. 3. That virtue consists in living according to nature, was the doctrine of the ancient Stoics,[2] and in maintaining this doctrine they, by implication, placed the basis of morality in nature. In what sense this term is to be understood Cicero has explained: "When," says he, "we say that the world stands together and is administered by Nature, we mean thereby not such a thing as a clod or lump of stone, or anything of that sort, with no nature of cohering (*i.e.*, no force uniting the parts into one organic whole), but such a thing as a tree or an animal, in which there is no haphazard, but order is apparent, and a certain resemblance of art."[3] From this it appears that to live according to nature does not mean to live according to this or that special nature, but to live according to the organized and orderly system of the universe. And with this agrees what Diogenes Laertius says in his exposition of the stoical scheme of Ethics: "To live according to virtue," says he, "is equivalent to living according to the experience of those things that come to pass by nature, as Chrysiopus says in his first book concerning ends (περὶ τελῶν); for our natures are parts of universal nature. Wherefore the end comes to be to live consequent to nature, that is, according to man's own and that of the universe, doing nothing which the common law is wont to prohibit, that is the right reason (ὁ ὀρθὸς λόγος) which pervades all, the same being in Jove, the ruler of all things that are." And again, "Chrysippus understands by that nature, consequent to which we are to live, both the common nature and that peculiar to man. But Cleanthes accepts only the common nature as that which ought to be followed, not also that which is partial."[4]

Thus explained, the Stoical system is not essentially different from that of Clarke, who places the basis of rectitude in the nature of things; and the objection which applies to the one system applies with equal force to the other. Define nature as generally as we please, it still remains to inquire, Whence came this nature, and what determined its essence? *Natura* from *nascor*, φύσις from φύω, imply *birth*, *generation*, *production*; and consequently we can never rest in mere nature as an ultimate basis. And even if nature be taken in the sense of essence, we shall not much forward the research; for the essence of a creature must be just as much derived as its form. These speculations, therefore, though true so far as they go, are chiefly useful in pointing out to us the direction in which we must travel if we would find the solution they fail to supply.

D. 4. Butler, who adopts the Stoical phraseology, and who in one place distinctly states that "moral duties arise out of the nature of the case,"[5] and in another says that "vice is contrary to the nature and reason of things,"[6] protects himself against the objection above adduced against the system of Clarke and that of the Stoics, by the explanation he has given of the sense in which he understands "nature" in such phraseology. "The general course of nature," says he, "that is, not surely the words or ideas *course of nature*, but Him who appointed it, and put things into it; or a course of operation, from its uniformity or constancy, called natural, and which necessarily implies an operating agent."[7] This latter statement may be elucidated by a previous statement in the same treatise. "The only distinct meaning of that word [natural] is *stated, fixed*, or *settled*; since what is natural as much presupposes an intelligent agent to render it so, *i.e.*, to effect it continually or at stated times, as what is supernatural or miraculous does to effect it for once."[8] According to Butler, then, conformity to nature is conformity to God, from whom nature derived its constitution and order.

We are thus conducted to the theory which places the basis of rectitude in the nature of God. This theory must not be confounded with that which founds rectitude on the *will* of God. The will of God is His purpose, appointment, or edict; and although this must ever be in full accordance with His nature, it is no more to be identified with it than the purposes or commands of a man are to be identified with his nature. "We ought," says Price, "to distinguish between the *will* of God and His *nature*. It by no means follows, because certain things are independent of His will, that they are properly distinct from Him and independent of His nature." And he goes on to say, that to conceive that moral distinctions, being necessarily immutable and eternal, are independent of the Divine nature, "would involve us in the greatest absurdities and inconsistencies." "Wherever," he adds, "or in whatever objects *necessity* or *infinity* occur to our thoughts, the Divine eternal nature and perfections are to be acknowledged, to which nothing of this kind can be unallied."[9]

This theory contemplates the moral universe as constructed upon a plan; as not a happy accident, or a congeries of powers working now in convenience and now in contrariety, but as a *cosmos*, or well-ordered and beautifully composed system, in which each part and power is adjusted to the rest, and the whole is fitted to a great and worthy end. Now, such a plan involves principles, and these must have a basis. But where shall we search for the basis of principles that themselves lie at the foundations of the whole world? Where but in the eternal nature of Him by whom that whole has been conceived and constituted? It is so in the physical world. The outer universe is what it is because God is what He is. On the awful and eternal "I AM THAT I AM" the whole scheme and order of existence repose. The universe is the work of His hands; the plan of the universe is the utterance of His will; and the archeal principles which regulate that plan are resolvable only into the necessary perfections of His being. Now, as it is in the material, so is it in the moral world. There, too, all things are arranged in order and on plan. The relations sustained by intelligent beings to the sentient and intelligent universe, and the duties flowing out of these, are all fixed parts of the scheme under which such find themselves existing. To fulfil these relations, and to perform these duties, is the order of the moral world, and accordant with the plan on which it has been framed. But this plan

[1] Vol. ii., p. 40.

[2] Τὸ ὁμολογουμένως τῇ φύσει ζῆν. (Diog. Laert., b. vii., c. i., No. 53.) Comp. Cic. *De Fin.*, b. ii., c. xi.; b. iii., c. vi., ff.; Stobæus, *Ecl. Eth. Pl.* ii., frequently; Clement of Alexandria, *Stromat*, b. v., § 98 (p. 253 ed. of Sylburg).

[3] Nos cum dicimus natura constare administrarique mundum, non ita dicimus ut glebam aut fragmentum lapidis aut aliquid ejusmodi, nulla cohærendi natura, sed ut arborem, ut animal, in quibus nulla temeritas, sed ordo apparet et artis quædam similitudo. (*De Nat. Deor.*, b. ii., c. xxxii.)

[4] B. vii., c. i., No. 53.

[5] *Anal.*, pt. ii., c. i.

[6] Pref. to *Sermons*, p. vii.

[7] *Anal.*, pt i., c. ii.

[8] Same book, pt. i., c. i.

[9] *Review of the Principal Questions and Difficulties in Morals*, &c., p. 119.

Rectitude.

rests upon certain great moral principles or laws, and these again find their basis in the Divine nature. It is because God is such as He is that moral law is what it is, and that the moral world is constituted as it is. In the Divine essence, then, unchangeable and eternal, lies the foundation of rectitude—a foundation which, as it is perpetual and immutable, gives to moral distinctions that character of fixedness and perpetuity which all sound moralists have asserted as belonging to them.

This doctrine coalesces in the main with Plato's sublime speculations regarding ideas—the eternal, uncreated exemplars in the Divine mind, according to which all creature existence has been formed and all creature excellence determined. In one passage, indeed, he expressly calls God the idea or exemplar of the good:—"This, then, which furnishes truth by means of those things which are understood, and communicates to those who understand the power of doing so, say thou to be the idea of the good, and the cause of knowledge and truth as understood by the mind."[1] Cicero also, in one of the passages in which he refers to the unwritten law which is above all law, says, "Orta autem simul est cum mente divina, quamobrem lex vera atque princeps, apta ad jubendum et vetandum ratio est recta summi Jovis;" and still more tersely he says, a few lines further on, "Illa divina mens, summa lex est."[2] When writing these words he had probably before his mind the memorable dogma of Chrysippus the Stoic:—"No other beginning, no other genesis of righteousness, is to be found than that from Zeus and the common nature; for thence must everything of this sort have its beginning, if we propose to say aught about things good and bad."[3]

SECT. IV.—CRITERION OF RECTITUDE.

Having arrived at a conclusion as to the basis of moral truth, we have now to investigate the *standard* or *criterion* of rectitude; for, in the nature of the case, the basis lies hid from human view, and can no more become a guide to practice than the foundation of a house can become a fitting place of abode.

Now at first sight it may appear as if a simple and sufficient answer to this demand were furnished by that acknowledged quality of all right actions—their utility. If, it may be said, it be granted that all right actions are useful, it follows that we have only to inquire what courses are most for the well-being of ourselves and others, or of society, or of being at large, to be furnished with a safe and simple rule of moral conduct. But, though it may be conceded that in many cases this rule will suffice, and that in the ordinary business of life it is sometimes the only one we are able to apply, we must nevertheless demur to accepting it as adequate to the full exigencies of the case. For though it be true that all virtuous actions are useful, it unhappily does not follow that all actions which *appear* to us useful are virtuous; and as it is only by the appearance that man can judge in such matters, it is possible that a specious utility may often betray him into grievous wrong and lasting mischief. It were ill for us were there no surer and more perfect standard of rectitude than one subject to such accidents as this.

We must go somewhat deeper into the subject in order to find such a solution of the problem now before us as will abide the test. Happily the conclusion to which our previous speculations have conducted us, opens the way for such a solution.

If the ground and basis of rectitude be found in the Divine essence, it will follow that the character of God,—that is, the combined perfections of Deity as a manifested personality,—must form an absolutely perfect expression of moral excellence. God exists in the universe as He is in Himself; the outer manifestation is the efflux and interpreter of the inner glory. What we call his attributes are not qualities assumed by Him, or capable of being severed from Him or modified in Him; they are simply partial representations to our minds of that infinite and unchanging essence which we can never fully comprehend.[4] In the revealed character of God, then, must be found the highest standard of moral truth for all his intelligent creatures; and the supreme aim of all of them, who would excel in goodness, must be to imitate God, to act so as that their characters shall resemble his. Hence we are commanded in Scripture to be "imitators of God" (μιμηταὶ τοῦ Θεοῦ), and to be holy according to the pattern or example of God; and the consummation of our regenerated being is set forth as consisting in our being made perfect in his likeness, changed into his image.[5] Even Plato assures us that the only escape from the present evil state is by assimilating ourselves to God as much as may be—to God, who is absolutely and ever righteous, and whom none so much resembles as the man who becomes most righteous;[6] and he points us to heaven as the place where alone the perfect paradigm of a State can be sought by him who would see it, and seeing it would inhabit it.[7]

But the character of God can be apprehended by us only as it is manifested to us. No man can by searching find out God. To be known by His creatures, the Infinite and Eternal must reveal Himself to them. Now, God has so revealed Himself to us. All that He does within the sphere of the sensible universe is a revelation of Him; on all that comes from Him he stamps the impress of His name. Hence creation in all its parts,—the constitution and order of nature, and the course of events, as controlled and regulated by His providence,—all, so far as they lie within our ken, supply us with information respecting the character of God. But in addition to these the world possesses a revelation of God in which He has clothed the truth concerning Himself in written words; and this He has placed before us as the fullest, clearest, and most instructive source of intelligence we can resort to on this sublime and all-important theme.[8] From these sources may be gathered that supreme law, conformity to which is practical rectitude.

SECT. V.—HOW A KNOWLEDGE OF RECTITUDE IS ACQUIRED.

It may be asked, however, By what process does man, in point of fact, come to be acquainted with the intimations of these standards of moral decision? In reply to this, it may be said that it is by listening to the lessons of *experience*

[1] *De Repub.*, p. 508, E.; in Stallbaum's edition, vol. iii., pt. 2, p. 81.

[2] *De Legibus*, b. ii., c. iv., v.

[3] Οὐ γάρ ἐστιν εὑρεῖν τῆς δικαιοσύνης ἄλλην ἀρχήν, οὐδ' ἄλλην γένεσιν, ἢ τὴν ἐκ τοῦ Διός, καὶ τὴν ἐκ τῆς κοινῆς φύσεως· ἐντεῦθεν γὰρ δεῖ πᾶν τὸ τοιοῦτον τὴν ἀρχὴν ἔχειν, εἰ μέλλομέν τι ἐρεῖν περὶ ἀγαθῶν καὶ κακῶν. (Plutarch, *De Stoicor. Repugnantiis*, Works, vol. vi., p. 55.)

[4] "Attributa Divina in se ac per se considerata sunt realiter et simplicissime unum cum divina essentia." (Gerhard, *Loc. Theol.* ii., c. 7). "Sunt attributa [Dei] nihil aliud quam conceptus essentiæ divinæ inadæquati, ex parte rei ipsam essentiam involventes, eandemque intrinsece denominantes." (Quenstedt, *Theologia Didac. Polem.* i. 284.)

[5] Compare Eph. v. 1, 1 Pet. i. 15, 1 Cor. xv. 49, 2 Cor. iii. 18, 1 John iii. 2.

[6] *Theætet.*, p. 176, B. C.; in the edition of Stallbaum, vol. viii., pp. 170, 171.

[7] *De Repub.*, b. ix., p. 592, B.; in Stallbaum, vol. iii., pt. 2, p. 295.

[8] In this respect we may truly say of the Bible what Aristophanes says of some philosophical treatise much in vogue in his day:—

BIBΛΙΟΝ τ' ἔχων ἕκαστος μανθάνει τὰ δεξιά. (*Frogs*, l. 1079.)

and correcting and enlarging these by regard to the teachings of *tradition* and *Holy Scripture*, that a thorough moral discipline may be best pursued. Each man's own experience will teach him that he lives in a world of which rectitude is the law; for he cannot but perceive that whatever departures men may make from this, every such departure is contrary to the primary order of things, is felt to be blameworthy even by those who make it, and is usually followed by such consequences as show that it cannot be done with impunity. What personal experience thus teaches, intercourse with other men, whose experience is found to be the same, confirms; and the concurrent testimony of past ages embodied in tradition, at once strengthens his own convictions, and corrects the mistakes into which a too partial induction may have betrayed him. And, in fine, when he is privileged to have the Holy Scriptures, he finds in them a law written which is the counterpart of the law written in the order of nature and on his own heart, and which at the same time completes and corrects the moral beliefs which nature, conscience, and testimony, have already instilled into him.

SECT. VI.—WHENCE THE CONCEPT OF RIGHT.

There is still another question which may be asked at this stage: Assuming that the basis of rectitude is discovered by a process of reasoning, and that the decisions of the standard of rectitude are ascertained by the same process, to what do we owe the original concept of right? Is this a simple or a complex notion? and do we arrive at it by a process of reasoning, or is it given to us by an inner revelation? These questions belong rather to Psychology than to Ethics. We shall therefore content ourselves with simply saying, that we incline to the opinion of those who regard this as a simple concept, incapable of analysis, and found in the mind as inseparable from its constitution.

PART II.—OF VIRTUE.

SECT. I.—VIRTUE DEFINED.

Virtue in individuals may be viewed under a subjective and under an objective aspect.

1. Virtue, viewed subjectively, may be described in the general as the harmony of the active with the moral nature of man. Virtue presupposes an agent of whom alone it can be properly predicated; for though we sometimes ascribe virtue to actions, this is only by an impropriety of speech akin to such metonomies as "a *spirited* action," "a *manly* career," &c.: virtue properly belongs to an agent—"appellata est enim ex viro virtus," says Cicero;[1] and it is conditioned by this that the emotional or conative energies of the agent shall be in accordance with his moral nature. Viewed as a mental state, virtue is this internal harmony in itself; viewed as an attribute of character, virtue is the habit of living to which this harmony leads, and by which it is exemplified.

OBS. Aristotle lays emphasis on the position that virtue is exclusively a ἕξις or *habit*, and cannot be ranked as either one of the capabilities (δυνάμεις) or one of the passions (πάθη) of our nature. By the former of these Aristotle means that part of our natural constitution by which we are capable of certain emotions; and by the latter he means the emotions themselves. Now, for neither of these in themselves, he argues, are we pronounced virtuous, but only for the due and proper exercise of them. But this presumes a deliberative choice, by which we regulate the indulgence of our desires and emotions, and by consequence our actions. Virtue, therefore, he defines to be ἕξις προαιρετικὴ, a habit predetermined or fore-chosen, the object of which is our affections and actions. When, consequently, man chooses as he ought, *i.e.*, in accordance with his moral nature, virtue is the result.[2]

Plutarch teaches the same doctrine,—"Moral character (ἦθος) is the quality of the impulsive part of our nature;[3] and it is so called because this quality, and the difference (=this differential quality), the impulsive part of our nature receives by custom (ἔθει); being moulded by the reason, which does not seek wholly to obliterate the passion (a thing neither possible nor desirable), but prescribes a certain limit and order to it, and effects the ethical virtues; these being not passionless, but the due measures and means (μεσότητας) of the passions. Now it effects these by constituting, through prudence, the susceptibility of the pathetic (or emotional) in our nature into a gracious habit (ἕξιν ἀστείαν): for they say there are three things appertaining to the soul—capability, passion, habit; of which *capability* is the beginning and material of passion—as, for instance, capability of anger, of shame, or of bravery; *passion* is the moving of the capability,—as anger, shame, bravery; and *habit* is the strength and structure of the impulsive capability, produced by custom, and which is vice or virtue according as the passion is ill or well tutored by reason."[4] To the same effect, in another of his writings, he speaks of virtue as "that best and most divine habit in us which we cognise as the rectitude of reason, the summit of the rational nature, and the acknowledged congruity of the soul."[5]

"Est virtus," says Cicero, "nihil aliud quam in se perfecta et ad summum perducta natura."[6] "Quando virtus est affectio animi constans conveniensque ex ea proficiscuntur honestæ voluntates, sententiæ, actiones, omnisque recta ratio; quamquam ipsa virtus brevissime recta ratio dici potest."[7]

2. The active nature of man comprises his various appetites, desires, and passions. These have been denominated his *active* powers, because it is by them that he is impelled to action; but it would be better to term them conative energies: *energies*, because they are all mental forces,[8] and conative, because what is common to them all is the *conation*, or effort to reach their object. Each of these has its own proper object, on which it terminates, and which it strives to attain; and though this striving may not always result in action, no action takes place without it. A mere perception, conception, or conviction, will never lead to action except as it awakens some appetite, desire, or passion.

3. The moral nature of man is summed up in the word *conscience*. Moral nature and conscience are two names of the same thing. The analysis of conscience, therefore, will unfold man's moral nature.

4. Conscience is a term describing a complex state of mind, which may be resolved into the following elements:

[1] *Tusc. Quæst.*, b. ii., c. 18. The Greek word ἀρετὴ, from ἄρω, has a wider signification; it expresses the idea of *fitness*, *ability*, and hence is used of inanimate objects as well as of men. The German *tugend*, from *taugen*, *tügen*, exactly corresponds to the Greek; tugend=tauglichkeit, =fitness, ability. The Latin *virtus* has its etymological cognate in the Gothic *wairths*, the German *werth*, and the English *worth*.

[2] See *Nicom. Eth.*, b. ii., c. iv. and vi.

[3] ποιότης τοῦ ἀλόγου. In what sense ποιότης is to be taken here, the following explanation of Aristotle's third category will show:—"ποιὸν = adjectivum quo quale quid sit significatur." (Trendelenburg, *Elementa Logices Aristotel.*, p. 53.) What Plutarch intends by τὸ ἄλογον will be best gathered from his own writings. Take the following instances:—εἰς τὸ ἄλογον καὶ φυσικὸν τῆς ψυχῆς. (*Symposiac.* 706, F.) τὸ δὲ ἄλογον καὶ παθητικὸν (τῆς ψυχῆς.) (*De Amic. et Adulter.* 61, D.) See Paris ed. of Stephen's *Thesaurus*, under ἄλογος.

[4] *De Virtute Morali*, c. iv., p. 211, of vol. iii. of the Tauchnitz ed. of his Moral Works.

[5] *De Audiend. Poetis*, c. vi., Mor. Works, vol. i., p. 56.

[6] *De Legibus*, b. i., c. viii.

[7] *Tusc. Quæst.*, b. iv., c. xv.

[8] "Occulta vis dicitur ἐνέργεια velut in semine, et *vis mentis in homine*." (Erasmus on Rom. vii. 5.) In illustration of this may be cited Alexander the Aphrodisian, who, in reference to conception, says, "ἀνέρχεται κατὰ τὰς αἰσθήσεις ἐνεργῶν φαντασίας λαμβάνει." (*De Animo*, b. i.)

Virtue.

(i.) A sense of the difference between right and wrong. Whence this arises it does not fall upon us here to inquire. It is sufficient that we signalize the fact that such a sense is common to men.

(ii.) A feeling of approval for what is right, and disapproval for what is wrong. This is a natural emotion implanted in us as part of our psychical constitution; and, like all our natural emotions, it is called into action immediately and directly on the presentation of its proper object. We commend what appears to us right, and we turn with censure from what appears to us wrong; just as we are drawn towards a beautiful object, or are repelled by one that is ugly; or as an object that pleases our palate is desired by us, while one that creates nausea is avoided. It is not implied in this that an action *is* right because it excites in those who witness it a feeling of approbation,—a doctrine which we have already sought to confute; on the contrary, we maintain that the existence of this feeling in the mind presupposes a perception or sense of the rectitude of the action, and thus implicitly assumes a standard and basis of rectitude distinct from and anterior to the emotion. Of the reality and speciality of the emotion itself every one may judge who will consider for a moment the difference between the feelings with which he regards the successful prosecution of a piece of reasoning, and the feelings that spring up within him when he contemplates a generous or righteous course of conduct: the former are those of admiration and assent yielded to the intellectual vigour or logical exactness of the reasoning; the latter are those of moral approbation called forth by the moral excellence—the rectitude and goodness of the action. It is this which the older writers had in view when they spoke of "the beauty of virtue," of "the symmetry of virtue," of "moral beauty," and such like expressions; they intended thereby to convey the idea that virtuous actions are such as excite in the mind feelings of complacency and commendation analogous to those which objects of physical beauty awaken. "Of those things," says Cicero, "which are perceived by sight, no other animal [but man] perceives the beauty, the grace, the accordance of parts; and nature and reason, transferring this analogy from the eyes to the mind, judge that much more are beauty, harmony, and order to be preserved in counsels and deeds, and guard against aught being done unbecomingly or feebly; moreover, in all opinions and acts, against aught being done or thought lustfully. Whence is collected and formed that which we seek, the proper (*honestum*); which, even though it be not celebrated, is still the proper, and of which we may truly say that even though lauded by no one it is laudable by nature."[1] "The mind," says Shaftesbury, "which is spectator or auditor of other minds, cannot be without its eye and ear; so far as to discern proportion, distinguish sound, and scan each sentiment or thought which comes before it. It can let nothing escape its censure. It feels the soft and harsh, the agreeable and disagreeable, in the affections; and finds a foul and fair, a harmonious and a dissonant, as really and truly here as in any musical numbers, or in the outward forms and representations of sensible things. Nor can it withhold its admiration and ecstacy, its aversion and scorn, any more in what relates to one than to the other of these subjects; so that to deny the common and natural sense of a sublime and beautiful in things will appear an affectation merely to any one who considers duly of this affair."[2] To these quotations may be added the following from one of the least fanciful of thinkers—Edwards:—"Virtue is the beauty of those qualities and acts of the mind that are of a moral nature, *i.e.*, such as are attended with desert, or worthiness of praise or blame. Things of this sort, it is generally agreed, so far as I know, do not belong merely to speculation, but to the *disposition* and *will*; or (to use a general word, I suppose commonly well understood) to the *heart*. Therefore I suppose I shall not depart from the common opinion when I say that virtue is the beauty of the qualities and exercises of the heart, or those actions that proceed from them."[3]

(iii.) By this adaptation of our nature to be affected with complacency on the recognition of virtue, and with the opposite on the perception of vice, we are led to approve or blame ourselves according as we act virtuously or viciously, or rather according as *we believe* ourselves so to act, for it is our judgment of the moral qualities of actions, and not these moral qualities themselves, by which our feelings are determined. In this commendation or censure, however, does not consist the *whole* of what we feel in such cases. Besides the perception of the moral character of the act, there is also a sense of *responsibility* attaching to man as a moral agent; and besides the moral approbation or disapprobation which actions excite, there is an ascription of *merit* or *demerit* to the agent according as his actions appear to us good or bad. Responsibility or answerableness has respect to our being under government; it implies that we are subject to laws, and that if we transgress these laws a certain penalty shall be incurred by us; and as connected with moral conduct, it has respect to our being under the moral government of God, and amenable to his justice for the manner in which we act. Under the influence of this conviction we come to regard ourselves not only as objects of moral approval, or the opposite, but as having attached to us the quality of good or of ill desert. When we review our conduct, we feel constrained to believe either that we are able to meet the scrutiny of our moral governor, or that we are deserving of punishment because of our transgressions of his law. In the latter case, the painful emotions we experience may be so violent as to constitute that sense of remorse which is itself one of the severest punishments of guilt.

In the operations of conscience this last element is the one which comes most distinctly into consciousness. The sense of responsibility, and of consequent good or ill desert, is inseparable from the human mind; and though means may be used by the guilty to blunt or quiet it, these avail only for the time, and the painful consciousness seeks its opportunity of returning with augmented pungency. The lessons which are constantly read to us by the phenomena of event around us, as to the retribution which, even in this world, treads upon the heels of sin, are of themselves sufficient to quicken and sustain this sense within us. As in the physical world we cannot violate or neglect law without suffering for it, so we find in the moral world that an analogous arrangement obtains. There is perhaps no man who has not had many painful illustrations of this in his own experience, as well as in what he has observed of the history of others. Hence a universal conviction pervades the race that a man's sin "will find him out"—that however he may conceal it from his fellow-men so as to escape their censure or punishment, there is an Intelligence he cannot evade, a retributory Power he cannot escape; and that of all sin, however pleasant it may seem in the commission, it may be said that at the last "it biteth like a serpent and stingeth like an adder."[4] The impassioned utterance which the tragic poet has put into the mouth of one of his characters, expresses what the deepest convictions of the race respond to:—

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[1] *De Officiis*, b. i., c. iv.

[2] *Characteristics*, vol. ii., p. 29.

[3] *Dissert. concerning the Nature of True Virtue*, c. i.

[4] Prov. xxiii. 32.

Virtue.

Ζεῦ, Ζεῦ κάτωθεν
ἀμπέμπων ὑστερόποινον
ἄταν βροτῶν τλάμονι καὶ πανούργῳ
χειρί.[1]

In consequence of the predominance of this element in the operations of conscience, some writers have contended that this *is* conscience, and so have identified the latter with the emotion of remorse. On the other hand, some, arguing that this emotion is a mere consequent on the judgment pronounced by man on the rectitude or wrongness of his own conduct, have resolved the act of conscience wholly into the judgment so pronounced, thereby identifying conscience with the purely intellectual faculty of judging. The truth, however, seems to be, that neither by itself completes the analysis of this complex state of mind. The emotion presupposes the judgment, and the judgment is followed or attended by the emotion; and both together constitute the main elements of conscience. With this accords the common popular usage of the term. We speak of a man's having a good conscience or a bad conscience, meaning thereby that, on looking back over his past conduct, he finds occasion either for self-commendation or self-blame, and either hopes for reward or dreads punishment, according as his conduct has been in conformity with, or opposed to, the standard of rectitude.

5. Now, according to the constitution of our nature, this moral faculty or conscience is the supremely-regulative power within us, and ought to control all the conative energies of our nature. When this takes place there is harmony between these two departments, and the consequence is a state of subjective virtue within the man; the entire system acknowledges and obeys its master-power, a just equipoise is preserved in all parts, and the whole moves easily and in order. On the contrary, when the appetites, emotions, and passions escape from this their proper control, there is a schism in the soul, order and propriety are disturbed, and vicious courses and habits usurp predominance in the life. It is possible, indeed, for the conflict between conscience and passion to become imperceptible, conscience being gradually suppressed and benumbed until it shall ultimately become wholly dormant, or, in the striking language of Scripture, "seared as with a red-hot iron;" but until this terrible consummation of depravity is reached, the conflict between the lower and higher powers of man's nature continues, and the schism within is perpetuated. Berkeley has graphically delineated the course of such an one in describing the English rake. "He is (as Aristotle expresseth it) at variance with himself. He is neither brute enough to enjoy his appetites, nor man enough to govern them. He knows and feels that what he pursues is not his true good; his reflection serving only to show him that misery which his habitual sloth and indolence will not suffer him to remedy. At length, being grown odious to himself, and abhorring his own company, he runs into every idle assembly, not from hopes of pleasure, but merely to respite the pain of his own mind. Listless and uneasy at the present, he hath no delight in reflecting on what is past, or in the prospect of anything to come. This man of pleasure, when, after a wretched scene of vanity and woe, his animal nature is worn to the stumps, wishes and dreads death by turns, and is sick of living without having ever tried or known the true life of man."[2]

Virtue.

6. Virtue, viewed objectively, is the accordance of the moral nature with the standard of rectitude. It has been already observed that we approve our conduct according as we believe ourselves to act rightly. But this belief may be founded on an erroneous estimate of what is right; and therefore, though there may be a state of subjective harmony in consequence of this belief, the man nevertheless cannot be pronounced virtuous in the full sense of the term. A truly virtuous man is one who not only walks according to conscience, but whose conscience is guided in its decisions and impulses by the dictates of the "perfect law."[3]

SECT. II.—CONDITIONS OF VIRTUE.

Aristotle has, with his usual pregnant brevity, set forth the conditions of virtue thus: "In reference to virtues, it is not enough that a thing be anyhow done so as to be justly or wisely done,—it is necessary also that the agent be in a certain way affected; *first*, he must have knowledge; *second*, he must choose, and choose for the thing's own sake; and, *third*, he must act with firm and inflexible purpose."[4] In this passage he specifies as the conditions of virtue,—1. Knowledge; 2. Freedom of choice; 3. Choice determined by regard to virtue itself; and, 4. Stedfastness and firmness of resolution. Of these the last may be discounted as being accidental rather than essential. There remain,—

1. *Knowledge.*—This includes both the capacity of moral judging and acquaintance with the standard of rectitude. Both are essential conditions of all virtuous action. A man might stumble into the path of rectitude without either; but without the former he would be incapable of understanding what rectitude is; and without the latter he would have no sure means of ascertaining whether the path he was in was that of rectitude or not. Virtue is reached only when the agent is capable of apprehending moral distinctions, and determining the rectitude of actions by a just standard.

2. *Liberty of Choice.*—This implies that the agent is free to choose such paths as seem best to him, and that he exercises this freedom. It is no part of our present object to attempt to solve the metaphysical difficulties which surround the question of the freedom of the human will; all that it concerns us here to do is to assert the fact that man is a free agent; and to maintain that without the exercise of this freedom there is no such thing as virtue or its opposite. Let a man do the best deeds in the world or the worst, by accident or under physical constraint, and all will feel that neither praise in the one case, nor blame in the other, can be justly attached to him. It is the *choosing* to do the one or the other which constitutes the *conditio sine qua non* of virtue or vice.[5]

OBS.—"Now, since the end is the object of will, and since things having respect to the end are willed and chosen, it follows, that actions relating to these must be by choice, and voluntary; but the energies of the virtues are relating to these; hence virtue is in our power, and so is vice. For in respect of these it is in our power to act; it is also in our power not to act. . . . . Some say that 'no man is willingly bad or unwillingly happy.' The former position is false, the latter true. No one is unwillingly happy, but wickedness is with the will. Else all we have above said must be repudiated; and it must be denied that man is a source (ἀρχὴν) and parent of actions as he is of children. If, however, this be ad-

[1] *Æsch. Choeph.*, 363-6.

"O Jove, O Jove, that sendest from below
The retribution slow,
Against the stout heart and bold hand
That dared defy thy high command." (Blackie's Translation.)

[2] *Alciphron, or the Minute Philosopher*, dial. ii., § 17.

[3] Compare Aristot. *Nic. Eth.*, b. ii., c. iii. [vi.]

[4] Τὰ δὲ κατὰ τὰς ἀρετὰς γινόμενα, οὐκ ἐὰν αὐτά πως ἔχῃ δικαίως ἢ σωφρόνως πράττεται, ἀλλὰ καὶ ἐὰν ὁ πράττων, πῶς ἔχων πράττῃ πρῶτον μὲν, ἐὰν εἰδώς· ἔπειτ' ἐὰν προαιρούμενος, καὶ προαιρούμενος δι' αὐτά· τὸ δὲ τρίτον καὶ ἐὰν βεβαίως καὶ ἀμετακινήτως ἔχων πράττῃ. (*Nic. Eth.*, b. ii., c. ii. [iv.], § 3.)

[5] See Chalmers's *Moral Philos.*, p. 166, Works, vol. v.

Virtue.

mitted, and we have not to refer to other sources than those in our power, it follows that the things of which the sources are in us are also in our power, and objects of volition. To this both the private conduct of individuals and the conduct of legislators bear witness, for they punish and chastise those who do evil, provided they have not done it by force or through ignorance, of which they were not themselves the cause; whilst they reward those who do good. This they do with a view to stimulate the latter, and to deter the former; but no one is stimulated to what is not in our own power, or an object of volition. Thus, nothing would be more absurd than to persuade men not to be warm, or to grieve, or to be hungry, or such like, for not the less should we endure these." (Aristotle, *Nic. Eth.*, b. iii., c. iv. [vii.]).

"Voluntas igitur nostra nec voluntas esset, nisi esset in nostra potestate. Porro quia est in potestate, libera est nobis. Non enim est nobis liberum quod in potestate non habemus, aut potest non esse quod habemus, nec voluntas esse potest si in potestate non est." (Augustine, *De Libero Arbitrio*, b. ii., c. 3.) "Semper est in nobis voluntas libera, sed non semper est bona." (The same, *De Gratia et Lib. Arb.*, c. 15.)

3. *Choice of the right for its own sake.*—The choice is determined by motives—a motive being, as the Greeks called it, τὸ ἕνεκα οὗ—*that on account of which* anything is chosen. Now one may choose the right from various motives. It may be chosen because it is the more convenient, or because it is the more agreeable, or because it is the more profitable course; or simply because it is the right course. It is only in the last of these cases that virtue can be predicated of the individual. It is not what is done that measures the virtue of the doer, but the *intention* with which it is done; "non quid fiat, aut quid detur, refert, sed qua mente."[1] Good actions done, therefore, without a distinct purpose to do good, are destitute of the quality by which alone they could reflect merit on the agent, or entitle him to be called virtuous.

SECT. III.—PRINCIPLE OF VIRTUE.

But if men can be virtuous only by acting with an intention to be so, they must live under the constant influence of an active principle of virtue operating within them. We have therefore to inquire what this principle is.

We may pass over such answers to this inquiry as those which make the love of pleasure, the desire of praise, or the sense of honour, the principle of virtuous action.[2] We shall notice—

1. That which places the principle of virtue in *benevolence* or *love to being in general.* This opinion has been ably advocated by the eminent American theologian and metaphysician Jonathan Edwards. According to him, "true virtue most essentially consists in benevolence to being in general; or, perhaps, to speak more accurately, it is that consent, propensity, and union of heart to being in general that is immediately exercised in a general good-will;" and in another place, he says, "That temper or disposition of heart, that consent, union, or propensity of mind to being in general, is virtue truly so called; or, in other words, true grace or real holiness. And no other disposition or affection but this is of the nature of true virtue."[3] This benevolence to being in general—which the author distinctly and consistently states to be irrespective of moral character, for it "does not necessarily presuppose beauty in its object," and so has nothing of the nature of complacency in it—does not exclude particular affections; on the contrary, whilst it inclines to the highest general good, it inclines also "to each being whose welfare is consistent with the highest general good, in proportion to the *degree* of existence, other things being equal." The degree of existence,—that is, as defined by the author, "the having every faculty and every positive quality in a higher [or lower] degree,"[4]—furnishes the *primary* ground of benevolence; a *secondary* is supplied by the existence of "virtuous benevolence itself in its object," and in this case esteem, complacency, and good-will, arise in the mind towards the being. It follows from this, that virtuous benevolence being determined in its degree, primarily, by the degree of existence in its object, and, secondarily, by the moral excellence of its object, virtue must consist in supreme love to God—who, on both grounds, infinitely surpasses all other beings—and in love to his creatures, according to the degree of existence and the moral excellence of each.

Virtue.

Of the most serious objections to which this theory is exposed, a condensed statement has been presented in such clear and felicitous language by the Rev. Robert Hall, that we cannot do better than extract the passage:—"1. Virtue, on these principles, is an utter impossibility: for the system of being, comprehending the great Supreme, is infinite; and, therefore, to maintain the proper proportion, the force of particular attachment must be infinitely less than the passion for the general good; but the limits of the human mind are not capable of any emotion so infinitely different *in degree.* 2. Since our views of the extent of the universe are capable of perpetual enlargement, admitting the sum of existence is ever the same, we must return back at each step, to diminish the strength of particular affections, or they will become disproportionate; and consequently, on these principles, vicious; so that the balance must be continually fluctuating, by the weights being taken out of one scale and put into the other. 3. If virtue consist exclusively in love to being in general, or attachment to the general good, the particular affections are, to every purpose of virtue, useless, and even pernicious; for their immediate, nay, their necessary tendency is to attract to their objects a proportion of attention which far exceeds their comparative value in the general scale. To allege that the general good is promoted by them, will be of no advantage to the defence of this system, but the contrary, by confessing that a greater sum of happiness is attained by a deviation from than by an adherence to its principles; unless its advocates mean by the love of being in general the same thing as the private affections, which is to confound all the distinctions of language, as well as all the operations of mind. Let it be remembered, we have no dispute respecting what is the ultimate end of virtue, which is allowed on both sides to be the greatest sum of happiness in the universe. The question is merely, What is virtue itself? or, in other words, What are the means appointed for the attainment of that end?"[5]

It may be added to these admirable strictures that the system of Edwards virtually abrogates the moral sentiments in man, by leaving no place for complacency in what is morally good and lovely. For what is his secondary ground of virtuous benevolence, on which alone he professes to find space for a love of complacency? It is the perception of "virtuous benevolence itself in its object." This, according to him, is "the beauty of the being in whom it is," and it is the seeing of this alone which awakens esteem or complacency towards that being. But wherein does this essentially differ from benevolence to being in general, which, according to Edwards, has no respect to character? If the only thing which awakens complacence be the perception in another of benevolence to being in general, what is the object of that complacence but this benevolence? Edwards himself admits that it is. "Loving a being on this ground," he says, "necessarily arises from pure benevolence to being in general, and comes to the same thing." But if so, the only thing in which we have complacence,

[1] Seneca, *De Beneficiis*, b. i., c. vi.
[2] See the strictures on these opinions in Berkeley's *Minute Philosopher*, dial. 1–3.
[3] *Dissertation*, c. i.
[4] *Diss.*, c. vii., note.
[5] *Modern Infidelity Considered*, Works, vol. i., p. 58, 8vo ed.

morally speaking, is a thing totally irrespective of moral character. In this case what place is left for the moral sentiments? or what is approbation of goodness but merely a modified form of a feeling which has nothing to do with goodness?[1]

2. Closely allied with Edwards's theory is that which resolves all virtue into love to God. This theory is as old as Augustine, who has in many parts of his writings dwelt upon this theme. From some scores of passages which might be cited we select the following, because of its fulness:—"Now, if virtue lead us to the blessed life, I would affirm that virtue is nothing else than supreme love of God. For, so far as I perceive, that which is called the four-fold virtue is named from the varying affection of love. Hence I should not hesitate to define those four virtues—of which I would that the power were as much in the minds as the names are in the mouths of men!—in such a way as that *temperance* should be love proffering itself entire to the object loved; *fortitude*, love easily enduring all things for the sake of the object loved; *justice*, love serving only the object loved, and therefore rightly ruling; *prudence*, love selecting wisely those things by which it may be aided from those by which it may be hindered. But this love we have said is not of any one, but only of God; that is, the chief good, the chief wisdom, the chief concord."[2] There is no great difference between this and what Edwards states when he says, "He that has true virtue . . . . must necessarily have a supreme love to God both of benevolence and complacence. And all true virtue must radically and essentially, and as it were summarily, consist in this. Because God is not only infinitely greater and more excellent than all other beings, but He is the head of the universal system of existence; the foundation and fountain of all being and all beauty; from whom all is perfectly derived, and on whom all is most absolutely and perfectly dependent; and of whom and through whom and to whom is all being and all perfection; and whose being and beauty are, as it were, the sum and comprehension of all existence and excellence, much more than the sun is the fountain and summary comprehension of all the light and brightness of the day."[3]

In proceeding to remark upon this theory it may be necessary to premise, that no question is here raised as to the supreme moral excellence of love to God, as to the obligation resting on all his intelligent creatures to love Him supremely, or as to the nullity of all virtue which does not include love to God as its crowning and controlling element. Our only question is, Does this constitute *all* virtue? Is there no moral excellence but what is immediately resolvable into love to God?

And here it occurs first of all to ask, What, on this theory, constitutes the moral excellence of God himself? There are some who would not scruple to answer, "His love of Himself;" and, rightly understood, the answer is unimpeachable; for the highest conception we can form of God is that of a being who finds in his own perfections the object of his eternal and unmixed delight, and all whose manifestations and workings are for his own glory. But it may be questioned whether this is properly called *love to God*. Is it not rather God's delight in moral goodness, which has its fountain-spring in his own eternal essence, and is enstamped on everything that He calls into being?

Descending to man, it is obvious to remark that, as used of him, "Love to God" is a phrase of ambiguous meaning. It may mean one of three things,—delight in God's holy character,—gratitude to God for his goodness,—and a desire for the Divine honour, or a rejoicing in the Divine felicity. Now, in which of these senses is the phrase used when it is said that all human virtue consists in love to God? If we take it in the last of the three, the theory coincides with that of Edwards, for love to God in this case is just benevolence directed towards Him as the greatest of beings, without respect to his goodness. if we take it in the second of the three, the theory resolves itself into the assertion, that all virtue consists in gratitude to God for blessings received; and if we take it in the first of the three, the theory is equivalent to that which affirms virtue to consist in the love of goodness for its own sake. Of these theories the first two must be rejected as inadequate, for there are surely many virtues which cannot be resolved into either a desire for the Divine felicity and glory or a feeling of gratitude to God for his goodness; indeed, to go no farther, neither of these will resolve into the other, and yet both are virtues demanded of man. The last of these theories we hold to be the true one; but we object to designating it by the phraseology now under consideration.

3. There is a theory which, borrowing from Edwards the latter part of his doctrine, resolves all virtue into general benevolence, or benevolence to the race at large. Of this theory it is part to depreciate the domestic affections, or particular affections of any kind, and to teach that the truly virtuous man is one who cultivates a cosmopolitan benevolence, and merges all claims upon his love in one common sentiment of universal philanthropy. On this theory it may suffice to observe, briefly—(1.) That it is essentially *atheistical*, inasmuch as in the scheme of moral duties to which a virtuous man is bound, it finds no place for those he owes to God; the existence of God is ignored, and a phantom god, in the shape of humanity or the race, put in his stead. (2.) This theory is opposed by the testimony of consciousness, which tells that we *have* particular affections, that these are called into constant action within us, and that in no case do they arise from any consideration of the general weal, but are awakened each by its own special object in consequence of certain relations existing between us and it. (3.) This theory impeaches the wisdom of that part of our constitution which provides for our affections being strongest when they are confined within the narrowest limits, whilst they become weak in proportion as we widen the circle and attempt to embrace within our regards the millions of the race. (4.) This theory reverses the order in which all experience teaches us that the benevolent affections are cultivated within our bosoms; for it is not by a descending process from the position of general philanthropy to the several spheres of patriotic, social, amical, and domestic affection, that we learn to love our fellow-men, but by a process the reverse of this—a process begun in the

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[1] See some additional strictures on this theory in Dr Wardlaw's *Christian Ethics*, Lect. ix., and in Sir James Mackintosh's *Dissertation*. To the following remarks of the latter of these writers, however, we must demur:—"The justness of the compound proportion on which human virtue is made to depend is capable of being tried by an easy test. If we suppose the greatest of evil spirits to have a hundred times the bad passions of Marcus Aurelius, and at the same time a hundred times his faculties, or, in Edwards' language, a hundred times his quantity of being, it follows from this moral theory that we ought to esteem and love the devil exactly in the same degree as we esteem and love Marcus Aurelius." Now, to this an Edwardsian might reply, that it is doubly wrong,—1*st*, by not observing that mere quantity of being cannot excite *esteem*,—that being called forth only by *benevolent* being; and 2*dly*, by overlooking Edwards' qualifying clause, when, speaking of degrees of existence, he includes among the objects of pure benevolence *only* those "whose welfare is consistent with the highest general good." As the devil's wickedness excludes him from the secondary ground of benevolence, this qualifying condition excludes him from the primary. Let the "quantity of his being" be what it may, he can never be the object of benevolent love, any more than of complacent love, on Edwards' principles.

[2] *De Moribus Ecclesiæ*, b. i., c. xv.; compare also c. xxii., c. xxiv., and c. xxv. See also his *Epist. 52 ad Macedonium*.

[3] *Diss.*, c. ii.

cradle, when the infant first responds to the tenderness of maternal endearment, and carried on through the successive stages of domestic and social life, until in favourable natures it at last reaches a universal philanthropy, which loves man as man, and yet reserves its fullest and tenderest affections for those to whom God and Nature have given the earliest and strongest claim. *In fine*, this theory is suicidal; for, by placing all virtue in universal benevolence, it secures that there shall be no benevolence at all. "When this savage philosophy," says Hall, "has completed its work,—when it has taught its disciple to look with perfect indifference on the offspring of his body and the wife of his bosom, to estrange himself from his friends, insult his benefactors, and silence the pleadings of gratitude and pity,—will he, by thus divesting himself of all that is human, be better prepared for the disinterested love of his species? Will he become a philanthropist only because he has ceased to be a man? Rather in this total exemption from all the feelings which humanize and soften,—in this chilling frost of universal indifference,—may we not be certain that selfishness, unmingled and uncontrolled, will assume the empire of his heart; and that under pretence of advancing the general good, an object to which the fancy may give innumerable shapes, he will be prepared for the violation of every duty and the perpetration of every crime?"[1]

4. We have already indicated the theory to which we incline in reference to the present object of inquiry. The principle of virtue we take to be *love of rectitude and moral goodness for its own sake*—a love which partakes of the nature of reverence, and which acts upon the mind with a force that constrains to virtue. This love of goodness is, in the Divine Being, the moral perfection of his person,—the δικαιοσύνη τοῦ θεοῦ,—the perfect becomingness of God, whereby "He conforms Himself to his essence, and carries Himself so fitly to Himself, that no spot, no darkness, no shadow of turning, no indecency or irregularity can possibly happen to Him."[2] In man this love of goodness is a serene and profound complacency in that moral excellence which has its source in the Divine nature, and is embodied in the moral law—

"The justice
Of the unbribed, everlasting law."

And inasmuch as it is embodied in such a law, this justice or moral goodness cannot be loved without being also reverenced. As the mind contemplates it with delight, there is also suffused over the soul a sense of awe that forbids us to rest in mere contemplation, and prompts us to obey the law lest we incur its penalties. The principle of virtue thus coalesces with that of conscience, as above described.

SECT. IV.—OF MORAL OBLIGATION.

The conclusions at which we have arrived enable us to give a definite answer to the question, What is moral obligation? This is not a mere conviction of the reason; for though reason may guide, it never by itself constrains or obliges. Nor is it a mere feeling of admiration for, and delight in, what is morally good; for however pleasing this feeling may be, it of itself exerts no motive force upon us. Nor is it a mere sense that we *ought* to do what is right and good; for though this may act in the way of urging us to the paths of virtue, it falls short of the idea of obligation, inasmuch as it is popish to conceive the existence of a sense of owingness where there is no feeling of being under any obligation to render what is due. "Obligation," says Warburton, "necessarily implies an obliger, [who] must be different from, and not one and the same with, the obliged;"[3] and to the same effect Paley says, "Obligation is nothing more than an inducement of sufficient strength, and resulting in some way from the command of another."[4] What obliges us to virtue is the sense of being under moral law; it is reverence for moral law involving a dread of the consequences of transgressing it; it is the voice of conscience commanding rectitude, and whispering retribution to those who neglect or contravene it.

We are not disposed to go the length to which Warburton and some others (Paley, by implication, among them) have gone in denying the possibility of a sense of moral obligation, apart from the distinct dogmatic recognition of the Divine existence and government. Assuming the possibility of a man's being a sincere atheist, we could still conceive of such an one as having a deep reverence for what Fichte calls "the idea of moral order" in the universe, and a salutary dread of the consequences which he sees to flow from violations of that order. At the same time, it is the realization of the existence and rule of God as a moral governor which gives to the sense of obligation its greatest force, pungency, and constancy; nor, if it be true that the foundation of rectitude is to be sought in the essential nature of God, can we forbear to conclude that those who deny the existence of God have placed themselves where logical consistency would extort from them a denial also of moral distinctions. In accordance with this, it has ever been found that religion is the surest promoter of morals, and that it is only as men fear the Supreme Lawgiver that they are inclined steadily and conscientiously to act the part of good men and good citizens. "We have reason to believe," says Hooker, "that all true virtues are to honour true religion as their parent, and all well-ordered commonwealths to love her as their chiefest stay."[5]

OBS. 1. Some have distingished between an *external* and an *internal* obligation; designating by the former that force of reason by which we are constrained to actions as in themselves good, and by the latter that constraint which issues from feeling that we are under the authority and law of God. (See Burlamaqui, *Juris Nat. Elementa*, p. i., c. vi.; p. ii., c. vii, sec. 13.) This distinction has its foundation in truth; for it is very certain that before we can feel any sense of *moral* constraint, we must not only know that a particular course is commanded, but feel that it is in itself good. On the other hand, however, it is quite possible to feel convinced that a course is good, and yet not feel any obligation to follow it. It seems better, therefore, to say that both form elements of the one complex conception of moral obligation. "Though sin and punishment are closely connected, yet the obligation of *non licet* (*it may not be done*), is distinct from the obligation of *non impune* (*not with impunity*), as sin and punishment are of distinct consideration. But a man is bound both when he cannot do a thing without sin, and when he cannot do a thing without punishment; and both these obligations are in every [divine] law, and both concur to make the obligation of it." (Appendix to Maxwell's translation of Cumberland *De Legibus Naturæ*, by the translator, p. 55.) The reader may compare the statements of the following writers on this subject:—Clarke, *Discourse*, p. 43; Warburton, *Div. Leg. of Moses*, vol. i., p. 93, 5th edition; Price, *Review*, &c., c. 6; Horsely, *Sermons*, vol. ii., p. 189; Stewart, *Active and Moral Powers*, vol. i., p. 293; Wardlaw, *Christian Ethics*, lec. 6.

OBS. 2. "The *Autonomy* of the will is the alone principle of all moral laws, and of their relative duties: all *Heteronomy* of the arbitrary will, on the other hand, not only founds no obligation, but is rather opposed to the principle thereof, and to the morality of the will. It is in the independence of all material of the law (that is, any desired object), and along with this the determination of the will by the simple general legislative form of which a maxim[6] must be capable, that the alone principle of morality consists. That independence, however, is liberty in the *negative*, this self-legislat-

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[1] *Modern Infidelity*, Works, vol. i., p. 54. To the advocates of this theory we may recommend the Terentian Chremes as an exquisite realization of their sublime morality. "Homo sum; humani nihil a me alienum puto," exclaims the universal philanthropist; and presently we find him scolding his wife because she had not, according to his orders, made away with their infant daughter.

[2] Polhill, *View of some Divine Truths*, c. iii.

[3] *Divine Legation of Moses*, b. i., § 4.

[4] *Mor. Philos.*, c. iii.

[5] *Eccles. Polity*, b. v., § 1.

[6] A maxim, in the Kantian phraseology, is, as defined by Kant himself, "the subjective principle of willing" (*Met. d. Sitten*, c. i.); or

Virtue.

ing of the pure and as such practical reason, is liberty in the *positive*, acceptation. Hence the moral law expresses nothing else than the autonomy of the pure practical reason, *i.e.*, of liberty, and this is itself the formal condition of all maxims under which they can alone coalesce with the superior practical law." (Kant, *Kr. d. Pr. Ver.*, b. i., c. 1, sec. 8.) If by this nothing more were meant than that an act to be binding must, whether prescribed by an outward law or not, be recognised by the mind as morally right, the doctrine of this passage would not differ from that above laid down. But by "the autonomy of the will" Kant meant that the will is its own law, and finds the reason of action, the categorical imperative, in itself. To this we confess we have always found it exceedingly difficult to attach any clear idea. It is easy to see how the reason, or the conscience, may be a law to the will; but how the will can be a law to itself we find it hard to conceive. Is not *autonomy*, in any strict sense of the term, a universal impossibility? How can one and the same power be at once above itself as lawgiver, and under itself as subject to law?

SECT. V.—PRINCIPLES CONCURRENT WITH THE PRINCIPLE OF VIRTUE.

In excluding all principles but the one specified, it is not intended to affirm that others besides it do not concur to animate and confirm virtuous activity. On the contrary, while we hold reverence for rectitude to be the alone principle of virtue, as such, we would carefully recognise others which concur with it, and aid it in directing the conduct of men. Of these, Mr Stewart has specified Decency, or a regard to character; Sympathy; a sense of the Ridiculous; and Taste, considered in its relation to morals.[1] Of these, the first and the last are the only ones that can pass unquestioned: a regard to character and a refined moral taste—a taste that cleaves instinctively to "the first good, first perfect, and first fair," in preference to all other objects, and which revolts from the grossness of vice, however outwardly adorned—are unquestionably principles that operate as auxiliaries to virtue; though even with regard to them it is necessary to give great prominence to Mr Stewart's qualifying condition, that "they maintain their due place in subordination to the moral faculty," and are not suffered to "prevail in the character as the leading motive to action." Of the other two he has specified, the claims to be reckoned among the auxiliaries of virtue are, we think, very doubtful. If the sense of the ridiculous was invariably, or even by a primary affection, excited by what is immoral, it might be regarded as intended to help us in the paths of virtue; but we suspect no analysis will show any natural relation between the two, and in point of fact we know that it is rather virtue than vice that is made the object of this sensibility. As for sympathy, it depends wholly on our previous moral character whether it shall aid or impede the course of virtue; for a bad man will sympathize with the bad just as readily as a good man will with the good, and perhaps with greater force. If instead of these we substitute such feelings as gratitude to God for his goodness, benevolence towards men, a love of what is useful for its own sake, we shall have principles, the operation of which no one can doubt to be eminently serviceable in strengthening the virtuous principle within us, and aiding to confirm us in all virtuous courses.

SECT. VI.—MEASURE OF VIRTUE.

Virtue.

As in Physics a motive force may be measured by the quantity of resistance it is competent to overcome, so in Morals the measure of virtue is found in the amount of resistance which the virtuous principle in an individual is able to surmount. A man who does right because he is never tempted to do wrong, shows less virtue, so far as this particular case is concerned, than the man who, though strongly tempted to turn aside from the path of rectitude, firmly adheres to it from sheer love of rectitude. And so, generally, in proportion as the inducements to evil are many and strong, is the degree of virtue which enables a man to resist them, to conquer them, and to pursue the good.

SECT. VII.—PRACTICAL RULE OF VIRTUE.

In the ordinary business of life it is impossible for men to stop to adjust every action by the absolute standard of rectitude, even when that is within their reach in an easily consultable form. The desirableness, consequently, of some compendious rule, which, if not scientifically exact, shall yet be sound so far as it goes, and shall supply readily a practical test by which actions may be tried, has been felt by all men, and various attempts have been made to supply it. Of these, none approaches in value to that which has received the sanction of the Author of Christianity, and which He thus enunciates: "Whatsoever ye would that men should do unto you, do ye even so unto them."[2] This rule is not peculiar to our Lord's teaching; heathen as well as Jewish moralists have before Him inculcated the same principle;[3] but He has not only enunciated it more distinctly than any other; He has, by enunciating it, given it an authority which it would not otherwise have had. Than this rule no better could be suggested. It is alike simple and comprehensive; a rule for men in all circumstances, capable of being instantly and easily applied, and such as cannot be followed honestly and intelligently without exercising a most wholesome influence on the whole of a man's conduct. Of morality as embodied in this rule it may be justly said, "It is not hidden from thee, neither is it far off. . . . It is very nigh unto thee; in thy mouth and in thy heart, that thou mayest do it."[4]

OBS. Kant's rule, "Act so as if the maxims of thine acting should, through thy will, come to be general laws of nature" (*Met. d. Sitten*, c. 2, and in many other places of that treatise, and the *Kr. d. Pr. Vern.*), has been sometimes cited as if it were identical with the rule of Christ, only presented in a somewhat more scientific form. But the identity is in appearance only. Kant's rule is really the old Stoic rule, "Live conformably to nature;" for, if we are to act only so as that our subjective grounds of acting might become general laws of nature, it seems very plain that the general laws of nature are the norm or standard to which our subjective principles of acting must be conformed.

Fichte's rule, "Act always according to the best conviction of thy duty; or act according to thy conscience" (*Sittenlehre*, p. 195), is unimpeachably sound; but before it can be acted on, one must possess all that knowledge to compensate for the want of which, in whole or in part, a short practical rule is desiderated.

PART III.—OF DUTIES.

1. Our previous inquiries have possessed chiefly a speculative interest; we now turn to investigations of a practical kind. When we have determined wherein rectitude consists and what constitutes virtue, we are prepared for, and urged upon, the question, What practical courses are right, and such as a virtuous man will pursue?

2. This question may be answered generally by affirming that a virtuous man will do his duty; or, what comes to the

as one of his disciples has explained it, "the practical rule which determines the free-will of any being." (Kiesewetter, *Darstellung der wichtigsten Wahrheiten der Kr. Phil.*, i. 160.)

[1] *Active and Moral Powers*, vol. i., p. 306.

[3] See Grotius and Wetstein on the place; Price, *Comment. in Varios N. T. libros* on the passage, &c.

[2] Matt. vii. 12.

[4] Deut. xxx. 11, 14.

Duties.

same thing substantially, will exemplify the practical virtues. This, however, leaves still open the question, What are the practical virtues? what are men's duties?

3. In answering this question we shall follow the method and classification most commonly adopted in this country,—that, viz., which arranges our duties according to our relations. This we prefer as the one which most naturally falls in with the tenor of our previous speculations, and at the same time affords the best scope for a clear and satisfactory discussion of the subject.

Obs. Of other methods we may notice the following:—

1. Some have taken the leading or cardinal virtues, and showed what is peculiar to each of them, and to what practical courses each of them tends. This is the course followed by most of the ancient ethicists, though declined by Aristotle.

2. Some have inquired whether all the virtues may not be generalized into one, of which the rest are the forms or manifestations; and having ascertained this, as they believe, have proceeded to show how all the practical duties of life flow out of this one magistral and reginal virtue. So Plato.

3. Some have arranged duties according to their relation to each other. With this view, some have distinguished between duties of perfect and duties of imperfect obligation,—a distinction recognised by the Stoics (see Cic. *De Fin.* iii. 7, 9, 17, 18; *De Off.* i. 3), and adopted by some modern writers; while others prefer distinguishing between determinate duties and indeterminate, or duties of primary and duties of secondary obligation. This latter distinction may be admitted as valid; but it comes to be of use chiefly as a guide in Casuistry, and cannot form an adequate basis of general classification.

4. Kant has adopted a somewhat complicated classification. He first divides duties into Duties of Right (*officia juris*), *i.e.*, such as are capable of being prescribed by law; and Duties of Virtue (*officia virtutis s. ethica*), for which no such prescription is possible, and this because they are directed to an *end*, to attain which is equally a duty, and the contemplation of which is an inner act of the mind, so that it cannot be effected by any outward legislation. He then distinguishes between man viewed simply under the peculiarity of his faculty of freedom,—simply in his manhood, as a personality independent of physical conditions,—man as a *noumenon*, and man as a *phænomenon*, or as subject to these conditions, and affected by them; and in relation to this he distinguishes duty as it respects—(1.) The right of manhood in our own person, from (2.) The right of men; and (3.) The end of manhood in our own person, viz., our own perfection, from (4.) The end of men, viz., their happiness. Of these, 1 and 3 are duty to ourselves, 2 and 4 are duty towards others; and 1 and 2 are perfect duty, 3 and 4 imperfect. He distinguishes also according to the subjective relation of the binding and the bound, and concludes that there is no relation of right between man and a being that has neither rights nor duties, nor between man and a being that has simply duties and no rights, nor between man and a being that has simply rights and no duties. The only relation that can be subjected to formal law is that of man to a being who has both rights and duties.[1]

5. Fichte has adopted a simpler classification. He distinguishes (1.) *Mediate* and *conditioned* duties, from *immediate* and *unconditioned* or *absolute*; meaning by the former, duties which terminate upon ourselves, and by the latter, duties which we owe to the universe; and (2.) *General* from *special* duties, denoting by the former, those which arise out of positions which cannot be *conferred* on men, and by the latter, those which arise out of positions that can. Combining these two distinctions, he divides his subject into general and special *conditioned* duties, and general and special *absolute* duties; and the latter more particularly into duties determined by one's natural condition, and duties determined by one's special vocation.[2] This classification has the merit of simplicity, but some of the distinctions on which it is based are of very questionable soundness. Why, for instance, should the one class be pronounced conditioned and the other absolute? The former, says Fichte, are conditioned because "they can be derived only through this position, that if the moral law wills the conditioned,—the realization of the mastery of Reason over me through me,—it wills also the condition that I be a fitting and adapted means to this end." But is not the duty I owe to others, in so far as it is due by me, conditioned by the same requirement, viz., that I am fitted and adapted to render it?

4. The relations which man sustains have been determined for him by God; and man enters upon them as part of the constitution of things under which he has to exist. In a sense, therefore, these relations are arbitrary; they are the result of the Divine volition and appointment. But in another sense they are not arbitrary; for God, in constituting things as they are, had reference to the inherent and essential attributes of his own nature, so that all the relations in which man finds himself placed are such as fall in with perfect rectitude, and such as could not but be if God was to create man at all. In like manner, the duties which flow out of these relations are fixed and necessary: having established the relations, God could not but make such and such duties to flow out of them.

5. Duty is a *debt* (*debitum*), something which we *owe* to some being. But we do not owe this to *all* being, nor even to all being of the existence of which we are aware; we do not owe anything, for instance, to *angels*, though we are assured of the fact of their existence: our duty begins where our relations begin; and it grows in extent and urgency as our relations become more numerous and close.

6. The correlative of Duty is Right. Wherever one person owes a duty to another, that other possesses a corresponding claim of right over the former. His claim is called a *right*, because wherever a duty is owing, rectitude dictates that it should be paid. It may be needful to remark in passing, that we are discoursing at present only of natural moral duties and rights, not such as may be created artificially by human legislation or arrangements.

7. The relations which man sustains are distributable into three classes: 1. Those which he sustains to himself; 2. Those which he sustains to his fellow-creatures; 3. Those which he sustains to God. Corresponding with these three classes of relations are the three classes of duties to which man is bound. These we now proceed to specify, though our limits forbid our entering into this part of our subject with any fulness.

SECT. I.—DUTIES WHICH MAN OWES TO HIMSELF.

At first sight it may appear as if something of a contradiction were involved in the assertion that a man owes duties to himself; for how, it may be asked, can a man be both giver and recipient in respect of one and the same object? or how can he be the holder of a right which binds, and the subject of a duty by which he is bound, in reference to one and the same thing? We may meet this difficulty by remarking, that man may be viewed under a two-fold aspect: either simply as a phenomenon—a concrete being existing in the world; or as a noumenon—a conceived personality endowed with freedom of will. In the latter capacity he is capable of being bound to duties; and it is this inner personality which is contemplated as so bound to the concrete phenomenal man, when we speak of man's owing duties to himself.[3]

Viewed in his aggregate existence, man may be regarded as 1. A being having life; 2. An intellectual being; and 3. A moral and religious being. In all these respects he owes duties to himself.

1. *As a being having life*, man owes it to himself to preserve and nourish the life he has received. For this purpose he must supply himself with necessary food, and clothing, and shelter; he must avoid whatever would injure his health, impair his strength, or shorten his life; and he must use means when his health has been injuriously affected to have it restored. This duty involves that of self-defence against the assault of another, even to the extent of taking the assailant's life should that be necessary for the preservation of our own. It also forbids self-murder, and all those practices, such as intemperance, debauchery, or excessive labour, which tend to shorten life.[4]

[1] *Rechtslehre und Tugendlehre*, in vol. ix. of his collected works, p 43 ff., p. 245.

[2] *System der Sittenlehre*, p. 326, ff.

[3] See Kant, *Tugendlehre*, b. i., Einleit.

[4] Comp. Xenoph., *Memorabilia*, b. ii., c. i.

Duties.

2. As *an intellectual being*, man owes it to himself to cultivate his mental faculties, to store his mind with useful knowledge, and to endeavour constantly to regulate his opinions and conduct by the free and impartial exercise of his intellectual powers. The gift of intellect should be prized for its own sake as well as for the uses to which it may be put; and means should be wisely and steadfastly employed to effect a catholic development of all the mental faculties and susceptibilities. Hence the duty of being educated—a duty which is incumbent not only on children and young persons, but which should be felt as a constant duty, to be attended to by all through life, so long at least as mental vigour is continued.

3. As *a moral and religious being*, man owes it to himself to cultivate his moral susceptibilities, to accustom himself to attend promptly and faithfully to the dictates of conscience, and to seek so to educate conscience as that its dictates shall be in accordance with what is right and good. Without culture the moral powers become feeble, and are irregular in their action; whereas, by due cultivation they are strengthened and directed, and may be brought to control with a supreme but not offensive sway the whole conduct. As a moral being, further, man owes it to himself to abstain from the indulgence of all polluting, degrading, or demoralizing passions and pursuits. He owes it to himself to be chaste, not in act only, but in imagination and purpose; to be truthful even when no other person is to be injured by his indulging in falsehood; to be moderate in his desires, not giving way to covetousness, to ambition, or to a vain love of display; to be humble, not merely in relation to others, but within his own soul; and to avoid all indolence, sloth, and apathy. As a religious being, man owes it to himself to cultivate piety, to habituate himself to a constant acknowledgment of God, to be assiduous in all religious duties, and to make the attainment of God's favour and preparation for heaven the supreme objects of his life.

SECT. II.—DUTIES WHICH MAN OWES TO HIS FELLOW-CREATURES.

Of creatures to which man sustains relations there are only two classes, his fellow-men and the lower animals.

I. Beginning with the latter as the less important, the duties which man owes to the animal creation around him are either general or special. To all animals he owes benevolence, to the extent of the avoidance of whatever would give needless pain to any of them; not that he may not pursue them and kill them either to free himself from those that are noxious, or to supply himself with food and other necessaries from those that are useful, but that in either case he is not to act cruelly by giving pain beyond what is necessary for the destruction of life. To those animals which he has domesticated man owes protection, provision, and all needful care to preserve them in health and vigour, as well as kindness in the treatment of them, not exacting of them more or severer labour than they can render, or subjecting them to pain and terror for mere amusement or for the sake of gain. All such barbarous amusements as bull-fights, bull-baiting, bear-baiting, dog-fighting, cock-fighting, are to be repudiated as *wicked*; and though some excuse may be pleaded for what are called field sports, on the ground that they promote health, keep down the numbers of noxious animals, or furnish a supply of food which could not be obtained in a way less painful to the animals slain, there can be no apology for such amusements as horse-racing and steeple-chasing, where a noble animal is subjected to "a pace that kills," merely to afford idle men and women a little excitement, and unprincipled men and women an opportunity for gambling.

Duties.

II. The duties which man owes to his fellow-men are also either general or special; the former being such as he owes to all men indifferently, the latter such as he owes to those in peculiar circumstances, and those to whom he himself sustains special relations.

1. *Duties owing to our fellow-men generally.*—"God hath made of one blood all nations of men for to dwell on the face of the earth."[1] This fact, for the knowledge of which we are indebted to the Bible, establishes a bond of relationship between all the members of the human race simply as such. Hence we owe to *all* men certain duties. These are—

(i.) *Goodwill.*—This implies not only the absence of all malevolent feelings towards others, such as envy, vindictiveness, malice, &c., and abstinence from all the acts to which such feelings lead, but also a propensity to be interested in the well-being of our fellow-men, and a readiness to do them good by the promotion of their bodily, their intellectual, their moral, and their eternal welfare. This is that φιλανθρωπία which the sacred writers ascribe to God (Tit. iii. 4), and which by various precepts they inculcate upon us.[2]

(ii.) *Respect.*—We are to "honour all men." This does not mean that we are to render to all an equal tribute of approbation, for some men we are bound to condemn, and in general the degree of approbation which we bestow on men ought to be measured by the degree of their moral worth. The precept means that we are to recognise the worthiness that is in man as man, and to render him corresponding respect; not despising any because of adventitious circumstances, not treating any with discourtesy however lowly, and not regarding as outcasts or unworthy of our notice even the most abandoned and base. In man as man there is a worth and a dignity that make it the duty of every man to honour all men.

(iii.) *Truthfulness.*—We owe it to all men, in conveying to them knowledge concerning any person or thing, to communicate to them exactly such a conception of the fact as we ourselves have. That conception may not be physically true, *i.e.*, the thing as conceived by us may not answer exactly to the thing as it is; but if we convey to another our own conception of it, neither more nor less, all the requirements of moral truthfulness are satisfied thereby. This implies that neither by word, nor look, nor hint, nor act, do we lead another to think of the matter of communication otherwise than it really is as contemplated by our minds. This forbids—(1.) All intentional falsehood, *i.e.*, all communications by word or deed designed to convey to another a conviction which we *know* to be false in fact; (2.) All uttering as true what we do *not* know to be true, or as false what we do *not* know to be false; (3.) All prevarication and shuffling by which we may seek to *evade* the truth, and, without directly telling a lie, may virtually do so by leaving a false impression on the mind of another; (4.) All equivocation and mental reservation, *i.e.*, the use of words which have an ambiguous meaning, for the purpose of leading the party to whom we speak to understand them in the sense which we know not to be the one consistent with the fact, and the use of words which only express part of the truth, the rest being kept back so as to mislead those to whom we speak; and (5.) All exaggeration or extenuation, so as to convey to the mind of another a stronger or a weaker impression of the fact than we ourselves entertain. In all these respects the command, "Speak every man truth with his neighbour," is binding upon us. It must, however, be kept in mind here, that it is the *intention* to deceive that constitutes a lie or gives guilt to falsehood; if the speaker is himself mistaken, or if he uses forms of speech which, though not corresponding exactly to the fact, are yet so understood as not to con-

[1] Acts xvii. 26.

[2] Comp. Matt. v. 33, 47, Lev. xix. 18, Jam. v. 9, Tit. iii. 3, Eph. iv. 31, Gal. vi. 10.

vey any wrong impression, he cannot be charged with having violated the duty of truthfulness.

(iv.) *Fidelity.*—This has respect to promises and contracts. A *promise* is a declaration that we will do something to or for another. It may be made either conditionally or unconditionally. In an unconditional promise we bind ourselves by what we give the recipient of the promise to understand is our intention in reference to the thing promised. We are not bound by whatever our words may be *made* to mean, or by whatever the promisee may *imagine* them to mean; we are bound in *foro conscientiæ* by what our words, fairly interpreted, express as to our intention at the time of making the promise, or what we meant them to convey to the mind of the promisee. A conditional promise is one, the fulfilment of which both parties agree to suspend on the happening of something doubtful. Thus, if A promises to give a sum of money to B, provided something B has told him shall turn out to be true, the promise is conditional, and no breach of promise ensues if, on its being found that what B said was not true, A should refuse to pay the stipulated sum. It may be added, that there is a sense in which all promises are conditional, inasmuch as all are suspended on the presumption that it is *possible* and *lawful* to do the thing promised; but in ordinary language, it is only when the possibility or lawfulness of the act is doubtful, that this is understood to impose a condition on the promise.

A *contract* is a species of conditional promise in which one party binds himself to another in consideration of something which that party has done or binds himself to do in return. Such a contract to be valid must be made voluntarily and intelligently; if either force has been used to compel to the contract, or one of the contracting parties is not of sound mind, or incapable of forming a just estimate of the obligation he is incurring, the contract is void. Abstracting from such cases, all contracts are to be faithfully kept according to the understanding which it was the intention of the contracting parties to convey to each other. If, however, the party who accepts the contract fail to fulfil his part of the engagement, the other party is *ipso facto* absolved from the obligation resting on him, and may even be entitled to compensation at the hands of the other for loss or injury he may have sustained. Under the head of contracts are included buying and selling, borrowing and lending, hiring and service, partnership in business, and such like.

Obs. The Roman jurists, who have studied all questions affecting what may be called commercial Ethics with the utmost minuteness, have been specially successful in describing the nature and law of contract. The following extract presents in a condensed form their teaching on this subject:—"Contractus est conventio sive consensus plurium in unum placitum, habens causam, *i.e.*, civile aliquid negotium dandi aut faciendi. Contractus vero nomine venit non tantum ea obligatio quæ synallagma habet, *i.e.*, quæ ultro citroque obligat, cujusmodi est *emtio*, *venditio*, *locatio*, *conductio*; verum et ea quæ ex altera tantum parte, veluti *mutuum*, *stipulatio*; sive etiam in suo stet nomine sive transeat in proprium nomen contractus. Quibus verbis insinuatur nova contractuum divisio in Nominatos et Innominatos. Nominati dicuntur quibus certum et proprium a legibus nomen est attributum ut emtio, locatio, societas ex quibus certa nominataque actio datur veluti actio emti, &c. Innominati vero qui certam et ligitimum nomen non habent quique non ita juris vinculo continentur, cum in iis locus sit pœnitentiæ, re integra, seu quamdiu alteruter tradendo non implevit a sua parte; suntque contractuum ejusmodi quatuor genera *Do ut Des*; *Do ut Facias*; *Facio ut Facias*; *Facio ut Des*; ex quibus certa et proprii nominis actio non datur sed actio præscriptis verbis, ita dicta quod ex præscripto conventionis datur." (Peresius, *Institutiones Imperiales erotematibus distinctæ*, b. iii., tit. 14, p. 325, 8th edit. Comp. the more copious comment of Vitriarius, *Universum Jus Civile*, p. 439, ff.)

(v.) *Justice.*—Justice, as an attribute of a voluntary agent, is the habit of mind which disposes such an one to leave all other men in the undisturbed enjoyment of whatever possessions, advantages, and privileges they may rightfully have. Self-love naturally prompts us to seek for ourselves whatever we see to be desirable; but justice teaches us sacredly to refrain from depriving our neighbour of aught that belongs to him (unless it be something which he has the power to give, and which we take with his free consent), however much the possession of it might benefit or delight us. It teaches us also not to take from our neighbour (or, what is in principle the same thing, to injure or diminish in value) anything that he prizes, even though we do not or cannot transfer it to ourselves. More specifically, justice requires us—

(1.) To abstain from injuring another man's *person*. This may be done in various ways. It may be done by inflicting wounds or blows upon him to the dismemberment of his limbs or to the interruption of the healthy action of his organs. It may be done by withholding from him necessary food, or by giving him unwholesome food, or by exposing him unnecessarily to pestilential vapours, or by preventing him from needful exercise, or by exacting from him undue and exhausting labour. It may be done also by exerting painful or depressing influences over his spirits, by which his general health is affected. When such treatment is not the result of pure accident, or of causes not subject to our will, but is to be traced to evil intention against another, or to careless indifference about another's welfare, it is to be condemned as a breach of what justice to our fellow-men demands.

(2.) To abstain from taking away *the life* of another. When this is done with deliberate and malicious intention, from revenge or for some sinister end, it is *murder*, by whatever means perpetrated, whether by blows, or by poison, or by some subtle agency the operation of which cannot be made obvious to the senses, and whether directly by our own agency or indirectly by that of others. A mitigated form of this offence is when life is sacrificed through our carelessness or thoughtlessness, without evil design on our part. This the law discriminates as *culpable homicide*. Where pure accident has caused the death of others, the instruments of this calamity are to be exempted from blame. In cases also where life has been taken in self-defence, the party must be held guiltless; for where an assailant has forced on us the alternative of either taking his life or allowing him to take ours, a duty higher than any we owe to him requires us to adopt the former of these courses. This plea, however, will not cover the practice of *duelling*; for we have no right *voluntarily* to place ourselves in such an alternative; and if it be said that the usage of society forces this alternative upon us as the only course by which, when we have been insulted, we can retain our place in society, the question then comes to be, whether the retaining of our place in society be of equal obligation with the duty of refraining from imperilling our own life or that of another—a question which the moralist can answer in but one way, in the negative.[1] It may be added, that the law which holds of the taking away of life holds equally of the preventing of life. If that be done by violent means, a crime of a very flagrant nature is perpetrated. Hence the Roman law enacted, "Si mulierem visceribus suis vim intulisse, quo partum abigerit, constiterit; eam in exilium præses provinciæ exiget."

(3.) To abstain from injuring another's *property*. A man's property is that which, by his own labour or by gift from others, has so become his own that an abstract right belongs to him to do with it as he chooses. Hence, if he chooses to give it to others, they violate no duty in accepting it, according to the maxim of the civil law, "Volenti

[1] See a full and able discussion of duelling in Wardlaw's *Systematic Theology*, iii. 517.

non fit injuria." But so long as he chooses to retain it, others have no right to appropriate it, in whole or in part. To do so is to be guilty of robbery, which may either be perpetrated by violence, as in highway robbery and housebreaking, or by cunning and artifice, as in pocket-picking, pilfering, and swindling. Justice to our neighbour also requires that we shall not take advantage of his ignorance to over-reach him in business or defraud him of gains which ought to be his; and also that in all transactions where we profess to transfer a portion of his property to ourselves, on the ground of giving him an equivalent for it, there shall be no deception practised with a view to make him regard as an equivalent what is not such, no fraudulent abstraction of any part of the offered equivalent after it has been accepted, and no substitution of something else in the place the very thing agreed on.

(4.) To abstain from injuring the *reputation* of others. This may be done either by saying of them what is false, or by saying of them what is true. In the former case the offence is forbidden alike by the law of veracity and the law of justice; in the latter case the law of justice prescribes that we are not to propagate what would injure our neighbour's reputation, unless some higher obligation than what we owe to him in this respect compel us to do so. Thus, if we have reason to suspect or believe that a person is dishonest, it may become our duty to give information of this, that others may be protected from his attempts; or if we know a party to have committed an offence, and are called to bear witness against him in a court of law, it will be our duty to do so; but all gratuitous and malicious tale-bearing, vituperation, or slander, whether openly uttered or conveyed by means of hint and inuendo, are direct violations of what justice to others demands.

(5.) To abstain from injuring the *virtue* of others. We may injure their virtue by misleading their judgment as to what is right and what is wrong; by tempting them to think lightly of what is immoral; by recommending vice to them through means of seductive stories or attractive representations; by appealing to their passions, or placing them in circumstances where these are appealed to; by provoking them to evil by our own example, or by using force or ridicule to constrain them to do what is wrong. Such conduct is highly criminal. It robs our neighbour of his most precious possession, a good conscience; it destroys his self-respect and mental tranquillity; it may lead to courses which end in ruin and suicide;[1] and it endangers the safety of his immortal soul. Surely, if those who maim the body or destroy life are held guilty, much deeper is the guilt of those who do their endeavour to pollute, degrade, and utterly and for ever ruin the soul.

2. *Duties owing specially to Particular Classes and Individuals.*—These may be enumerated thus:—

(i.) *Duties arising out of the Difference of Sex.*—The great duty binding on the sexes in their relation to each other is that of chastity. The law of chastity forbids not only all promiscuous and licentious intercourse between persons of different sex, but also all carnal connection between parties nearly related by blood to each other, whether under the tie of marriage or not; all polygamy, concubinage, and marriage dissolvable at the pleasure of either or both parties. It forbids also all practices tending to licentiousness; the indulgence of impure thoughts or feelings; the publication or use of obscene songs, descriptions, jests, or pictures; indecent conversations, looks, or gestures; and, in short, whatever tends to inflame the sexual passion and loosen the restraint which should be imposed upon it.[2]

(ii.) *Duties arising out of the Domestic Relation.*

(1.) *Of Husband and Wife.*—Marriage is the perpetual union of one man with one woman for their mutual solacement and benefit, and with a special view to the procreation and education of children. This union is to be based on the mutual affection and free choice of the parties; all marriages formed without mutual affection, for purposes of mere convenience, for the sake of gain, or through the adhibition of force or fraud, are immoral in their nature, and seldom, if ever, are productive of happiness to the parties.

This primary law of marriage is violated where polygamy is tolerated. By such a practice all the advantages which marriage is designed to promote are precluded; woman is degraded from the companion and helpmate of man into a mere slave of his lusts;[3] the happiness arising from the consociation of hearts, united by affection, is prevented; all the benefits of sympathy and united counsel are superseded; constant jealousies and quarrels invade the domestic circle; and the children, deprived of proper care and discipline, often perish in infancy, or grow up with untamed passions, jealous and hateful of each other, and without any just sense of the duties or responsibilities of life.

The law of marriage is also violated when the union of the parties is treated as dissoluble, or when it is actually dissolved, without sufficient cause. By "sufficient cause" is meant such conduct on either side as virtually destroys the consociation implied in marriage. Such is adultery, and such also, as it appears to us, is cruelty used by the one party towards the other to such an extent as renders cohabitation impossible. In such cases the marriage is really at an end, and consequently the formal separation of the parties may legitimately follow. But to dissolve a marriage for any inferior reason is immoral and mischievous.

Of the parties united in marriage the *common* duties are—(1.) The cultivation of mutual affection; (2.) Fidelity to their conjugal engagements, not in deed only but in thought and word; (3.) Care for each other's health, honour, and comfort; (4.) Mutual helpfulness, both as respects duties and sorrows, both as respects this life and that which is to come; and (5.) Mutual confidence, leading to an entire community of knowledge and interest. The *special* duties of the parties arise out of the modifications which that love which is the basis of their union receives from their respective constitutional and social differences. The husband is to give scope to his love for his wife by protecting her; providing for her maintenance and comfort; acting as her head and guide with all wisdom, patience, and gentleness; giving her honour, not only before others, but when alone, and that not in word only, but in deed; and nourishing and cherishing her as his own flesh. On the part of the wife, love is to show itself not only in the caresses of a womanly tenderness, but still more in consulting for her husband's comfort at home and for his reputation abroad; in revering him and submitting to him as her head; in taking care of his property; and in saving him from all household cares that do not properly fall to his lot.

(2.) *Of Parent and Child.*—The duties which parents owe to their children are those of nurture and education; including under the former all that is required for the physical welfare, and under the latter all that is required for the intellectual, moral, and religious up-bringing of their offspring. In their intercourse with their children, also, it

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[1] Aristophanes makes Æschylus charge on Euripides the guilt of having brought many ladies, the wives of honourable men, to drink hemlock, in consequence of being brought to shame through the effect of his immoral representations. (See *The Frogs*, l. 1016.) This is but one of many instances in which the drama has had to answer for domestic misery and disgrace, ruin and suicide.

[2] "Nos autem," says Cicero, "naturam sequamur, et ab omni quod abhorret ab oculorum auriumque approbatione fugiamus. Status, incessus, sessio, accubitio, vultus, oculi, manuum motus, teneant illud decorum." (*De Off.*, i. 35.)

[3] Animus multitudine distrahitur, nullam pro socia obtinet, omnes viles sunt. (Sallust., *De Bello Jugur.*, c. 80.)

is requisite that the law of kindness should ever be on their lips, and that their own example should be such as to command and enforce the precepts they inculcate. In the matter of discipline, the extremes to be avoided are undue laxity and indulgence on the one hand, and undue severity on the other. "A child left to himself bringeth his mother to shame;"[1] but when fathers correct in a passionate or tyrannical spirit, they are apt to increase the very evil they desire to allay; they "provoke their children to wrath," and discourage them from the path of obedience and love.

The duties of children to their parents are those of gratitude, reverence, and obedience. They are to honour their father and mother, to listen to their instructions, to avoid wounding their feelings, to be careful of their reputation, and to obey promptly and cheerfully all their commands. It is their duty also to solace the declining years of their parents by every means in their power, and, if necessary, to repay the care which nourished them in early life by supporting their parents in as much comfort as their means will allow.

(3.) *Of Brothers and Sisters.*—The duties of the fraternal relation are chiefly those of mutual goodwill; and they differ from those of the same kind which we owe to men in general only in the priority of their claim and the intensity of the affection. Goodwill to the race must be learnt in the nursery and around the domestic hearth by the exercise of goodwill and kindness between the children of the family. And all through life this, which was the first lesson to be learnt, ought to remain the strongest in its influence upon us. Other things being equal, a brother or a sister has a prior and a stronger claim on our sympathy, our kindness, and our aid, to any one standing without the family circle. "Quis amicior quam frater fratri? aut quem alienum fidum invenies si tuis hostis fueris."[2]

(4.) *Of Master and Servant.*—The relation of master and servant arises, except where slavery prevails, out of a contract formally or virtually made between the parties, and the duties devolving on each must be, to a considerable extent, determined by the terms of their contract. Besides these, however, there are duties of a purely moral kind which no contract can determine, and which no human legislation can enforce. It is the duty of servants not only to do what they have contracted to do, but to do it cheerfully, and with scrupulous integrity, so as to give their masters the full benefit of their time and powers. It is their duty also to show all respect to their masters, to be courteous in their manners and speech towards them, and to be always ready to vindicate their reputation as well as to protect their property. The master, on the other hand, must take care not to be unreasonable in his demands on his servants' energies, nor to treat them otherwise than with that kindness and respect which is due to his fellow-men, avoiding all overbearing deportment, all harsh and hurtful speeches, all contemptuous treatment, and all passionate threatening, in his intercourse with them. The master who not only gives his servants "that which is just and equal," but treats them respectfully and kindly, will find his own interest greatly promoted thereby; whereas "he that troubleth his own house shall inherit the wind."[3]

(iii.) *Duties arising out of Difference of Condition and Circumstances.*—Of these the most important are those created by differences of rank and of property. In most states some persons are raised to an artificial dignity, which is symbolized by a title or by some personal decoration; in all states where order prevails some are invested with official rank; and everywhere the distinctions of rich and poor, prosperous and suffering, obtains. Out of these arise certain moral obligations, resting on one or both parties. The duty of the great and wealthy is to show kindness to their inferiors in society, and especially to employ their influence and resources to alleviate the sufferings of the unhappy, and to provide for the support of the destitute. Institutions for the cure of disease, for the education of the ignorant, for the reclaiming of the profligate, and for the comfort of the aged and the indigent, are entitled to look for support to those whom Providence has blessed with plenty; and the duty of charity to the poor is one of constant obligation on all who have anything to spare. On the other hand, those who are in possession of rank and dignity are entitled to expect from their inferiors in society that respect and homage which belong to their station; honour is to be given to whom honour is due. The poor also owe to their benefactors the duty of gratitude for benefits received, and the duty also of scrupulously abstaining from unnecessarily taxing their generosity, or laying a burden on their resources.

(iv.) *Duties of Teacher and Taught.*—The duty of the teacher is to use every endeavour to make himself thoroughly master of the subject which he has to teach, to divest himself of all prejudices and interests that would preclude his seeking after and embracing truth, to aim at clearness and precision in all his communications with his learners, and to use the influence he possesses under a constant sense of responsibility, and with a sacred regard to the cause of morality and religion. This applies not only to the professed teacher, but to all who by tongue or pen seek to influence the opinions or conduct of others. To his teacher the learner owes respect, docility, deference, and gratitude, but not abject submission to his dogmas, nor an acceptance of his *ipse dixit* in lieu of all reason or argument.

3. *Duties connected with the Relations of Civil Society.*—Civil society is the ordinance of God,—not that He has in any code enacted that men shall live in such society, or anywhere prescribed any particular form of civil polity as alone accordant with His will; but that He has so constituted man that to live in society is not only natural to man, but necessary for the full development of his capacities and for his well-being. "Man by nature," says Aristotle, "is a political animal (φύσει πολιτικὸν ζῶον), and if any one lives out of society by choice and not by misfortune, he is either a bad man or better than man;" and again he says, "If any man is incapable of associating, or through self-sufficiency needs it not, he is no part of a state,—such an one is either a beast or a god." "By nature," he adds, "there is a propensity in all to such association; and he who first instituted it became the author of the greatest benefits."[4] It should consequently be esteemed a privilege to be a member of a state; for even in the worst ordered states the condition of the people is better than it would have been had there been no civil society at all; and in proportion as the constitution under which we live is wisely and righteously ordered, in that proportion does it demand the reverence, the support, and the love of the citizens. The body of the citizens, indeed, constitutes the state, and it is for their benefit, and theoretically by their will, that it exists; but the state, as an organic whole, may be thought apart from the individuals that compose it, and thus two parties may be represented to the mind as owing civil duties to each other,—the πόλις or state, and its citizens (πολῖται). Practically this distinction resolves itself almost wholly into that of rulers and ruled.

(i.) *Duties of States to each other.*—These are analogous to those of individuals to each other. States, in their dealings with each other, are bound not merely by artificial compacts and accidental treaties, but by the dictates of that great moral law which, as Cicero sublimely says, "is not one at Rome and another at Athens,—one now and

[1] Prov. xxix. 15.
[2] Sallust, *Jugur.*, c. 10.
[3] Prov. xi. 29.
[4] *Politics*, b. i., c. ii.

Duties.

another afterwards; but it is one and the same eternal and immortal law which holds together all nations through all times; and one God, the common master, as it were, and commander of all, who is the discoverer, the umpire, the enacter of this law; and the man who obeys Him not is untrue to himself, and contemns the nature of man, and on this very account shall endure severest punishment, even although he may escape other penalties, as they are considered."[1] Hence nations are morally precluded from making aggressions on each other's territory, or doing aught gratuitously, avariciously, or vindictively, to damage the prosperity of each other. Instead of this, there ought to be a firm alliance among the nations, binding them to respect each other's rights, to refrain from in any way seeking each other's injury, and to refer all disputes that may arise between any to the arbitration of some common tribunal. In the present state of the world, however, especially where states in very different stages of civilization are placed in close contact with each other, such a state of things can at the best be only approximately reached, and in many cases not at all. Hence aggressions will be made by the stronger on the weaker, by the more restless and needy on the more civilized, industrious, and wealthy; and constantly cases will be arising of misunderstanding and conflict between even those states which are most devoted to the arts of peace. In such cases the resort will in all probability be to arms, as the only arbitrement to which the dispute can be referred; and however horrible in many of its aspects such an expedient may be, there does not appear to be any ground on which the moralist can condemn it, apart from circumstances. Nations as well as individuals possess the right of self-defence; and if either their liberties or their possessions are forcibly invaded, they not only are morally at liberty to resist force by force for the protection of these, but they are bound, by a duty higher than any they owe to the invading power, to do their utmost to repel its assault. It is only an extension of the same principle when nations are justified in going to war for the purpose of restraining the ambition or repressing the advances of some warlike power, which, though it may not have directly attacked them, is pursuing a course such as cannot but bring it into collision with them, and that under circumstances less favourable to them than if the collision took place now; for if it be right to repel an attack when made, it is on the same ground right to prevent, if possible, the attack from being made when it might be impossible to repel it. It is less clear whether nations are justified in going to war for causes which do not touch upon either their liberties or their possessions,—such as questions of commercial prerogative, national honour, theoretical policy, or dynastic alliance. On a calm survey of such cases, the balance seems to decline in favour of the negative side of the question, and it can only be in very urgent cases that so frightful an expedient as war can be justified for any such cause.

(ii.) *Duties of States to their Subjects.*—The prime duty of a state to its subjects is that of affording protection to their lives, liberties, persons, and properties; for which ends laws must be enacted, courts of justice instituted, and an efficient executive force maintained. In the enacting of laws, sacred regard is to be had to the interests of the community as a whole, as the end for which the law is made; and in the judicial administration of them impartiality is scrupulously to be maintained, without any respect of persons, either through fear or favour. The supreme duty of the executive consists in fidelity to the trust reposed in them, to be shown by vigilance in the detection of offenders, and unflinching performance of what the law enacts, and the judge has determined, as due to the offence; but with this should be united the utmost possible avoidance of all personal feeling against the culprit, and the exhibition of as much of gentleness and forbearance as may be compatible with the faithful discharge of official duty. But though protection be the principal duty of a state towards its subjects, it may legitimately extend its operations beyond that, and make provision for the advancement of the commercial prosperity of the community, for the prevention of influences prejudicial to public health or morals, for the education of the people, for the relief of the poor, and for the cure of disease.

(iii.) *Duties of Subjects to the State.*—These are,—(1.) Subjection to the constituted authorities—"the powers that be." It is not implied in this that subjects are bound to *approve* of every law or act of their rulers, nor that they may not use means to obtain the repeal of oppressive or unwise laws; but simply that, in their capacity as citizens, they are not to set themselves against their rulers, nor to refuse obedience to the laws which are in operation. To this obedience there is but one limit, and that is, when the law requires what it would be plainly a sin against God to perform. In this case a higher law demands that the law of the human legislator should be disobeyed; only this must be done as quietly and as respectfully to the authorities as possible. (2.) The rendering of homage and respect to the magistrate as such, to be shown in the avoidance of all impertinent familiarity, all uncourteous language or deportment, and all severe and railing censure. (3.) The prompt as well as honest payment of all the taxes appointed to be levied by the proper authorities, regarding this as a debt due to government for the benefits it secures to society, and esteeming it a privilege that the amount we have to pay for this is *fixed*, so that it neither depends on the caprice of individuals, nor is left to the dubious and perplexing settlement of our own conscience. (4.) The being ready to make sacrifice of personal ease, property, and, if need be, safety, for the defence of our country, and the being forward to promote, as we have the means, the intellectual, moral, social, and political improvement of the community.

SECT. III.—DUTIES WHICH MAN OWES TO GOD.

Some German philosophers and theologians have advanced the opinion, that it is incompetent for philosophy to attempt to determine the duties we owe to God; and some have even gone so far as to assert that man owes no duties to God distinct from those which he owes to himself and his fellow-creatures. With those who hold pantheistic views, such conclusions are unavoidable; for if God be not personally distinct from the universe, it becomes absurd to speak of our owing anything to Him as a being with whom we have special relations. But the opinion is not confined to the pantheistic school; it is advanced also by some who strenuously uphold the belief in an extra-mundane Deity. Of these we may take Kant as *instar omnium;* and it may suffice here to notice what he has said on the subject.[2] After asserting that, "in respect of an essence which lies entirely beyond the sphere of our experience, and yet is, as respects its possibility, found in our ideas,—namely, the Deity,—we have indeed a duty, which is called duty of religion, and this consists in the recognition of all our duties as divine commands," he goes on to say,—"But this is not the consciousness of a duty *towards* God; for since this idea proceeds entirely from our own reason, and is made by us with a theoretical view only to illustrate the conformity to purpose of the universe, or to serve as a motive

[1] Fragment of the 3d book of the treatise *De Republica*, preserved by Lactantius. Inst. vi. 8.

[2] See also Garve's *Philosophische Abhandlungen*, appended to his translation of Cicero, *De Officiis*, vol. ii., p. 55, ff., 5th ed.; Tieftrunk, *Grundriss d. Sittenlehre*, vol. i., p. 272, ff.; Niemeyer, *Handbuch für Christliche Religionslehrer*, p. 66, ff.

affecting our behaviour, it follows that we have here before us no given being *towards* which our obligation binds us. In order to this, his actuality must be first proved by experience (or revelation); but it is a duty of man to himself to apply this idea, which inevitably presents itself to the reason, to the moral law in us, where it is of the greatest moral fruitfulness."[1] Now, without adverting here to other questionable doctrines taught in these sentences, let us confine ourselves to the argument they contain against the possibility of our realizing duties towards God. This, it will be seen, rests solely on the assumption that we can be under moral obligation only towards beings whose actual existence we know by experience. But is this assumption tenable? Is experience the only medium through which we may arrive at a conviction of the actual existence of any being? And provided we know a being actually to exist, and to exist in relation to us, is it of the least moment *how* we acquire that knowledge, in respect of the duties which our ascertained relation to this being imposes on us? In the case before us, if we have sufficient assurance that God exists, and that He is a being with whom we have to do, we surely know enough to enable us to go some length at least in determining the duties we owe to Him. But it may be said, as Kant has, in the passage quoted, distinctly affirmed, that our knowledge of God does not amount to such assurance of His existence and of our relation to Him, but exists merely in the form of an idea or unavoidable conclusion of reason. Now, if the whole amount of what reason constrains us to conclude on this subject were, that something is conceived by us as theoretically possible, and is assumed by us to exist in order to complete our theory of the universe, it must be granted that towards such a being we could have no duties to perform. But we may appeal with confidence to the consciousness of the race, whether this be the only idea of God instilled into us by natural reason. At the very least, the something which is conceived of as accounting for the evidences of design and purpose in the arrangement of the universe is conceived of as a *causal* something, as a being who has brought into actual manifestation what previously existed potentially in himself, and must have been contemplated as the object of purpose in his mind. Kant himself admits this in another part of his writings. "The existing world," says he, "presents to us so immense a scene of variety, order, adaptation, and beauty, ... that the universal All must sink into the abyss of nonentity, unless we assume something that, outside of this boundless realm of the contingent, and existing primarily and independently for itself, upholds it, and, as the cause of its origin, secures to it also its continuance."[2] But if men know this much, they know enough to enable them to perceive a relation between themselves and this being, and enough consequently to enable them to determine that they owe *some* duties to Him. It is granted that the knowledge thus acquired is limited and imperfect, but it is sufficient to lay the basis of duty on the part of man towards God.

There is a sense in which all our duties are duties to God, inasmuch as all are comprehended in obedience to His will. But there are some duties of which He is directly the object, and it is to these we have now to attend.

(i.) It is our duty to seek earnestly to have just views of the being and perfections of God. Such views lie at the basis of all true piety: we are pious just in proportion as we think worthily of God; all religious emotion which does not spring out of just conceptions of God is mere superstition, and is only offensive to Him. "Primus est Deorum cultus Deos credere," says a heathen philosopher, "deinde reddere illis majestatem suam."[3] Hence the duty binding on all to follow up the convictions which nature may have impressed on them respecting the existence of God, by inquiring diligently whether He have given any more precise and complete revelation of Himself, and the duty of candidly examining the evidence of that book which professes to contain such a revelation.[4]

(ii.) It is our duty to cherish proper affections towards God. It behoves us to regard Him with reverence and holy fear, and to speak of Him with awe; to exercise constant dependence on Him, trust in Him, and submission to Him; to cultivate entire and cheerful resignation to His will; to delight in Him as the All-Perfect and All-Holy; and to gratefully love Him as our bountiful Father, from whose favour a continual stream of benefits descends upon us.

(iii.) It is our duty to exemplify our devout feelings towards God by appropriate acts. We are bound to receive with implicit belief whatever He makes known to us, assured that He neither can deceive nor be deceived; and on the same ground we are bound to have faith in that constitution and order which He has established in nature, including those natural sources of knowledge which He has opened in our own souls. We are bound to offer Him formal worship as an expression of internal love and reverence,—celebrating His praises, commemorating His goodness, and "speaking of the glorious honour of His majesty." We are bound to pray to Him for what we need, with confession of our sins and acknowledgment of His constant care and kindness. We are bound to swear only by His name; but we are not to take that name upon any trivial matter, on any matter of less than urgent importance; and having sworn by Him, we must dread, as a sin of enormous magnitude, the violating in the minutest particular of our oath. We are bound to practice the most stedfast obedience to all His commandments, and to use all our energies, and capacities, and opportunities, so as to serve Him and manifest His glory.

(iv.) It is our duty to imitate God's character and methods of acting, so far as may be competent to us. Infinitely as we are beneath Him in knowledge and power and goodness, we yet find in Him not only the source of all moral excellence, but the perfect model to which we, as moral agents, have to conform. All our studies, therefore, of his character and ways should be directed towards an assimilation of our characters to His, and our conduct to His. So important a place does the imitating of God occupy in the moral and religious life of man, that it is presented in Scripture as the counterpart and complement of our filial relation to God: "Be ye imitators of God, as dear children."[5]

SECT. IV.—COLLISION OF DUTIES.

Strictly speaking, there can be no collision of duties: in themselves, and viewed in the pure light of reason, all duties are in perfect harmony with each other. Nor can there be any real collision of duties practically; for when two duties appear opposed to each other, either the reasons in morality urging to the one exactly balance the reasons urging to the other, in which case the agent is placed in a moral lock, where one of the conditions of virtue, liberty of choice, is denied to him, so that neither of the two is a duty for him in the circumstances; or the reasons for the one overbalance the reasons for the other, in which case the latter ceases in the circumstances to be his duty. Cases, however, frequently

[1] *Tugendlehre*, Works, ix., 300. See also *Rechtslehre*, p. 46 of the same volume.

[2] *Kritik d. Reinen Vernunft*, p. 650.

[3] Seneca, *Ep.* xcv. Comp. Epictetus, *Ench.*, ch. xxxi.: τῆς περὶ τοὺς θεοὺς εὐσεβείας, ἴσθι ὅτι τὸ κυριώτατον ἐκεῖνό ἐστιν ὀρθὰς ὑπολήψεις περὶ αὐτῶν ἔχειν, &c.

[4] See Chalmers, *Natural Theology*, ch. ii., Works, vol. i., p. 56.

[5] Eph. v. 1. Not far from the same thought is the sentiment of the heathen Seneca,—"Satis illos (Deos) coluit quisquis imitatus est." (*Ep.* 95.)

Happiness. occur in actual life, where of two duties only one can be performed by us, and it is in reference to such cases that the phrase "collision of duties" is used.

In all such cases the question which each man has to determine is, on which side the overbalance of obligation lies; and this can be determined only by ascertaining which of the duties is urged upon us by the greater force of moral reasons. In pursuing this inquiry care must be taken to abstract from all considerations of expediency or advantage; for these do not enter into a moral calculation, and if allowed to sway the judgment may lead to an immoral conclusion.

To lay down rules for the guidance of conscience in such cases belongs to the science of Casuistry, or, as Kant calls it, "The Dialectic of Conscience." We can only here suggest one or two rules of a general kind.[1]

(i.) We must distinguish duties of *universal* obligation from duties of *particular* obligation, and assign to the former a superior moral authority to that of the latter. Thus, to speak the truth is a duty of universal obligation, whilst the duties arising out of social or domestic relations are of particular obligation; hence, if the latter cannot be performed without violating the former, they cease in such a case to be binding.

Obs. A question has been raised and discussed by all casuists, whether cases of necessity do not justify the telling of a lie—the case, *e.g.*, where, by telling the truth, we may cause serious injury, perhaps death, to a friend or relative. On this point the following remarks of Fichte are worthy of attention as going far to settle the question:—"The justification of a lie of necessity, or in general a lie for the sake of some good end, is without doubt the most senseless and the most perverse that can be heard among men. It is the most senseless. Thou sayest to me, that thou hast convinced thyself that a lie of necessity is permitted. Now, if I am to believe this, I must no less disbelieve it; for I cannot know whether thou, even whilst thou art speaking, mayest not, for the sake of some praiseworthy end—who can know all thy ends?—be making use of thy maxim against me, and whether, consequently, thine assurance that thou holdest a lie of necessity allowable, may not be itself a lie of necessity. Whoever really holds such a maxim can neither declare that he holds it, nor wish to make others hold it: he must carefully shut it up in himself, and wish it to be held only for himself; communicated, it destroys itself. . . . Without doubt, then, it is pure nonsense to demand belief for what, if it is believed, annuls itself. The justification of such a lie is further the most perverse that is possible for man: the justifier thereby discloses his thoroughly corrupt mode of thought. That the lie should have occurred to you as a possible means of escape from certain contingencies, and that you can seriously deliberate whether one may avail himself of such, is the true seat of your corruptness. In nature there is no instinct toward lies; the ethical mode of thought knows not the lie; there needs for this thought something positively evil, a reflective searching after some crooked way, and desire not to follow the straight path which offers itself to us. To the virtuous man this expedient does not occur; and were it left to him, the concept of lying would not be brought into the system of human concepts, nor the question as to the morality of a lie of necessity into ethics."[2]

(ii.) We must distinguish duties of *primary* from duties of *secondary* obligation, and give the former the preference in cases of apparent collision. Thus, to do justice is a duty of primary, to be generous a duty of secondary obligation; and hence we can be generous only when we have fulfilled the requirements of justice.

(iii.) As our duties arise out of our relations, their comparative urgency—*i.e.*, the degree in which we are morally obliged to perform them—varies according to the number and closeness of these relations. Hence our duty to God, to whom we sustain the most numerous and intimate relations, far transcends any duty we may owe to creatures, and must be allowed, consequently, to take precedence of all such duties: we must obey God rather than men, and love and honour Him above all beings. On the same principle, our relations and friends and fellow-countrymen have a claim upon us which is strong in proportion to their proximity to us, and in that order must the calls of duty in relation to them be obeyed.

(iv.) We must distinguish between what is simply *right* and what is *meritorious*. As a mere matter of rectitude, for instance, no man is required to prefer the interests of others to his own; but when a man chooses to sacrifice what he owes to himself for the good of others, he not only does no wrong, but he acquires merit and deserves reward. Hence, if my duty to myself requires me to follow one course, and the duties I owe to others require me to follow another, no one can justly blame me if I follow the former, but as little can any commend me unless I follow the latter.

(v.) Sometimes *mere circumstances* may determine us in our choice of duties. Thus, if I see several persons in danger of drowning, all equally indifferent to me, and of whom I can save only one, the question, *Which* one? may be best determined by circumstances, such as proximity of position, ease or certainty of success, &c.

PART IV.—OF HAPPINESS.

1. Happiness is the repose of an intelligent being in the full enjoyment of all that, according to its nature, it seeks. The term describes a purely subjective state, which must not be confounded with the objective possession of what is desirable; for a being may have everything that he can desire, and yet not be happy. Of happiness it has been justly said,—"Its home is within us rather than without us; to be happy depends less on what is possessed, than on how one regards and uses the possession."[3]

Obs. Kant defines happiness thus: "Happiness is the condition of an intelligent being in the world, to whom, in the whole of his existence, everything happens according to will and wish; and it rests, consequently, on the accordance of nature with his whole aims, by implication with the essential determining motives of his will." (*Kritik. d. Prakt. Vern.*, b. ii., chap. ii., sect. 5; vol. viii., p. 264, of his collected works.)

"Actual or formal felicity," says Leighton, "is the full possession and enjoyment of that complete and chief good [that, namely, which most perfectly supplies all the wants and satisfies all the cravings of our rational appetites]. It consists in a perfect tranquillity of the mind; not a dull and stupified indolence, like the calm that reigns in the Dead Sea, but such a peace of mind as is lively, active, and constantly attended with the purest joy; not a mere absence of uneasiness and pain, but such a perfect ease as is constantly accompanied with the most perfect satisfaction and supreme delight; and if the term had not been degraded by the mean uses to which it has been prostituted, I should not scruple to call it pleasure." (*Theological Lectures*, p. 18, Eng. tr., Lond. 1763.)

2. To aim at the attainment of happiness is inseparable from the constitution of man, or, indeed, of any intelligent agent; for it would be absurd to suppose a being, capable of happiness and endued with intelligence, who should be indifferent whether he was happy or not. Hence, as the schoolmen were wont to say, "in beatitudinem fertur voluntas, non ut voluntas sed ut natura,"—the will is borne towards happiness, not as will, but as nature. Happiness is, indeed, as Pope calls it, "our being's end and aim,"—

> "That something still which prompts the eternal sigh,
> For which we bear to live, or dare to die."[4]

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[1] See Ames, *De Conscientia et ejus jure vel casibus*, Amst. 1630; Perkins, *Cases of Conscience*, 4to, Lond. 1635; Sanderson, *Casus Conscientiæ*, Cant. 1688; Taylor, *Ductor Dubitantium*, &c., fol., Lond. 1660; Kant's *Tugendlehre*, &c.

[2] *System der Sittenlehre*, pp. 371–3.

[3] Weissäcker in Herzog's *Real-Encyclopädie*.

[4] *Essay on Man*, Ep. iv., l. 3, 4.

But though universally sought, happiness is not always or generally wisely sought by men. It is too often after a "confused manner," as Barrow expresses it, that they pursue their quest; "they rove through all the forest of creatures, and beat every bush of nature for it, hoping to catch it either in natural endowments and improvements of soul, or in the gifts of fortune, or in the acquists of industry,—in temporal possessions, in sensual enjoyments, in ludicrous divertisements and amusements of fancy, or in gratification of their appetites and passions. They all hunt for it, though following a different scent and running in various tracks; . . . . but all search in vain, or without any considerable success; finding at most, instead of it, some faint shadows or transitory flashes of pleasure, the which, depending on causes very contingent and mutable, residing in a frail temper of fluid humours of body, consisting in slight touches on the organs of sense, in frisks of the corporeal spirits, or in fumes and vapours twitching the imagination, do soon flag and expire; their short enjoyment being also tempered with regret, being easily dashed by any cross accident, soon declining into a nauseous satiety, and in the end degenerating into gall and bitter remorse."[1] Besides being true to the life, this passage suggests some of the causes, natural, and resulting from acquired habits, by which men are misled in their pursuit of happiness, or prevented from attaining it.[2]

3. The simple psychological law of happiness is, that the conative energies of our nature should terminate on the object to which they are directed. Thus happiness, so far as dependent on the appetites, is secured by the gratification of these; and so in respect of all our desires and passions, happiness, in so far as dependent on them, is secured by the attainment of the object by which they are excited. It is evident, however, that this psychological law will not cover all the requirements of the case; for unless there be some power to control and regulate our conative energies, man may enlarge his desires so as to render the supply of them impossible, or he may so fix his affections on unworthy objects as to do violence to his own higher nature. To this psychological law, therefore, must be added an ethical one that shall prescribe the order in which the various objects of human affection are to be sought, and the degree in which each is to be desired.

4. This ethical law may be presented under two forms: either we may determine among things desirable that which is most worthy of human pursuit, and enjoin upon man the attainment of this as his supreme end, and of other objects in the degree of their relative importance as compared with this; or we may analyze man's own nature, and making an estimate of the relative value of each of its parts, exhort him to cultivate and satisfy them, in the order and degree of their relative value.

The former of these methods was that chiefly affected by the ancient philosophers, whose ethical speculations terminated on the determination of the *summum bonum* or chief good of man. Their success, however, was not such as to prepossess us in favour of this method of prosecuting the inquiry; for their researches plunged them in endless diversity and controversy,[3] and tended ultimately rather to give a handle to the mockeries of the sceptic than to guide the sincere inquirer. Besides, if happiness depend rather on the mental condition of the individual than on the actual attainment by him of any outward good, it would seem altogether the more rational and hopeful course, in attempting to lay down rules for the attainment of happiness, to survey the subject in relation to man's own tendencies and capacities.

5. To man there may be said to belong two natures,—a higher and a lower. Of these, the latter embraces his animal functions, and the appetites and desires pertaining to these; and to the former belong his intellectual and moral capacities, with the desires and affections connected with them. In virtue of the one, man is connected with the brutes that perish, however much he may surpass them in excellence and beauty; in virtue of the other, man is assimilated to God, however far below Him in majesty and perfection; and hence there can be no doubt that the one is properly denominated the higher, *i.e.*, the more dignified, the more important, the more precious; the other the lower, that is, the less worthy and estimable. On this distinction, then, would we erect the ethical law of happiness. It may be enunciated thus:—So live as to secure primarily the full development and free activity of the higher powers, tendencies, and desires of your nature, and let the lower be attended to, ever as in subordination to these.

But in the higher nature of man there are also degrees. Embracing as it does the moral and intellectual being of man, it contemplates him as a creature made for religion, for virtue, and for intelligence. Now these do not stand on the same level either in dignity or worth. However precious be intelligence, it is not equal to virtue; and virtue, which falls short of religion, fails to provide for man's loftiest susceptibilities and most weighty interests. The order, then, in which these claim the attention of man is that in which we have named them. Religion occupies the highest place, and demands his supreme attention; virtue next; and knowledge, as subordinate to these.

6. When, then, religion and virtue predominate in man's nature, when his intellectual powers are exerted in the pursuit of knowledge as in subordination to piety and morality, and when all his animal propensities are kept under the control of reason and conscience, he obeys the great ethical law of happiness, and cannot fail to secure that measure of it which is attainable in the present life, and the fulness of it in that life which is to come.

7. If these remarks are just, it will not be difficult to answer a question which sometimes has perplexed inquirers, viz., In how far the pursuit of pleasure, as pleasure, is consistent with morality? On this question it is possible for the moralist to take much too high ground, and, by denouncing too vehemently and unqualifiedly all pleasure-seeking, to place his teachings in antagonism with the natural constitution of man and the obvious will of God. For man is made to seek pleasure as an end; and it is to be inferred that God wills it to be so, inasmuch as He has bestowed upon us so many susceptibilities of pleasurable enjoyment, has opened for us so many sources of pleasure, and has impressed upon us so strong a tendency to seek pleasure for its own sake. But there are limits to this pursuit within which alone it can be legitimately indulged.

These limits are transgressed—1. When men make mere enjoyment the sole or the supreme end of life; when they make nothing a study, nothing a duty, nothing a work, but are solely or chiefly occupied in flying from amusement to amusement; when, whether they are intellectually amused or sensually amused, they find in the mere amusement their end, and never rise beyond this in either case. 2. When men pursue pleasure to the neglect of duty;

[1] Barrow, *Sermon* xliii., Works by Hughes, vol. iii., p. 136.

[2] Mr Stewart has treated, with his usual sagacity and at length, the same aspect of the subject in his *Philosophy of the Active and Moral Powers*, vol. ii., p. 376, ff.

[3] Alii in animo, alii in corpore, alii in utroque fines bonorum posuerunt et malorum. Ex qua tripartita velut generalium distributione sectarum, M. Varro in libro de Philosophia tam multam dogmatum varietatem diligenter et subtiliter scrutatus advertit ut ad ducentas octaginta et octo sectas, non quæ jam essent sed quæ esse possent, adhibens quasdem differentias facillime perveniret. (Augustine, *De Civ. Dei*, b. xix., c. i.

Happiness. whether the duty neglected be one owing to themselves, such as temperance and moderation, or one owing to others, such as equity and honesty, or one owing to God, such as worship and obedience. 3. When men pursue pleasure so as to enervate their intellectual faculties, to blunt their moral susceptibilities, and to create a sensitiveness of the nervous system or the æsthetic faculty which unfits for the actual business of life. In all such cases pleasure is pursued immorally and to the permanent injury of the party; so that what our bountiful Creator gave us for a blessing is perversely turned into a curse; and what was intended to add to our happiness becomes a source of misery.

8. It only remains that we should advert to the question touching the relation to each other of goodness and happiness as supreme ends of human effort. As man is bound to both, they cannot be antagonistic to each other. But how are they connected with each other? Is the one to be absorbed in the other, or are they distinct and independent of each other?

By the ancient philosophers, with whom this question was one much discussed, the former of these positions was universally maintained; they differed only as to which of the two was the superior and absorbing power. On this point the Epicureans and the Stoics occupied the antipodal positions; the former of whom held that virtue was an accidental element of happiness, the latter that happiness was an accidental element in virtue. "To be consciously influenced by maxims that lead to happiness is virtue," exclaimed the Epicureans. "To be conscious of virtue is happiness," rejoined the Stoic. Kant, however, has shown[1] that such a connection of the two is untenable; that they are so different in kind, that identity cannot be sought between them. He maintains, further, that the connection between them is not causal; for experience shows us that neither is the desire for happiness a motive to virtue, nor is virtue an immediate cause of happiness, otherwise all virtuous persons would be happy in proportion to their goodness. He would, therefore, keep the two distinct as independent ends for man. There thus emerges what, in the peculiar phraseology of his school, he calls "the antinomy of the practical reason;" *i.e.*, not a case where two assumptions contradict each other, so that if one of them be true, the other must be false; but a case in which two propositions are both known to be true, yet cannot be construed in their harmony to the mind. Man is bound to pursue virtue; man cannot but pursue happiness; and yet neither are these identical, nor does the one lead directly to the other. This antinomy can be resolved only by taking into account the whole extent of man's being as destined for immortality, and spending now a probationary life for the future; and along with this his relation to God, in whom perfect holiness and perfect happiness are eternally conjoined; and who, having all things under his control, not only can reward the obedience of his servants here by a futurity of blessedness, but can make even present sufferings and sorrows conducive to future felicity. It is by living at peace with Him, through that reconciliation which He graciously offers to us, and by constantly serving Him, that virtue and happiness are to be united. Though we cannot directly command happiness, we shall thus follow a course which shall secure for us, along with the pleasure that springs from doing what is right, the prospect of perfect felicity above, and the consolation amid present ills which such a prospect, and the assurance that these ills will themselves be made conducive to a higher measure of felicity, cannot but communicate.

9. The conclusion at which we thus arrive is that in which alone the mind can rest. If we confine our view to the present state, it becomes impossible to show whether happiness or virtue should be the supreme object of pursuit. "When disputing with my friend," says Augustine, "concerning the ends of good and bad, I would have given the palm to Epicurus in my own mind, had it not been for my belief in the soul's life and the reach of deserts after death."[2] The natural conclusion of the majority of men, when the moral government of God and a future state of rewards and punishments, consequent upon our conduct in the present, is denied or overlooked, is that expressed by the words, "Let us eat and drink, for to-morrow we die." On the other hand, to the cultivated few the beauty of virtue, and the advantages of it, may appear such as to induce them to prefer it to all sensual indulgence; and they may loudly and eloquently commend the same course to others. But if, after all, the decision is to turn merely on which course produces the largest amount of present enjoyment, the majority will still be on the side of pleasure; and rightly, for if there be no futurity and no final retribution, a life of careless ease and sensual enjoyment is on the whole to be preferred to one of self-denial, toil, and struggle. It is only when the mind realizes man's true condition, as the subject of a moral government which is administered on a scheme of rewards and punishments, consequent on the desert of conduct, that the supreme importance of virtue and holiness is perceived; and men are disposed to count nothing a loss by which these are secured, and nothing a gain by which they are forfeited or missed.

"Si ergo quæratur a nobis quid civitas Dei de his singulis interrogata respondeat, ac primum de finibus bonorum malorumque quid sentiat, respondebit æternam vitam esse summum bonum, æternam vero mortem summum malum: propter illam proinde adipiscendam, istamque vitandam recte nobis esse vivendum."[3] (W.L.A.)

[1] *Kritik d. Prak. Vernunft*, b. ii., c. ii., vol. viii., p. 246, ff., of his collected works.
[2] *Confess.*, b. vi., c. xvi.
[3] Augustine, *De Civ. Dei*, b. xix., c. iv.

MORALES, Ambrosio, a Spanish historian and antiquary, was born at Cordova in 1513. After studying at the university of Salamanca under his uncle Fernan Perez de Oliva, he assumed the garb of the Dominicans at the age of nineteen, and became a strict and zealous ecclesiastic. At the same time his literary abilities were raising him to notice. He was afterwards appointed a professor at Alcala, and his learning as an antiquary procured for him in 1570 the office of historiographer to Philip II. It was at this period, when he was sixty-seven years of age, that he began to write his continuation of Ocampo's *Chronicle of Spain.* He had brought down the narrative as far as the union of the crowns of Castile and Leon, when he died in 1591. The best edition of Morales' *Chronicle* is that of Madrid, 6 vols. 4to, 1791. To this are generally added his *Spanish Antiquities*, 2 vols., 1792, and his miscellaneous works, 3 vols., 1793.

Morales, *Luis*, surnamed *El Divino*, from his character as a painter of sacred subjects, was born at Badajos in 1509. He made himself a proficient in his art by visiting the principal cities in Spain, and studying carefully the works of the different masters. His pictures of the "Saviour" and of "Magdalene" became especially famous for their faithful representation of intense bodily suffering blended with serene meekness. Morales was dragging out his old age in severe poverty, when Philip II., passing through Badajos in 1581, sought him out, and conferred upon him a pension of 300 ducats. He died at his native city in 1586. The masterpiece of Morales is his picture of "St Veronica," in the church of the Bare-footed Trinitarians in Madrid.

MORANO, a town of Naples, in the province of Calabria Citra, picturesquely situated on a conical hill on the western slope of Monte Polino, 5 miles W.N.W. of Castrovillari. The summit of the hill is occupied by an ancient Gothic castle; and the town has some manufactures of silk and woollen stuffs. Pop. 8352.

MORAT (Germ. *Murten*), a town and lake of Switzerland, in the canton of Fribourg. The town, which is situated on the eastern shore of the lake, stands on a rocky eminence surmounted by an ancient castle. The lake is about 5 miles in length by 3 in breadth, and is 60 fathoms in depth. It discharges its waters by the River Broye into the Lake of Neuchâtel. This place is celebrated as the scene of the victory gained by the Swiss in 1476 over the troops of Charles, Duke of Burgundy, in which the latter lost 15,000 on the field of battle, besides many others drowned in the lake. The bones of the dead remained for three centuries piled up in a building called an *ossuary;* but this was destroyed, and most of the bones carried away, in 1798, by the soldiers in the Burgundian legion of the French army. The few bones that remained were buried, and an obelisk raised over them on the spot where the ossuary formerly stood.

MORATIN, Leandro Fernandez, a celebrated Spanish dramatist, was the son of the poet Nicolas Fernandez Moratin, and was born at Madrid on the 10th March 1760. Under the tuition of his father he evinced a strong devotion to poetry and painting; but it was thought a part of parental duty to divert his thoughts from such profitless aspirations towards some lucrative calling. He was therefore apprenticed at an early age to a jeweller. His poetical studies, however, were continued; and at the age of eighteen he appeared before the world as the gainer of the second prize awarded by the Spanish Academy for a heroic poem on the conquest of Granada. The winning of another prize in 1782 for a satire against poetasters, entitled *Leccion Poetica,* encouraged him to abandon his trade, and to hope for some more congenial calling. At the recommendation of the famous statesman Jovellanos, he was appointed secretary to Cabarrus in 1786. Attending his master in the following year at the court of Versailles, he acquired that intimacy with the French drama which formed so important an element in his dramatic education. On his return to Spain in 1789, the minister, Florida Blanca, presented him with a benefice in the archbishopric of Burgos, and Moratin had only to take the tonsure to become the occupant of a sinecure of 300 ducats annually. Thus fortified against all pecuniary anxiety, he turned with enthusiasm to the prosecution of the drama. His first comedy, *El Viéjo y la Niña*, was produced on the stage in 1790. Strongly marked with that regularity of plan, liveliness of dialogue, and elegance of style which afterwards became the chief basis of Moratin's fame, it called forth great applause. His *El Café*, or *La Comédia Nuéva,* acted in 1792, was equally successful, and may be said to have completed that reformation of the Spanish theatre which had been begun sixty years before. In the same year Florida Blanca was disgraced; but Moratin immediately found another patron in Godoy, who bestowed upon him a pension of 600 ducats, and even supplied him with money to gratify his desire for foreign travel. He accordingly visited in succession England, Holland, Flanders, Germany, and Italy, studying the dramatic literature of each of these countries, and extending his knowledge of men and manners. On his return he began to translate the *Hamlet* of Shakspeare, the *Médecin Malgre lui* and the *École des Maris* of Molière. His most popular comedy, *El Si de las Niñas*, appeared in 1806. It was acted to crowded houses for twenty successive nights, ran through four editions in one year, and was afterwards translated into many languages. Moratin was now in the noonday of his prosperity. He was among the wealthiest of poets; he was a frequent guest in the mansions of the great, and he could retire at pleasure to indulge his æsthetic tastes in a luxurious country retreat. In 1808, however, his good fortune began to wane. His patrons were forced to flee before the French invasion, and relinquish the throne of Spain to Joseph Bonaparte. It was in vain that Moratin bartered his patriotism for the continuation of his pensions, that he temporized with the invaders, and that he allowed himself to be appointed chief librarian to the usurper. He saw himself compelled in 1812 to abandon the sinking fortunes of the French, and to take refuge in the camp of the patriots. He was received with cold distrust, his private property was sequestered, and his revenues and pensions were withheld. Even after he had been pardoned and restored to his privileges by Ferdinand VII. in 1814, his dread of official assassins would give him no rest until he had crossed the Pyrenees, and had taken up his abode at Paris. In 1821 Bordeaux became his settled residence; and there his learned work, *Origenes del Teátro Español*, was elaborated. He returned to the French capital in 1827, and died there in June of the following year. Moratin also wrote the three dramas of *El Barón*, *La Lugareña orgullósa*, and *La Mogigáta*, and several lyric poems. There are several editions both of his lyrical and of his dramatic works.

Moratin, *Nicolas Fernandez*, an eminent Spanish poet, was descended from an old Biscayan family, and was born at Madrid in 1737. He became at an early age a convert to the opinions of those who were attempting to drive the romantic drama off the Spanish stage. His friendship with Montiano, a cultivator of the classical tragedy, confirmed his zeal; and his earliest efforts were devoted to the cause of theatrical reform. In 1762 he published a comedy, *La Petimétra,* written in accordance with French models, and three discourses against the old drama and the *Autos Sacramentales.* The comedy did not succeed. The discourses were so far successful, that the *Autos* were condemned by a royal edict in July 1765. His ultimate measure in behalf of the reformation of the drama was taken in 1770, when he produced on the stage his tragedy of *Hormesinda*, written in entire obedience to the canons which governed

Corneille and Racine. It was received with favour. Meanwhile Moratin had been displaying his finish of diction and his harmony of versification to greater advantage in several poetical works. He had published in 1764 a collection of short pieces, under the title of *El Poéta*, and in the following year a diadactic poem on the chase, entitled *Diana*. In 1765 had appeared his greatest work, the spirited historical epic styled *Las Náves de Cortès Destruidas*. Although intimate with several of the chief courtiers, Moratin disdained to cringe for promotion by hanging on the skirts of some great man. He chose rather to live in retirement, and to drudge at the uncongenial pursuit of law for the support of his wife and son. At length his appointment to succeed Ayala in the chair of poetry in the Imperial College placed him in his proper sphere. He directed his professorial instructions to that life-long aim of his, the improvement of the taste of his fellow-countrymen. To further the same project, he gathered around him the principal literary men of the capital. A club was formed, and met regularly in the "Fónda de San Sebástian," to discuss contemporaneous literature, both native and foreign; and, above all, to devise methods for reviving the decaying spirit of the country. Moratin died in 1780. A collection of his poems, with a Life, was published at Barcelona in 1821 by his son, the dramatic poet Leandro Fernandez Moratin. He was also the author of several prose works.

MORAVA, the principal river of Servia, formed by the confluence of the East and West Morava, about 30 miles W. of Nissa. The united stream flows northwards to the Danube, into which it falls at Kullica, 6 miles N.E. of Semendria, after a course of 115 miles, and the upper branches are each about 150 miles in length.

MORAVIA. See Austria.

MORAVIANS. See Bohemian Brethren.

MORAY or Elginshire, a maritime county of Scotland, on the Moray Firth, bounded N. by the same, W. by Nairnshire, S.W. by Inverness-shire, part of which severs it into two parts, and S.E. and E. by Banffshire. The northern portion of it, lying between Inverness-shire and the sea, is 26 miles in length by 23 miles in breadth; the southern portion, inclosed by Inverness-shire, 14 miles long by 12 miles in breadth; while both together have an area of 340,000 statute acres. In its physical aspects Morayshire presents the characteristics of the Lowlands as well as those of the Highlands of Scotland. The former constitute the maritime section of the county, and the latter the interior. A light, gravelly soil, resting on a Devonian bottom, characterizes the surface of the maritime portion of the county, extending from 4 to 6 miles from the sea-coast. Undulations spread through this district, and in the parishes of Duffus and Elgin become hills of slight elevation. Southward, in the interior, the land becomes always more and more mountainous, until, on the borders of Inverness-shire and Banffshire, it attains a very considerable elevation. The geologic system of this, the highland section, is primary, with here and there strata of mountain limestone. Gneiss is the most prevalent rock among the hills, but it frequently approaches to granite in its structure, especially on the borders of Banff and Inverness shires. The climate of the county is generally considered healthy. On the coast, where the soil is gravelly, and consequently of a dry nature, the temperature is mild; but on the uplands it is more changeable and more subject to extremes. Westerly winds prevail in Morayshire for nearly three-fourths of the year; but most of the heavy gales that visit this county are from the N. or N.W. Easterly winds, however, are prevalent in spring, to the great injury of vegetation. The annual fall of rain upon the N.E. part, near Speymouth, is stated to be little more than 25 inches, and the mean temperature of the year to range from 45° to 50°. In the hilly region, however, the winter is long and often severe, and the harvesting is generally late in being brought to a close. Moray, however, has the other advantages of an extended sea-coast, and large rivers traversing its valleys. The former stretches for about 30 miles along the Moray Firth, from the mouth of the Spey to beyond the Findhorn. It presents to the sea several bold headlands, such as Burgh and Stotefield Heads, and has likewise considerable inlets at the mouths of the Findhorn and Spey rivers. The harbours on the coast are, however, few and insecure. The principal streams of Morayshire are the Spey, on its eastern boundary; the Findhorn, on the W.; and the Lossie, in the centre of the county. The first of these rises from Loch Spey in Inverness-shire, and has about one-half its entire course in that county, after which it enters Moray at Tomachrochri. It then bounds the parish of Abernethy on the W. for about 3 miles, and afterwards separates it from the parish of Duthil. After traversing the detached part of Inverness-shire, the Spey again enters Morayshire, and forms its boundary on Banffshire for the greater part of its course downwards. The stream at last reaches the sea, below the town of Speymouth, by means of a wide mouth studded with islands, after a course of about 110 miles. It has a very rapid and tortuous course; and, after the Tay, discharges the largest volume of water of any stream in Scotland. No part of it is navigable, but it is much used for floating down timber. From the great bends in its course, together with the rapidity of its flow, the strath or valley has been long subject to very destructive inundations. The scenery on the banks of this river is frequently of a highly picturesque character. The Findhorn, which enters Moray on the west, is next in importance to the Spey. Rising among the mountains of Badenoch, it takes its meandering course north-eastwards through Inverness, and entering Nairnshire a little above Balknockan, traverses that county in the same direction. It enters Moray at Kilmoney, when it gradually turns to the N., and after receiving the waters of the Dorbas and other smaller tributaries, falls into Loch Findhorn, an inlet of the sea. Its total course is about 50 miles, for 10 of which it flows through Moray, but its waters are not navigable. Valuable salmon-fisheries pertain to the stream. Like the Spey, it is noted for sudden and destructive inundations. The "Moray floods" of 1829 were caused by a great outbreak of the Findorn. The only other river worthy of mention is the Lossie, which, rising from a loch of the same name, traverses the centre of the county by an irregular N. by E. course, receives the Lochty on its left, and, after passing the town of Elgin, empties itself into the Moray Firth after a course of 25 miles, all within this county. The surface of Morayshire is otherwise diversified by several small lakes. In regard to its soil and agriculture this county may be divided into the maritime or lowland and the highland districts. Of the first, the soil is open and well suited for both wheat and oats. The highlands, on the other hand, are, with the exception of some parts of the valleys, exclusively devoted to pasture, especially for sheep. The breeds that are fed on the hills are mostly Cheviots and black-faced, while crosses with the Leicestershire and South Downs are generally confined to the lowlands. Most of the cattle are crosses between the native breed and those of Teeswater or Aberdeenshire. The great stimulus given to the agricultural interest in the production of stock, corn, and other commodities for the metropolitan markets, by the ready communication obtained either by sea or railway, has been the cause of many improvements in farming, as well as of a steady rise in the price of land. In 1857 there were 82,401 acres in the county under rotation of crops, against 80,413 acres in the preceding year; and the following statistics for the year 1857 give the acreages as returned:—There were in that year 28,560 acres under grass and hay, 17,213 under oats, 12,737 turnips, 9522 barley, 8749 wheat, 3190 po-

tatoes, 776 rye, 481 bere, 409 tares, and 284 under bare or summer fallow. Of live stock in the same year there was an aggregate of 88,916, against 90,982 in the preceding year. In 1857 the following were the specified numbers:—56,336 sheep, 23,231 cattle, 5024 horses, and 4325 swine. The number of occupants of arable lands was in the same year 1146, or 1 to every 72 acres of arable farmage. In 1856 the valuation of the county (excepting the two burghs) amounted to L.116,851, against L.113,954 in 1855, and L.62,312 in 1811. Morayshire is not rich in mineral resources; excellent sandstone, however, and limestone are to be had in the county, which latter is shipped in considerable quantities. Peat is plentiful among the hills, and is much used for fuel. Large plantations of fir, larch, and other trees, supply the county with plenty of timber, which is generally floated down the streams in rafts. The manufactures are insignificant, and consist chiefly of beer, whisky, woollens, and ropes. The Great North of Scotland Railroad traverses the lowland part of the county, and sends off a branch line from Elgin to Lossiemouth on the coast. Regular communication with the south is also kept up by means of steam-packets. Moray unites with Nairnshire in returning a member to Parliament. It belongs to the northern circuit, and the assizes are held in Aberdeen. Ecclesiastically the county pertains to the synod of Moray; and in 1851 it contained 62 churches, with 28,293 sittings. Of the former, 24 belonged to the Established, 20 to the Free, 8 to the United Presbyterian, 4 to the Independent, and 2 each to the Episcopal, Baptist, and Roman Catholic denominations. For educational purposes there are 65 public schools and 31 private seminaries. The county shares with those of Banff and Aberdeen in the Dick Bequest, left for the purpose of increasing the salaries of teachers in these three counties. The number of poor relieved in the year ending May 14, 1856, was 1472, out of a population of 39,494 (in 1851); and the total amount collected for this purpose was, in the same year, L.8904, against L.8659 expended. The present Morayshire formerly occupied the middle district of the old county of Moray. Its earliest reliable history commences with the invasion of its territory by the Danes in 1008, when Malcolm II. of Scotland marched against them, but was defeated near Forres. They afterwards brought over their wives and children, and established a settlement here; but their possession of the country was disturbed by defeats which they sustained on three different occasions at the hands of the Scots, who ultimately forced them to leave the country. Moray was then incorporated in the kingdom of Scotland. There are many antiquities in this county, one of the principal of which is Pluscardine Abbey church, on the Lossie, near Elgin, a fine cruciform edifice, with a square tower of hewn stone. It was founded in 1230 by Alexander II., and bestowed upon the monks of Valles Caulium, a reformed order of Cistercians. Darnaway Castle, in the parish of Dyke and Moy, is likewise a building of great antiquity, and has been the seat of the Earls of Moray, of the Randolph, Douglas, and Stuart families. Besides other interesting reliques, some remains of Danish monuments and fortifications are still extant. Of the former, the most remarkable is Sweno's Stone, near Forres, a large slab covered with representations of beasts, &c., 23 feet in height by about 4 in width, and said to reach into the ground for more than 10 feet. The aggregate population of the whole county was, in 1821, 31,398; in 1831, 34,498; in 1841, 35,012; and in 1851, 38,959. Of the last, 20,768 were females, and 18,191 males. Of towns containing more than 2000 inhabitants there were only two here in 1851,—viz., Elgin, the capital (6337), and Forres (3468), both of which are parliamentary and municipal burghs.

MORBIHAN, a department in the W. of France, bounded on the N. by that of Côtes-du-Nord, E. by Ille-et-Vilaine, S. by Loire-Inferieure and the Bay of Biscay, and W. by Finistère. It lies between 47. 27. and 48. 15. N. Lat., and 2. 1. and 3. 38. W. Long.; and its length from E. to W. is 72 miles, by 52 in extreme breadth. Area, 3627 square miles. The coast is very much indented, and contains one remarkable inlet called the Morbihan, from which the department takes its name. The entrance is narrow, but it spreads out to a large extent inland, and contains numerous islands. To the west of the entrance of the Morbihan is the peninsula of Quiberon, extending southwards into the sea for 10 miles, and connected with the mainland by a narrow isthmus, which is covered with water at the highest tides. The bay to the east affords excellent anchorage, and is capable of containing a large number of vessels. It is protected by a fort built on the peninsula. Several islands lie off the coast of the department, the largest of which is Belle-Isle, to the south of Quiberon. The surface of Morbihan is rugged and hilly. In the north there is a range of hills covered with barren moors and heaths; but in the lower grounds there are many fertile valleys. The soil is not deep, except near the coast. The rocks of the department belong principally to the primary formation, but in some places stratified and crystalline deposits occur. There are numerous rivers, but none of any great size: they flow generally from N. to S., and some are navigable for a short distance from their mouth. The most important are,—the Blavet, Oust, Auray, and Vilaine. Morbihan is traversed by two canals, one of which follows the course of the Blavet; the other, connecting Nantes with Brest, crosses the department from S.E. to N.W. The climate is mild, but foggy; and the principal wind is from the S.W. Agriculture is not in a very advanced state, and the cultivated land is comparatively small in extent, amounting to about 666,500 acres. The pasture land occupies 170,637 acres; woods, 88,372 acres; and the moors and heaths, 720,415 acres. The department produces corn in greater quantity than is necessary for the supply of the inhabitants, so that a considerable part is exported. Rye and buckwheat are the kinds principally grown. Maize, potatoes, hemp, flax, and apples for cider, are also among the productions of Morbihan. It is further estimated to contain 295,000 horned cattle, 255,000 sheep, 10,000 goats, 60,000 swine, and 42,000 horses. Bees are kept in large numbers, and produce a very excellent quality of honey. The department contains iron and tin mines, which are worked to a considerable extent, besides quarries of granite and other building stones, slates, clay, &c., and salt-pans at various places on the coast. The manufactures of Morbihan consist chiefly of iron, linen, cloth, leather, paper, and porcelain. Ship-building is carried on to a great extent, especially at Lorient, where many of the best men-of-war in the French navy are constructed. The fisheries, especially of sardines, in which branch alone 500 boats are engaged, give employment to a large number of the inhabitants of the coast, and yield annually more than L.60,000. The principal articles exported are horses, cattle, corn, rye bread, honey, wax, fish, salt meat, &c. Morbihan is divided into four arrondissements, as follows:—

	Cantons.	Communes.	Population (1851).
Vannes	11	74	132,171
Pontivy	7	45	105,984
Lorient	11	49	148,779
Ploermel	8	61	91,238
	37	229	478,172

In 1856, however, the department contained 234 communes and 473,932 inhabitants. The capital is Vannes; but the most populous town is Lorient, which has nearly twice as many inhabitants. The people of Morbihan, like those of the other parts of Brittany, are of Celtic origin, and speak a language similar to the Welsh and Cornish dialects of our island, which have the same origin. They

are very much behind the rest of the French in civilization, and preserve almost unchanged the dress, manners, and superstitions of their ancestors. Morbihan forms the bishopric of Vannes, and has two tribunals of commerce at Vannes and Lorient.

MORCELLI, STEFANO ANTONIO, a learned antiquary, was born at Chiari in 1737. While attending school at the neighbouring city of Brescia he attracted the notice of the Jesuits, was drawn by them within their society, and was sent to study at Rome. The chair of eloquence in that city was conferred upon him in 1771. In this situation he continued zealously to advance the cause of learning, both by his teaching and by his works on antiquarian subjects, until the suppression of his order in 1773. He was then received into the house of Cardinal Albani, where, in the magnificent library of his patron, he passed several years of literary leisure, composing his chief work, *De Stilo Inscriptionum Latinarum, Libri III.* It was published at Rome in 1780. In 1791 Morcelli was recalled to Chiari to be provost of the chapter. The rest of his life was characterized throughout by self-denying benevolence. He refused the archbishopric of Ragusa, through a desire to end his days in his native town. He founded and endowed an institution for the education of young females, restored the schools, repaired the churches and other public edifices, and presented his library to his fellow-citizens. His death took place in 1821. Some of Morcelli's other works are,—*Inscriptiones Commentariis Subjectis*, 4to, Rome, 1783; *Kalendarium Ecclesiæ Constantinopolitanæ*, 2 vols. 4to, Rome, 1788; and *Africa Christiana*, 3 vols. 4to, Brescia, 1816.

MORCONE, a town of Naples, province of Molise, is situated on a hill 15 miles S.S.W. of Campobasso. It has a fort, and is surrounded by walls. The manufacture of woollen stuffs is carried on here. Pop. 5000.

MORDAUNT, CHARLES, Earl of Peterborough and Monmouth, celebrated for his extraordinary exploits both by sea and land, was the son of John, Lord Mordaunt, Viscount Avalon, and was born about the year 1658. He was brought up at the profligate court of Charles II., where he learned early to advocate scepticism and play the libertine. Sated with court pleasures and longing for adventure, he joined Sir John Narborough's fleet in his seventeenth year, and set out for the Mediterranean waters to strike a blow at the Algerine corsairs who then preyed upon the industry of the British trader. On the night of the 14th January 1675 he witnessed the destruction of the corsair ships in the harbour of Tripoli, and fought gallantly by the side of Lieutenant Cloudsley Shovel, who had the command of that daring expedition. On his return to England in 1677 he succeeded to the titles and estates of his father, who had died during his absence; and before he had attained to man's years he married a daughter of Sir Alexander Fraser of Dotes in Kincardineshire. This marriage had not the effect of improving his character: the quiet of domestic life did not suit his temper; and his wild, restless spirit burned for adventure either by flood or field. In 1678 we find him once more engaged in some fierce scuffles with the Algerine rovers; and during the following year he saw much hard fighting at the siege of Tangier. He had no sooner returned to England than he entered Parliament, and assumed his first political position as a "peer of the realm" by offering a determined opposition to the royal proposal to remove the Parliament to Oxford. From that hour he employed all his influence to thwart the royal race, against whom he had cherished a bitter hatred from his very boyhood. He had qualities in him, moreover, which rendered him a formidable opponent. He had already a reputation as a daring soldier and a bold sailor, and was well known to be an accomplished scholar and a ready wit. His mind had ever been as active as his body. Whether he was occupied in "nayling up his hangings" on Sabbath, and shocking the chaplain with his profanity while tossing about in the Bay of Biscay, or hotly engaged in boarding an African rover in the Mediterranean, he never neglected to snatch a quiet hour for reading and culture. Despite the dark menace of Judge Jeffreys and his infamous supporters, this enthusiastic young lord became an earnest partisan of Lord Russell and Algernon Sidney. He stood by those noble men to the last, and accompanied Sidney to the scaffold. Yet these ennobling associations could not wean him from indulging in occasional bursts of mad frolic and wild eccentricity. He delivered his first speech in Parliament on the 19th November 1685, in opposition to the keeping up of a standing army. It was characterized by great power and boldness, and was full of impetuous, fiery eloquence. Among his friends it excited great hopes, and among his enemies it rendered him a marked man.

His prodigal generosity, combined with a limited income, had led him into pecuniary embarrassments, and he resolved to seek that employment abroad which was denied him at home. He had a hearty hatred of Popery and despotism; and in 1686 he quitted England for Holland, then the home of liberty and Protestantism. After vainly urging the Prince of Orange to an immediate invasion of England, he took up his abode in Holland, and remained there till the Revolution. Here he formed an intimate friendship with John Locke, who was then meditating his great *Essay* in exile. Mordaunt accompanied the Prince to England in 1688, received a lieutenant-colonelcy, and did good service during that critical period. On the 9th of April 1689 he was made first commissioner of the Treasury, and on the day following was created Earl of Monmouth. He stood by his royal patron in his signal defeat in the matter of the Test Act; but many months had not elapsed before he became jealous of his Majesty, and assumed a position of hostility which cost him his office. Monmouth formed one of the council of nine appointed by the King to aid Queen Mary in directing public affairs during the absence of her royal husband in Ireland. "The nine kings," disliked and suspected each other, and Monmouth strove sedulously to damage his fellow-councillors in the eyes of the Queen. He was accused of writing the notorious *lemon letters*, and intrigued hard for the sole command of the fleet. The restless ambition and immoderate vanity of the man here, as elsewhere, proved his greatest snares. He was obviously getting tired not only of the existing government, but of the royal family itself. The campaign of 1691 gave scope to his activity; and after serving with distinction on the Continent at the head of his regiment, the Royal Horse Guards, he returned to England and went into retirement. Here he sought the society of men of letters, cultivated his mind and his garden, made a boast of his immoralities, and sneered at religion. His Majesty did not seem disposed to recall him to power, and the Earl's growing dislike to royalty continued. In 1696 he got involved in Fenwick's plot, which deprived him of all his employments, and sent him to the Tower. Here "he was as violent as a falcon just caged;" but William, with his accustomed leniency, gave early orders for his release. In the midst of his disgrace he found that he had inherited the earldom of his house; and with an undaunted front and characteristic energy, he resolved to atone for the tarnished scutcheon of Monmouth by adding fresh lustre to that of Peterborough. The way was not yet clear before him, however, and he found time to visit the pious Fenélon. On coming away, the sceptic remarked, "If I stay here another week, I shall be a Christian in spite of myself." The King died in 1702; and Marlborough had no sooner come into power under Queen Anne, than Peterborough, with his graceful flattery and brilliant wit, was by the side of Lady Marlborough, and had already conquered her dislike, and won

her esteem. The war of the Spanish succession had now to be engaged in, and the Low Countries and Spain were the chosen battlefields for the arms of England. Marlborough reaped fame and fortune on the one, Peterborough amazed all Europe on the other.

Early in 1705 an English fleet and army were equipped for the Mediterranean shores of Spain, and Peterborough was named commander of the troops, and joint commander of the fleet with his old fellow-soldier, Sir Cloudsley Shovel, who long years ago had fought by his side in that fiery midnight exploit among the corsairs of Tripoli. The generous Earl well nigh beggared himself in fitting out his raw and undisciplined army of 5000 men. After much fruitless manœuvring on the Spanish coasts, he at last besieged Barcelona, and by a series of dexterous movements, characterized by unparalleled boldness and transcendant military skill, he succeeded in making the city his own. Having left King Charles III. to the protection of his Catalan subjects, Peterborough turned his attention to the reduction of Valencia and Catalonia. This, with the means at his disposal, would have appeared to any other man an absolutely hopeless undertaking. Before him lay an enemy many thousands strong and well disciplined, commanded by able officers and secured by strong positions; while he, instead of an army, had only a small escort, imperfectly equipped, and in a hostile country beset with incredible difficulties. Against such fearful odds this audacious general, with his gallant little band, undertook to reduce the Spanish Peninsula, and commenced one of the most extraordinary campaigns to be found in the annals of warfare. What he could not effect by material strength and valour, he resolved to accomplish by superior sagacity, and, if need were, by the most unblushing deceit. He magnified his numbers by every fanciful artifice, circulated the most mendacious intelligence respecting his strength and movements, scoured the sierras with the most incredible swiftness, and swept down upon the affrighted foe with the speed and nimbleness of a falcon. He frightened his enemies by the incomprehensible mystery which the rapidity of his movements cast over all he did. All their calculations were at fault: ordinary military skill was of no avail against this wild reckless adventurer, whose very folly proved wiser than the concentrated wisdom of the enemy's council. The most successful exploits were not unfrequently achieved "without money and without men;" while his opponents, many thousands strong, with all Spain at their back, could not succeed in keeping him out of their strongest cities. "A skeleton in outward figure," as Swift says of him, he was capable of the most incredible physical endurance, and seldom indulged in a moment's rest, except when the dark-eyed señoras of Spain lured him for a short hour from his prey. His military daring, his gallantry to the fair sex, and his courtesy to the priesthood, made him a universal favourite with the Spaniards. If they showed resistance, he made them quail by the very wind of his stroke; and once within their gates, he put up his sword, and won the rest by the smoothness of his tongue and the light of his eyes. He relieved Barcelona when greatly harassed by the French by sea and land, and drove the Duke of Anjou out of Spain, with his 25,000 Frenchmen at his back. He soon gained possession of Catalonia, of the kingdoms of Valencia and Aragon, with part of Murcia and Castile, and had prepared the way for Charles making a safe entry into Madrid, which would in all probability have put an end to the campaign, and have secured him his throne. His Majesty, however, put more confidence in his dull German advisers than in the brilliant Earl, who, it must be said, was less obsequious to royalty than those jealous and stupid councillors from beyond the Rhine. Peterborough, who saw that this silliness would cost Charles his kingdom, and undo all that had been already achieved, urged with uncommon patience and devotion the necessity of pursuing an opposite course. But it proved of no avail. The Earl's immoderate vanity had combined with his success in making him be heartily hated by the mean and incompetent; and the foulest lies regarding his conduct had found their way to the ears of his royal mistress in England. Dissensions at length arose among the allied generals. Lord Galway claimed the sole command of the armies in Spain; Stanhope insisted upon offensive measures, Peterborough on defensive; and the disastrous battle of Almanza subsequently proved that the latter was right. Peterborough's counsel was neglected, however, and the prince for whom he had well nigh won a crown, treated him with careless ingratitude. The proud warrior turned his back on the land of his romantic career, and with bitterness in his heart, and a "God preserve any country from the best of German ministers" on his lips, he embarked at Valencia on the 14th May 1706, and bade adieu to Spain. He made his way for Turin, where he remained for some time; but his recall being urgently repeated, he returned to England on the 20th August 1707. Public opinion ran high in his favour on his arrival. Anonymous authors penned extravagant pamphlets in eulogy of him, grave pulpits sounded his praises, and Swift wrote quaint doggrels in honour of "the ramblingest lying rogue on earth." The House of Lords, after much jealousy and a great parade of ceremony, condescended publicly to thank him for his "wonderful and amazing success."

The war, which enriched Marlborough, well nigh beggared Peterborough. The latter hated the Whigs almost as heartily as he did the Tories; and it was considered a great relief to get him despatched for a time to the court of Vienna on some piece of imaginary diplomacy. On his return to London he retired to his residence at Parson's Green, where he gathered round him the leading wits of the day, and gave many "a jovial supper," cooked by his own hands, to Pope, Prior, Lewis, Gay, Friend, and the gruff Dean of St Patrick's, who "loved the bang-dog dearly." In 1709, and a very short time after the death of his two brilliant sons, Peterborough lost his wife, "a lady of admirable wit and judgment," whom he seems to have neglected much more than was meet. After her death he consoled himself for his loss by marrying Anastasia Robinson, a sweet dramatic singer of unblemished reputation, who cherished his declining years with much care. To vary the monotony of married life, he engaged in a sort of Platonic correspondence with Mrs Howard, the mistress of George II., and afterwards Countess of Suffolk, which is still preserved, and is full of much solemn nonsense and lamentably poor verses. His iron constitution had for some time been rapidly giving way, and having undertaken a voyage to Lisbon for the benefit of his health, he died on reaching that city on the 25th of October 1735.

The character of Peterborough, with all its faults and excellences, has not had justice done it. Samuel Johnson said of him once, "he is a favourite of mine, and is not enough known; his character has been only ventilated in party pamphlets." Sir Walter Scott seems also to have taken an interest in his history, as it is known that he was engaged on a Life of the Earl, which he never lived to complete. A highly interesting *Memoir of Charles Mordaunt, Earl of Peterborough and Monmouth, with selections from his Correspondence*, 2 vols., appeared in 1853, from the pen of Eliot Warburton.

MORDEE BAY, on the east coast of the island of Bombay, in Hindustan. The site having been pointed out as an eligible locality for the terminus of the Bombay Railway, a project has been sanctioned for its reclamation from the sea. Lat. 18. 56., Long. 72. 54.

MORE, Sir Anthony. See Moro, *Attoni*.

More, *Hannah*, an eminent writer of religious and moral works, was born in 1745 at Stapleton in Gloucestershire,

More, Hannah.

where her father held the humble situation of village schoolmaster. Being afterwards appointed to the parochial school of St Mary Redcliff at Bristol, his daughter gained the intimacy and patronage of Dr Stonehouse, who enabled her to set on foot a flourishing school for boarders and day pupils, which continued to be conducted with great success by her sisters. Her first literary efforts were some poetical pieces, and amongst them was a pastoral drama. Manuscript copies of these effusions were seen and admired by several persons of literary taste and discrimination at Bristol, who strongly recommended their publication. They accordingly appeared; and the drama, which was entitled the *Search after Happiness*, soon became very popular. This flattering reception induced the author to try her strength in the highest walk of dramatic poetry; and she successively brought upon the stage her tragedies of the *Inflexible Captive*, *Percy*, and the *Fatal Falsehood*. Garrick was warmly attached to her; and it was owing in no small degree to the talents of that distinguished player that the second of these compositions was enacted at Drury Lane during fourteen successive nights. Soon after the production of her first tragedy she published two legendary poems, entitled *Sir Eldred of the Bower* and the *Bleeding Rock*, founded upon popular traditions current in Somersetshire. These pieces had very great success, as had also her volume of *Essays for Young Ladies*, which she afterwards expunged from the edition of her works published in 1801, on the ground that the book was superseded by her *Treatise on Female Education*.

In 1782 Hannah More greatly added to her reputation by the publication of a volume of *Sacred Dramas*, to which was annexed a poem called *Sensibility*, much commended by Dr Johnson. In 1786 this indefatigable writer gave to the world two poems—*Florio, a Tale*, and *Bas Bleu, or the Conversation*. The first is a respectable and not ill-natured satire on the frivolous manners of the young gentlemen of the period. The second, also a satire, is directed against the Blue-Stocking Club, which met at Mrs Montagu's in Portman Square, and was so called from one of the members, Mrs Jarningham, always wearing stockings of a blue colour. Other works successively proceeded from her pen. Of these the principal are,—a *Poem on the Slave Trade*, printed in 1788; a tract entitled *Thoughts on the Manners of the Great*, which appeared the same year; *An Estimate of the Religion of the Fashionable World*, published in the year 1791, and esteemed one of her best productions; *Remarks on the Speech of M. Dupont in the National Convention on Religion and Education*; and further, with the view of opposing the propagation of sedition and infidelity, she, in 1795, commenced at Bath the *Cheap Repository*, which was published in monthly numbers, and contained several very pleasing tales. This periodical obtained a very wide circulation, and was said to have had considerable effect in calming the public mind, then agitated by the doctrines so prevalent in France.

Hannah More now removed from Bristol to Cheddar, where the ignorance and destitution of the place having deeply affected her, she opened a number of schools for educating the poor children and alleviating their misery. Her benevolent designs were at first strenuously opposed; but she ultimately succeeded in establishing a number of schools, not only at Cheddar, but all round the Mendip Hills; and the good effects which they produced soon became apparent. In 1799 appeared her *Strictures on the Modern System of Female Education*, three editions of which issued from the press during the same year. This work was censured by some of the critics as too austere; but notwithstanding this circumstance, she was called upon by the highest personages in the realm to put her sentiments in writing on the proper course of instruction to be adopted for the infant heiress to the British throne. She set diligently to work at the command of royalty, and produced in 1805 a work in two volumes, entitled *Hints towards forming the Character of a Young Princess*. It gave high satisfaction generally; but offence was taken in one quarter, and much abuse was in consequence poured upon it. In the year 1809 was published *Cœlebs in Search of a Wife*; two years afterwards appeared *Practical Piety* and *Christian Morals*; in 1815 came out an *Essay on the Character and Writings of St Paul*—an attempt more ambitious than successful; and in 1819 her literary career terminated with the publication of *Modern Sketches*. She was now aged and infirm, but still continued to take a great interest in the welfare of charity schools, bible and missionary societies, and other benevolent and religious institutions. Her piety supported her in her later afflictions; and she expired with the composure, and full of the hope and faith, of a Christian, on the 7th of September 1833. She is said to have realized L.30,000 by her works, a very considerable proportion of which she bequeathed to religious and benevolent societies.

The works of Hannah More have always been highly esteemed by the religious world, and she is generally considered as one of the most distinguished of that class of writers who unite great piety with considerable literary talent, and dedicate the creations of fancy as well as the deductions of reason to the service of religion. Her poetry is not much prized, except by a select few, for the piety and sound judgment which it displays. Her prose is justly admired for its sententious wisdom, its practical good sense, its masculine vigour, and the dignified religious and moral fervour which pervades it. *Cœlebs* passed through six editions in one year; and since its first appearance it has frequently been reprinted, besides being translated into several foreign languages. A collected edition of her works has been published in 11 vols.; and *The Memoirs and Correspondence of Mrs H. More*, by W. Roberts, were published in 4 vols. 8vo, 1834. A new and abridged edition of this Life, with selections from her correspondence, 12mo, appeared in London in 1856.

More, Henry.

MORE, *Henry*, an eminent English philosopher and divine, was born at Grantham in Lincolnshire on the 12th October 1614. His father, Alexander More, a gentleman of property in that county, was a staunch Puritan, and educated his family in the strictest principles of Calvinism. At the age of fourteen, Henry was sent to Eton, with many affectionate charges to stand fast to the principles of his hereditary creed. Young More, however, who had always been of a retiring and thoughtful disposition, had already secret misgivings as to the soundness of the predestinarian doctrine; and now that he no longer breathed the Calvinistic atmosphere at home, he gave freer scope to his speculative tendencies. While the Eton boys bounded after the ball, Henry More "with his head on one side, and kicking now and then the stones with his feet," was dimly working his way to the bold conclusion that the doctrine of predestination was inconsistent with the justice and goodness of God. He was, moreover, prepared to maintain this position at all hazards; and with characteristic ardour and genuine speculative courage, he stoutly disputed the question with his elder brother, who, in company with his uncle, shortly afterwards visited him at Eton. This uncle of his, who was a blunt, matter-of-fact sort of man, and who believed more in the rod than in the reason, threatened the young heretic that if he did not give over these immature philosophizings, he would subject him to a wholesome course of corporal punishment. Henry of course did not give over his speculations, but continued to vex his young brain with quite insoluble problems. He seems, however, even in those boyish years, to have been remarkable for sincerity and humble purity of heart. At the advice of his uncle—

who seems to have monopolized the direction of his education—he was, after a three years' residence at Eton, removed to Christ Church, Cambridge, in 1631, just a year before John Milton left it. Here the young philosopher displayed an extraordinary thirst for knowledge, and read eagerly the works of Aristotle, Cardan, Julius Scaliger, and other thinkers of that class. But such writers could not satisfy his longings for higher light. They made him more sceptical than when he began; and renouncing the guidance of the logicians for ever, he directed his attention to the Platonic writers and mystic divines, and discovered the long-looked for treasure in the dreamy pages of Marsilius Ficinus, Plotinus, and Trismegistus. "That golden little book," ascribed to John Tauler, the *Theologia Germanica*, "pierced and affected" him more than all the rest. The simple knowledge of phenomena no longer had any charm for him; he sought for the proper food of the soul among those archetypal ideas which were believed to lie behind all sensible objects. He learned to think away all objects of sense, and strove with his "illuminated" teachers to live alone with God in a supersensible world. The earthly body, however, clogged the upward progress of the spirit; and what he gained in fancied illumination he lost in bodily strength. After a few years practice of this course, the poor youth found himself reduced to a very skeleton, and from his strange talk about "particular experiences," his friends began to charge him with enthusiasm. Some idea may be formed of his state of mind during this period from his philosophical poem called *Psychozoia, or the Life of the Soul*, published in 1640. He took the degree of Master of Arts in 1639; and on being chosen a fellow of his college, he became tutor to several persons of distinction, and among others to the brother of Lady Conway. At the request of this lady, who was a noted disciple of William Penn, More wrote, among other treatises, the *Conjectura Cabalistica*, and the *Philosophiæ Teutonicæ Censura*; and if he did not succeed in converting her from Quakerism, he at least secured her friendship, and at her death a legacy of L.400, which the benevolent mystic devoted to purposes of private charity. If ever man strove to be true to the light that was in him, it was Henry More. He repeatedly declined the most flattering offers of church preferment, choosing rather to linger about the quiet halls of Christ Church, and muse as he listed, than enjoy the honours of a bishopric at L.1500 a year. The rectory of Ingoldsby, which had been purchased for him by his father, he resigned in 1642, and afterwards presented it to his college. He even declined the mastership of his own college in 1654, when the celebrated Cudworth was appointed; and if he accepted a prebend in the church of Gloucester in 1675, it was only to make it over to his friend Dr Fowler. Not that he lightly regarded the wants of his country. He is said to have wept over its miseries. But he believed himself to be more in his proper sphere using his pen in studious retirement, than mingling with the busy turmoil of the world. He was no doubt a little of the "intellectual epicure," as Norris of Bemerton called him; but yet his pen was constantly occupied in behalf of what he judged the cause of religion and virtue. He engaged in a correspondence with Descartes during 1648–9; and three of More's letters, with the replies of the French philosopher, are still to be read at the end of most editions of Descartes' works. More had a great esteem for Descartes, and judging from those letters, the admiration must have been mutual. Not that the English Platonist began with Cartesianism and ended with mysticism, as Cousin in his hasty generalization (*Cours de l'Histoire de la Philosophie*, Leçon 12me) seems to convey. On the contrary, while More always admired the Cartesian philosophy as "a fine, neat, subtle thing," he constantly maintained that "for the true ornament of the mind, it bears no greater proportion to that principle I told you of [viz., the divine sense], than the dry bones of a snake made up elegantly into a hat-band is to the royal clothing of Solomon." More pursues a still more passionate and unjust strain of invective against Cartesianism in his *Enchiridium Metaphysicum*, published in 1671. In this work we obtain a more profound and methodical view of More's metaphysical system—if system it can be called—than in any of his other writings. Metaphysics, according to him, is the science of incorporeal existence, and admits naturally of a two-fold division. The one demonstrates the existence of other substances than bodies; the other determines the essence and principal attributes of those substances. His proof of the existence of immaterial things is threefold: first, space, which contains all matter, cannot be itself material; secondly, matter is contingent, for it is possible to think it away, while space is necessary, no such abstraction being possible for it; thirdly, the general series of natural phenomena come and go, begin and end, ceaselessly change, in a word, are contingent; but this supposes some necessary existence beyond the sphere of the sensible world, from the bosom of which the contingent emerges. In attempting to demonstrate the latter position, More ranges over all the sciences with the ease of a master, displaying a knowledge at once extensive and profound. As a speculator, More was perhaps more of the eclectic than the mystic, but his thoughts always gravitated towards mysticism, and found their last expression there. After his own doctrines, More preferred Descartes' to all others; just as Hobbes is said to have preferred More's system to every one but his own. Indeed, the extravagant admiration which More always showed for his own conceits and fancies, no matter how groundless, stood in marked contrast with his acknowledged learning, charity, and humility. His allusions to himself and his own productions in the *prefatio generalissma* to the Latin edition of his works, and elsewhere, betray more than a mere amiable egotism,—they savour much more of personal vanity. More, however, while sometimes extravagant, seldom falls into the rude fervour or weak sentimentalism of the ordinary mystics, and has always the good sense and proper feeling to avoid the gross profanity which often characterized the English mystics of that age. He even wrote an express treatise in 1656, entitled *Enthusiasmus Triumphatus*, in which he traces the nature, causes, and cure of enthusiasm, and concludes by ascribing this abnormal state of mind mainly to bodily causes. If he was sometimes credulous, he was very generally shrewd and sagacious; and with all his defects, he unquestionably occupies a high place among that bright though small constellation of thinkers known as the English Platonists of the seventeenth century. Some of his books seem to have met with an extensive sale. *The Mystery of Godliness* was said by a London bookseller to have "ruled all the booksellers" for twenty years. Yet the appreciation which they met with did not quite satisfy their author, and he seems to have occasionally appealed to that "perspicua et pacifica posteritas"—that wise and peaceful posterity—which is to remodel the temple of fame. The young could not understand him, and the old thought him mad. Yet his merits were duly appreciated by such men as Cudworth and Norris. Three hundred pounds were left by an admirer to have some of More's pieces translated into Latin; a circumstance which induced the author to publish the whole of his works in Latin in three folio vols. in 1679. After completing this task, he does not seem to have written any work of importance. His last work was the *Medela Mundi, or Cure of the World*, which he did not survive to finish. His health had never been robust, and in 1686 he was seized with a fever, from the effects of which he never recovered. He died on the 1st September 1687, in the seventy-third year of his age. Besides the complete Latin edition of More's works already referred to, the greater number of his productions

appeared in English, under the title of *A Collection of several Philosophical Writings*, folio, London, 2d ed., 1662, and 4th ed., 1712. *The Life of the Learned and Pious Dr Henry More*, 8vo, London, 1710, was written by the Rev. Richard Ward, an enthusiastic and not very discriminating partisan of More's system. (See also the *Biographia Britannica*, the *Dictionnaire des Sciences Philosophiques*, and *Hours with the Mystics*, by R. A. Vaughan, 2 vols. London, 1856. A detailed list of Dr More's works will be found in Watt's *Bibliotheca Britannica.*)

MORE, *Sir Thomas*, the greatest Englishman of his day, was the only son of Sir John More, one of the judges of the King's Bench, and was born in 1480 at Milk Street in the city of London. His first lessons were received from Nathaniel Holt, an eminent schoolmaster of that day in Threadneedle Street. It was at that time a custom with genteel parents to allow their sons, for the benefit of their training, to serve as pages to the nobility or to the high dignitaries of the church. More was accordingly placed, about his fifteenth year, in the family of the aged Cardinal Morton, a man of great wisdom, learning, and virtue. His residence there seems to have been both pleasant and profitable. He daily heard, as he waited at table, the conversation of the noble and learned guests that frequented his master's board. During the merry-makings of Christmas, when the household was assembled to witness the rude plays peculiar to the season, he was wont to step up among the players, form a character for himself on the suggestion of the moment, and delight the audience by his extempore jests. The old cardinal was charmed with the lively and ingenuous wit of his young ward. He was fond of pointing him out to his visitors, and of remarking that "that child would prove a marvellous rare man."

In 1497 More entered the university of Oxford as a student of Canterbury, a college which was afterwards abolished to make room for Christ Church. His whole appearance and bearing at that time were peculiarly fitted to prepossess men in his favour. He had a well-proportioned figure, of a middle stature; his small gray eyes twinkled with innocent pleasantry; and his countenance beamed with good nature and benevolence. In a short time Grocyn, Linacre, and William Latimer, three of the most learned men of that day, had drawn towards him. Erasmus, too, who was then sojourning at Oxford in the height of his fame, would often leave the company of his eminent and aristocratic admirers to visit the young student of seventeen, in his solitary rooms in St Mary's Hall. The heart of the great scholar was touched with an affection almost womanly for the youthful Englishman, and a friendship sprung up between the two which all the toils and troubles and wanderings of after years could not impair. In the society of such men the susceptible nature of More could not fail to catch a noble ardour for learning. The scanty means of support to which he was restricted by his prudent father kept him back from the haunts of idle indulgence and dissipation. All his time was therefore devoted to his intellectual culture. He became an enthusiastic student of the Greek language, which was then slowly forcing its way amid much opposition to a place among the regular studies at Oxford. He composed Latin epigrams, both witty and sentimental. He also resolved his hard and rugged mother-tongue into the soft and flexible forms of poetry, and wrote many English verses sparkling with harmless quips and merry conceits.

After completing the ordinary curriculum at Oxford, More studied law first at the New Inn and then at Lincoln's Inn. He was subsequently appointed to lecture at Furnival's Inn on jurisprudence, and at St Lawrence's church on Augustine's *De Civitate Dei*. About this period a bitter remorse for his youthful sins began to haunt and torment his soul. That he might take refuge, as it were, in a holy atmosphere, he fixed his abode near the great Carthusian monastery called the Charterhouse, and daily attended the spiritual exercises of the priests. Every form of penance was also employed for mortifying the flesh. He kept Fridays and high fasting-days with severe austerity, and began to wear a shirt of hair next his skin. He often flung himself down to sleep on the cold floor, or on a bare settle, with a hard log under his head, and woke up after four or five hours' repose to watching and prayer. As the last stroke in this process of self-crucifixion he was meditating to consecrate his life to the priesthood, when an event occurred which diffused a sunshine over his gloomy condition and still gloomier prospects. A certain Mr Colt, a hospitable country gentleman, and the father of a family of daughters, was wont to invite the young lawyer to spend his holidays at the mansion of Newhall in Essex. More became fascinated with the artless and pious conversation of the young ladies, and thought of making one of them his wife. His taste would have led him to choose the second of the sisters; but his sympathetic heart shrunk from seeming to slight her who had a claim to his preference by her priority of birth, and so he married the eldest.

Towards the close of the reign of Henry VII. More had risen into professional eminence. There was scarcely an important case brought before the courts in which he did not appear as one of the counsel. He also held the honourable office of judge of the Sheriff's Court in the city of London. His merit was recognised about the same time by his being appointed a burgess in the Parliament which the King had summoned in order that he might obtain a grant of three-fifteenths for the marriage of his eldest daughter with the King of Scotland. It was then that More became, as Sir James Mackintosh asserts, the restorer of political eloquence. For this noble achievement the qualities of both his head and heart peculiarly fitted him. A moral courage unsurpassed for its serene dignity was supported by a ready power of thinking, an equally ready command of language, a polished wit that could wound deeply but not harshly, and a tone of speech that could conciliate an opponent without sacrificing a single opinion. Accordingly, no sooner was the royal demand laid before the House, than he stood forth to oppose it in a vigorous and eloquent speech. The silent and timorous burgesses, while astonished at the unwonted voice of opposition that sounded so boldly through the Parliament-hall, responded to the appeal of the orator, and refused the request of the King. Henry heard with indignation that "a beardless boy had disappointed all his purpose." He resolved to be revenged. But as the young offender had no possessions upon which the avaricious King might seize, old Sir John More, on some pretext, was cast into prison, and fined L.100.

About 1509, the year of the accession of Henry VIII., all the available time of More was engrossed with his professional avocations. Yet in the few hours stolen from sleep his studies were diligently prosecuted. His attention was chiefly directed to the composition of *The Life and Reign of King Edward V.* This was the first history of England written in the vernacular, and it was also the first specimen of real classical English prose. It therefore forms no ordinary landmark in the annals of the literature of England. One of its more marked characteristics is the easy, sweet, and spirited flow of the narrative,—a striking type of the author's own disposition. More had scarcely finished this work in 1510, when he was appointed under-sheriff of London. In the same year he received a visit from his friend Erasmus. The household scene which the eminent scholar then saw, and which he afterwards described, was a perfect picture of domestic felicity. More's first wife had died, leaving one son and three daughters. A widow—elderly, shrewish, and worldly—had succeeded to her place. Yet even she proved no obstruction to the well-ordered domestic routine. In the morning the inmates

of the house knelt together round the family altar. Then they busied themselves with studies, reading, or the quiet and cheerful discharge of more special duties. In the evening the head of the house returned to chat with his family round the hearth. His very presence diffused harmony and good order. The impatient exclamations and worldly saws of "Mistress Alice," as he called his wife, were drowned in a flood of merry jests; the studies of his children were stimulated by an overflowing kindness; and the lessons of virtue and piety were inculcated by quaint and pleasant similes. He also spoke a kind and fatherly word to his servants, and saw that they were maintaining their good character. The day was then closed, as it had been begun, with family devotion.

Such domestic felicity filled the soul of More, and expelled from it every hankering after political preferment. There was also a wariness fitting in exactly with the other parts of his well-balanced character, which kept him back from climbing the unsteady ladder of ambition. Accordingly, the attempts which were made at the beginning of the reign of Henry VIII. to entice him into the service of the state were all in vain. Even after he had been employed in two embassies to the Netherlands, in 1514 and 1515 respectively, he returned immediately to his privacy, and refused the pension by which the King sought to buy his services. At length, in 1516, More was persuaded to venture into the arena of politics, and was elected a member of the Privy Council. The favours with which he was immediately loaded prevented his speedy retreat. The King became excessively fond of the company of his new councillor. On days of council he consulted with him, and on holidays he jested with him. In his grave moods he conversed with him on theology. When the nights were clear he took him up into the leads to observe the courses of the planets, and to discourse about astronomy. Then he would take him down to a private supper, and would crack jokes with him far on into the night. Even when the courtier had contrived to throw off these encumbering favours for a while, and thought himself safe in the bosom of his family at Chelsea, the King would drop unexpectedly in to dine. After dinner he would walk in the garden in deep consultation, with his arm round his favourite's neck. These great honours would have completely intoxicated the majority of men; but they did not even affect the strong head of More. His clear eye detected the bloated selfishness from which they all proceeded. "If my head," said he at that time to his son-in-law Roper, "would win the King a castle in France when there was war between us, it should not fail to go." Therefore, instead of dwelling upon the preferment which the royal kindness portended, his mind was quietly engaged in the composition of his *Utopia*. This work, written in good Latin, was published at Basle in 1518, became speedily popular among the scholars of France and Germany, and was soon afterwards translated into French, Italian, Dutch, and English. It is a description of the laws and customs of an imaginary island of America, feigned to have been discovered a short time previously. Of the principles of polity described many are wildly chimerical, some are plausible, and others are just. At first sight the book appears to be nothing else than a freak of the author's fantastic and exuberant fancy. There is a likelihood, however, that it has a hidden character. At this time the large mind of More cherished several wide and catholic opinions—such as the principle of religious toleration—which were obnoxious to the spirit of the age. To profess these sentiments openly would have been to dare the unscrupulous vengeance of Henry. It is probable, therefore, that in accordance with his ordinary custom of uttering a grave truth in the garb of a gay jest, he employed the cunningly-devised romance of *Utopia* for a cover to his earnest political opinions.

More had entered on the road to preferment, and he was now carried rapidly forward. A knighthood and the office of treasurer of the exchequer were conferred upon him in 1521. About the same time, greatly against his taste and home-feelings, he was employed in the artful negotiations which Wolsey carried on with France. In 1523 the Parliament that was then convoked elected him to be their speaker. On this occasion he stood forth once more as the restorer of political oratory and the champion of parliamentary freedom. The grant of a very heavy subsidy had been demanded from the House by the government. That the members might be awed into compliance, Cardinal Wolsey appeared with all his attendants and insignia, and made a solemn speech in support of the subsidy. The burgesses replied to it by a dogged silence. At length the speaker was demanded to return an answer for the rest. After calmly vindicating the ancient liberty of the Parliament to speak or to be silent, Sir Thomas More, with all due reverence, said, that though the members had entrusted him with their voices, yet they had not entrusted him with their heads, and therefore he could not answer his grace in so weighty a matter. The cardinal hurried from the House in a great rage against the speaker; yet the King, in spite of this thwarting of his wishes, continued his favour toward Sir Thomas, and in 1526 appointed him chancellor of the duchy of Lancaster. It was about this time that More began to occupy himself specially with the controversies against the Reformers. His attachment to that old form of religion through which he had derived so much pious comfort, and his natural love of peace and good order, made him cling fast to the sinking cause of Popery. Accordingly, mustering all his learning, wit, and acuteness, he set himself industriously to wage a war of pamphlets against Luther, Tindal, and other Reformers. The excitement of debate hurried him into an exaggeration of statement, and a bitterness of feeling, into which he had never fallen before; yet perhaps he was as fair and as charitable as any other writer that ever ventured on this same irritating controversy.

In 1527 Henry VIII. began to search for reasons for divorcing Queen Catherine. The opinion of Sir Thomas More, who stood so high in the estimation of the country and of Europe in general, was especially desirable. He was therefore sounded on the great subject that was perplexing the public mind. To advocate the divorce would have been to offend his conscience; to condemn it would have been to offend his liberal benefactor the King. He therefore evaded returning a direct answer. But Henry was not to be diverted, and resolved to overwhelm the scruples of his favourite by a great benefit. Accordingly, on the 25th October 1529 More was raised to the position of lord chancellor, that high and giddy seat from which Wolsey had just fallen. The duties of his new office were performed with all his native benevolence and unpretentious industry. He sat daily in his own hall to receive the petitions of the poor; he kept his hands clean from bribes; and, without being cruelly intolerant, he did his utmost to suppress heresy. But this conscientious performance of duty was not all that was expected by his royal master. His opinion on the divorce was repeatedly demanded. Again and again did More reply that he was neither worthy nor willing to be his Majesty's adviser. At length, foreseeing that he would soon be required, in his official capacity, to countenance the King's marriage with Anne Boleyn, he resigned the great seal in May 1532.

Sir Thomas More laid aside his robes of office as poor a man as when he had put them on. The establishment at Chelsea, in which, like a patriarch of old, he had gathered all his children and grandchildren under one roof, was immediately broken up. His sons and daughters went to their several homes. He himself retired to the chapel in his garden to prepare his soul by meditation and devotion

for the storm that was coming in the distance. It soon came. Commissioners arrived to exact from him an assent to the King's recent marriage. They first tried to wheedle him, by reminding him of the royal favour towards him. But his conscience accused him of no ingratitude. They then tried threatenings. "Terrors are arguments for children, not for me," replied he, placidly. At length, in 1534, the act of succession for securing the throne to the issue of Anne Boleyn was passed. More was demanded to assent to it by an oath. He refused to swear, and declined to give any reasons for his refusal. Four days afterwards he was lodged in the Tower. There he lay for more than a year, resisting calmly every attempt to break his resolution, receiving the visits of his friends with his usual outflow of quaint and pious apophthegms, and writing devotional treatises and letters to his favourite daughter, Margaret Roper, with fragments of coal. On the 1st July 1535 his trial came on. He was indicted under the act of supremacy passed towards the close of 1534, for constituting the King supreme head of the church. His refusal to swear to this act was declared high treason, and he was condemned to death. On the 6th July he appeared on the scaffold in that same jesting humour which was a part of his nature. His head was already on the block, when he desired the executioner to stop until he had removed his beard, "for that," said he, "hath committed no treason." The next moment the fatal blow fell.

The best English translation of the *Utopia* is that of Bishop Burnet. More's English works were published at London, 1557, and his Latin works at Louvain, 1556. There are Lives of More by his son-in-law Roper, 8vo, 1626; Hoddesden, 8vo, 1652; his great-grandson Thomas More, 4to, 1726; and Sir James Mackintosh, 1844.

MOREA (anc. *Peloponnesus*) forms the southern part of Greece, and one of the three great divisions of that kingdom. It extends in N. Lat. from 36. 23. 20. to 38. 26. 4., and in E. Long. from 21. 5. to 23. 29., being 7920 square miles. (See GREECE.)

MOREAU, JEAN VICTOR, one of the greatest generals of the French revolution, was born at Morlaix in 1763. He was the son of an advocate who had destined him for the same profession, but having early contracted a decided predilection for the army, he enlisted in a regiment, in which he served for a short time, until his father purchased his discharge, and sent him to resume his studies. He did so with considerable success, and at length became *prévôt de droit* at Rennes, where he exercised a sort of supremacy over the students, by whom he was greatly beloved. In 1787, when the ministry wished to effect a revolution in the magistracy, he joined in resisting the attempt; and having figured in the early troubles as chief of the youth of Rennes, he was called "the General of the Parliament." At the commencement of the revolution he raised a company of volunteer gunners, of which he became captain; and having organized and instructed it, he continued to serve in the same capacity until the year 1792, when he enrolled himself in a battalion of volunteers which was then setting out to join the army of the north. He made his first campaign under Dumouriez, as commandant of a battalion. In 1793 he became general of brigade, and the following year he was promoted to the rank of general of division, on the recommendation of Pichegru, who immediately confided to him a corps destined to act in maritime Flanders. Moreau took possession first of Menin, then of Bruges, Ostend, Nieuport, the island of Cassandria, and lastly of Sluys, which capitulated on the 26th of August. At the moment when he made this conquest for the republic, the revolutionists of Brest were sending his aged father to the scaffold as an aristocrat. This venerable old man, whom the people of Morlaix called the "father of the poor," had undertaken to manage the property of some emigrants; and this was employed as a pretext to destroy him. Moreau had already become disgusted with the revolutionary system, and such an event naturally increased his detestation. He conceived that he had no longer any country but the camp, nor any home but his tent in the field.

He commanded with great distinction the right wing of the army of Pichegru during the celebrated winter campaign of 1794; and when that general assumed the command of the army of the Rhine and Moselle, Moreau was promoted to the command of the army of the north. After the retreat of Pichegru, he placed himself at the head of the army of the Rhine and Moselle, and in the year 1796 opened that campaign which became the foundation of his military fame. Having driven back Wurmser towards Manheim, he effected the passage of the Rhine near Strasburg, attacked the Archduke Charles at Rastadt, forced him to abandon the course of the Necker, and on the 11th of August fought a battle near Heydenheim, which lasted seventeen hours. The Austrians having retired on the Danube, Moreau advanced and soon found himself opposed by General Latour, who was daily receiving reinforcements; but believing himself supported by the diversion, or rather the parallel invasion of Jourdan towards Ratisbon, he continued his forward movement. The discomfiture and retreat of Jourdan, however, disconcerted all his combinations, and leaving his flank completely uncovered, obliged him to retire. This retreat commenced on the 11th of September, and though severely criticized by Napoleon, is unquestionably one of the finest operations of the kind recorded in the history of war.

At the opening of the next campaign in 1797, Moreau effected the passage of the Rhine in the face of the enemy ranged in order of battle upon the opposite bank. The immediate consequences of this brilliant action were, the surrender of the fort of Kehl, and the capture of nearly 40,000 prisoners, besides several standards. Owing to some misunderstanding with the executive directory relative to his old friend Pichegru, Moreau was obliged, on the 7th September 1797, to resign, and to shelter himself in retirement. He remained comparatively unemployed until April 1799, when the misfortunes which had attended the recommencement of war rendered his talents necessary. Moreau was therefore sent to Italy, where he superseded Schérer in the command of the army. On the 11th of May he repulsed the Russians near Bassignano, and then passed the Bormida; but being assailed by the greater part of the forces under Suwaroff, he was obliged to evacuate Valentia and Alessandria.

Moreau had just been appointed to the chief command of the army of the Rhine, when Joubert arrived to replace him in that of Italy. Being on the point of fighting a battle, —which, by the fall of Mantua and the junction of Kray with Suwaroff, had become inevitable,—Joubert wished to leave the direction of it to him; but he refused, and begged permission to combat under the orders of the new chief of the army. At this battle, which was fought at Novi, and in which Joubert fell, Moreau ran the greatest risks, having had three horses killed under him, and his uniform pierced by balls. After a fierce conflict, the French army was defeated; but Moreau conducted his retreat with so much superiority that he almost nullified the victory which the allies had gained.

On the arrival of Bonaparte, who had escaped from Egypt, Moreau consented to serve under the orders of that general, and by his influence and means to promote the revolution which was then preparing. But scarcely had it been effected at St Cloud, on the 9th of November 1799, when he saw reason to apprehend that he had concurred in giving a tyrant to his country. Being almost immediately called to assume the command on the Rhine and the Danube, he introduced several important changes into the constitution

Moreau.

of the army. His plan was not approved by Bonaparte, who, thinking only of reconquering Italy, wished to make the army of the Rhine merely an army of observation. But Moreau stuck firmly to his plan, and resisted. Napoleon felt greatly offended; and this dispute as to the cooperation of the two armies proved the germ of that mutual hatred which sprung up between these celebrated rivals, and which was probably one of the causes of their common ruin. Napoleon saw it necessary, however, to yield, and to leave to Moreau all the honour of the conception of the plan of campaign, and all the means for carrying it into execution.

The success of the campaign which ensued was throughout decisive. He encountered the enemy, first at Stockach, where he defeated him, and then fought successively the battles of Engen, Moeskirch, and Biberach, in all of which he was victorious. Those victories gained by Moreau facilitated the conquest of Italy; and he even detached a corps of 12,000 men to reinforce the army of the First Consul. Finding, however, that neither his demonstrations nor his rapid incursions into Bavaria, could induce Marshal Kray to quit his unexpugnable position at Ulm, Moreau advanced beyond the Lech, attacked the Austrians along their whole line, crossed the Danube at Blenheim, and in the plains of Hochstadt, obtained, by similar manœuvres, on the 19th of June, an advantage similar to that which Bonaparte had gained at Marengo only three days before. Kray having at length abandoned his position at Ulm, Moreau marched in pursuit of the marshal, whom he once more vanquished at Neuburg; he then entered Bavaria, again defeated the Austrians at Landshut, and only suspended his operations after having caused them to sign, on the 15th of July, the armistice of Parsdorf.

This suspension of arms continued until the end of November, when Moreau was attacked by the Archduke John with an army of Austrians amounting to 120,000 men. Moreau retreated from the banks of the Inn, and continuing his movement on Hohenlinden, succeeded in drawing the enemy into the defiles near that place. The moment for striking a blow had now arrived. Accordingly, on the 3d of December 1800 was fought that bloody and decisive battle, in which there was not a French corps that did not come into action and cover itself with glory. Eleven thousand prisoners and 100 pieces of cannon fell into the hands of the victors. More than 6000 Austrians remained on the field of battle, whilst the loss of the French did not exceed 2500 men killed and wounded. To the congratulations of his generals, Moreau replied by attributing to them the principal share in the glory of the day, adding at the same time, "My friends you have conquered peace."

The archduke having taking refuge behind the Inn, Moreau pursued him without intermission, gained another victory at Lauffen, and having passed the Salza, occupied Saltzburg; and, continuing his advance, carried terror to the gates of Vienna. Nor did he suspend his march until the Archduke Charles, who had been again placed at the head of the imperial army, announced to him that the Emperor had resolved to make peace, whatever might be the determination of his allies; and this declaration served as the basis of the armistice of Steyer, signed on the 25th of December. This campaign of twenty-five days placed Moreau in the rank of the greatest captains, and entitled him to the homage of public admiration, which was paid to him on his return to Paris. Bonaparte presented him with a pair of pistols magnificently mounted, observing that he had wished to have had his victories engraved on them, but found that there would not be room. Despite this show of personal admiration, Napoleon could not forgive the success of Moreau, and especially the affection with which he was regarded by his officers. Moreau, who was deficient in civil prudence, acted in such a manner as to increase the suspicion with which he was regarded. His house became the rendezvous of persons avowedly inimical to the consular government; and he was by imperceptible degrees drawn into that fatal connection with Pichegru and his associates which eventually proved the cause of his ruin. (The particulars of this affair, with the arrest, imprisonment, trial, and sentence of Moreau, will be found narrated in the historical portion of the article FRANCE.) On the 10th of June 1804 he was sentenced to two years' detention, which, by the influence of Fouché, was commuted into permission to travel, on condition that he should retire to the United States, and not return to France without the leave of Bonaparte. He accordingly set out for Spain, escorted by gendarmes, and in 1805 embarked at Cadiz for the United States, where he resided for about eight years, beloved and respected by all who knew him.

After the disasters which befel the French grand army in the retreat from Moscow, the Emperor Alexander, aware that he had no general capable of contending with Napoleon, made secret overtures to Moreau; and the latter having decided to embrace the offers of the Czar, and join him in the approaching contest, embarked on the 21st of June 1813 with M. de Svinine, chancellor of the Russian embassy, and on the 24th of July entered the port of Gottenburg. At Stralsund he passed three days with his old companion in arms Bernadotte, then Crown Prince of Sweden, and having concerted with him the plan of the ensuing campaign, proceeded to join the allied sovereigns at Prague, where, as might have been expected, he was received in the most flattering manner.

The plan of the allies consisted in debouching from Bohemia with their grand army, in order to turn and attack Dresden, which formed the pivot of Napoleon's operations. The attack commenced on the 26th of August, and was resumed the following day, when Moreau, having advanced to observe a movement of the French, was struck by a cannon-ball, which fractured the knee of the right leg, and, passing through, carried away the calf of the left. He fell into the arms of Colonel Rapatel, exclaiming, "I am done for, but it is pleasant to die in so good a cause." Being removed to an adjoining house, he there underwent amputation of the right leg, and the same operation was performed on the left, which had been too much shattered to admit the possibility of its being saved. In this horribly mutilated condition, the allied army being now in full retreat, he was transported as far as Laun, where he lingered in agony till the morning of the 2d of September, when he expired. At the time of his death he had prepared for publication a proclamation to the French, which the Emperor Alexander had approved, and in which he explained the object of his return to Europe,—the most questionable act of his life,—namely, to assist the French in emancipating themselves from the despotism of Bonaparte, and to sacrifice his life, if necessary, to restore prosperity to his country, all the true sons of which he invited to rally round the standards of independence. As a warrior, Moreau was superior to all the generals of the Revolution, Napoleon excepted; he combined the caution of Fabius with the cool determination of Turenne; in every succeeding campaign his genius shone forth with increased splendour; and his last achievement at Hohenlinden exhibited a union of scientific combination with precise and vigorous execution which has seldom been equalled and never surpassed. (J. B—E.)

Morecambe Bay.

MORECAMBE BAY, in England, separates Lancashire into two parts, and washes the coast of Westmoreland, where it receives, by a wide estuary, the River Kent. The bay is very shallow; and at low water a large extent of sand is left dry, and may be crossed without danger or difficulty.

MORELL, André, an eminent antiquary, was born at Berne, in Switzerland, on the 9th of June 1646. He turned his attention early to the study of numismatics, and in 1680 he went to Paris, where his reputation procured him admission into the society of the learned, and where, in 1683, he published *Specimen Universæ Rei Nummariæ Antiquæ*, a second edition of which, corrected and enlarged, appeared at Leipsic in 1695. The encouragement which was originally held out to him in Paris was not confirmed; and after being imprisoned for three years in the Bastile for the heinous offence of claiming the remuneration promised him as joint-keeper of the Royal Cabinet of Medals, he went to Germany in 1694, on the invitation of Count de Schwartzenburg-Arnstadt. Here he prosecuted the preparation of a great work on numismatics, but his labours were closed by death in 1703. Havercamp having collected and arranged his scattered materials, published, in 1734, *Thesaurus Morellianus, sive Familiarum Romanarum Numismata Omnia*, in 2 vols. folio; and, in conjunction with Schlegel and Gori, published in 1752, from Morell's MS., the *Thesauri Morelliani Numismata Aurea, Argentea Ærea, cujusque moduli xii. priorum Imperatorum*, Amsterdam, in 3 vols. folio.

Morell, *Thomas*, an eminent classical scholar and editor, was born at Eton, in Buckinghamshire, on the 18th of March 1703. Having graduated at King's College, Cambridge, he was appointed curate of Kew in 1731, and for some time officiated in the same capacity at Twickenham. In 1737 he was made rector of Buckland; and in 1775 we find him acting as chaplain to the garrison at Portsmouth. He died on the 19th of February 1784. His principal works are,—*A Collection of Theological Poems, original, and translated from the Latin of Vida*, with notes, London, 1732-36, in 8vo; an edition of Chaucer's *Canterbury Tales*, with modern imitations, London, 1737; an edition of the works of Spenser, 1747; the *Hecuba, Orestes, Phænissæ*, and *Alcestes* of Euripides, with ancient scholia and notes, London, 1748; an English translation of the *Hecuba*, with annotations; the *Prometheus* of Æschylus, with scholia, notes, and an English translation in blank verse, 1767; *Two Letters on Greek Inscriptions found upon an altar at Corbridge in Northumberland*; editions of the *Greek Lexicon* of Hederick, and of the *Latin Dictionary* of Ainsworth; *Thesaurus Græcæ Poëseos, sive Lexicon Græco-Prosodiacum*, Eton, 1762, in 4to, an imitation of the *Gradus ad Parnassum*, since considerably enlarged by Dr Maltby, Cambridge, 1815; and various other works, particularly Annotations on Locke's *Essay*, 1793, 8vo.

MORELLA, a town of Spain, in the province of Castellon-de-la-Plana, is situated on the S. slope of a mountain, 45 miles N. of Tortosa. It is surrounded by Moorish fortifications, and on the top of the hill stands a strong castle, with a Moorish tower. The streets are steep and irregular, and though many of the houses are handsomely and substantially built, a great part of the town is in a ruinous state. The principal church of Morella, built in 1317, is remarkable for its internal architecture. There are also two other churches, three convents, several schools, a town-house, a theatre, and an hospital. The manufacture of blankets and sashes, which is carried on here, gives employment to 1500 hands; and these articles, together with wheat, form the exports of the place. Morella was taken by surprise in 1838 by Cabrera, who kept possession of the town till it was retaken by Espartero in 1840. Pop. 5180.

MORELLI, Giacomo, a celebrated librarian of Venice, was born in that city on the 14th of April 1745. He was educated by the Dominicans, and was in due time admitted to the priesthood. The subject, however, which chiefly interested him was that of bibliography, in which he was destined to attain to great eminence and distinction. In 1774 he printed his *Dissertazione Storica della publica Libreria di S. Marco*. In 1785 he published his Latin version of the Oration of *Aristides against Leptines*, the Declamation of *Libanius for Socrates*, and fragments of the second book of the *Harmonic Elements of Aristoxenes*, all from Greek manuscripts. One of his most important publications is that of the *Fragments* of Dion Cassius on Roman history, with new readings, which appeared in 1798, and was followed by a great variety of other works and editions. In 1802 the Emperor Francis conferred on him the title of aulic counsellor; in 1816 he received the decoration of a knight of the iron crown. He died in 1819, at the advanced age of seventy-four. A list of his dissertations on history, philology, literature, and the fine arts, will be found in the first volume of his *Opuscoli*, Venezia, 3 vols. 8vo., 1820, preceded by an interesting notice of the author by Moschini.

MORERI, Louis, author of the *Dictionnaire Historique* which bears his name, was born at Bargemont, in Provence, on the 25th of March 1643. He received the elements of his education at Draguignan and at Aix, and after studying theology at Lyons, where he acquired a knowledge of the Italian and Spanish languages, he took priest's orders. At the age of eighteen he composed the *Pays d'Amour*, a frigid allegory, and, under the title of the *Doux Plaisir de la Poésie*, made a collection of pieces in verse possessing but little merit. But the idea which had long occupied his mind was the composition of his Dictionary, which appeared at Lyons in 1673, in one volume folio, when he was only thirty years of age. The immense erudition displayed in this work excited general admiration; but, as might have been expected, it was found to be very incomplete. The author, however, applied himself with great vigour to enlarge it; but was cut off by death at Paris on the 10th July 1680, at the premature age of thirty-eight. The second edition, in two volumes folio, was printed at Paris in 1681, the year after his death. The third edition, which appeared in 1683, is merely a reprint of the second; but in 1689 a third or supplemental volume was published; and the whole, revised, corrected, and enlarged by Leclerc, was afterwards printed at Amsterdam, 1691, in four volumes folio. To the imperfections of this dictionary we are indebted for that of Bayle, who at first proposed only to correct the errors or supply the omissions of Moreri. The principal defect of Moreri's work consists in the inaccuracy of the geographical portion, in the awkward jumble of mythology and history, in his perplexed nomenclature, and the number and prolixity of his genealogies; but he has nevertheless the merit of being the author of the first work in which are found the names of all those personages who have any title to celebrity. Moreri was also the editor of the *Vies des Saints*, in three volumes, and of De Chinon's *Relation Nouvelle du Levant*, or treatise on the religion, government, and customs of various eastern nations. Besides collecting materials for an historical and bibliographical dictionary of celebrated Provençals, he had commenced a History of the Councils; and left in manuscript a treatise on New Year's Gifts.

MORESQUE. See Arabesque, and Grotesque.

MORETO-Y-CABANA, Augustin, a celebrated Spanish dramatist, flourished in the former half of the seventeenth century. A few isolated facts are the only record of his personal history. He shared in the patronage which Philip IV. extended to literary men, and he stood second to Calderon alone in the favour of the theatre. In wealth of fancy, fertility of invention, and rapidity of composition, he was inferior to the greatest of his contemporaries. Yet his power of depicting character was rivalled in few of the dramas of his predecessors. So strikingly life-like was his

picture of *The Handsome Don Diego*, that the name in a short time came to be used as a national synonyme for a fop. He also showed an infallible dexterity in constructing dramas on borrowed plots, which in course of time superseded their originals in the public favour. The best of all his plays, *Disdain met with Disdain*, was founded on the great Lope's *Miracles of Contempt*, and drove it off the stage. But he was fated to be imitated as well as to imitate. The play last mentioned was copied, though unsuccessfully, by Molière in his *Princesse d'Elide;* and it has since been translated into German, and altered to suit the German stage. Some of Moreto's dramas were religious, such as *The Most Fortunate Brothers;* and a few were heroic, such as *The Brave Justiciary of Castile.* But the greater number were comedies of familiar life, or, as they were called, "comedies of cloak and sword." A collection of Moreto's plays was published in three volumes, 1654 and 1681. Meanwhile their author, renouncing literature, had retired to a religious house at Toledo in 1657, and had died there in 1669.

MORETON BAY, a bay of Australia, on the coast of New South Wales, about 27. 15. S. Lat., and 153. E. Long., is formed by the islands Stradbroke, Moreton, and Bribie; and is about 60 miles in length, by 20 in breadth. It may be entered by two navigable channels; that to the N., between Bribie and Moreton Islands, being 8 miles wide, and that to the S., between Stradbroke and Moreton, being neither so broad nor so secure. The bay abounds in fish, and turtles and crabs are also obtained.

MORETON-HAMPSTEAD, a town of England, Devonshire, situated on a hill on the borders of Dartmoor Forest, 11 miles W.S.W. of Exeter. It has an ancient parish church, with a lofty tower; also Independent, Baptist, Methodist, and Unitarian places of worship; and several schools. Leather and ropes are manufactured here, and granite is quarried in the neighbourhood. There are near the town some Druidical remains, and the ruins of two castles. Pop. of the parish (1851), 1858.

MORETON-IN-THE-MARSH, a town of England, Gloucestershire, 28 miles E.N.E. of Gloucester. It has a parish and an Independent church, and a national school. A market formerly held here has been discontinued, but there are still two annual fairs. Pop. (1851) 1812.

MORGAGNI, GIOVANNI BATTISTA, one of the greatest physicians of the eighteenth century, was born at Forli in Italy on the 25th February 1682. He studied medicine at Bologna, and subsequently proceeded to Venice and Padua, where he pursued his investigations both in physics and in comparative anatomy with great ardour. At the age of twenty-four he published his *Adversaria Anatomica prima*, a work of great originality; and in 1712 was appointed professor of the theory of physic at Padua. He then occupied himself with the continuation of his *Epistolæ Anatomicæ*, in which he described the structure of a number of organs which had been ill observed before his time; refuted the criticisms of Bianchi, who had disputed some of his views; and exposed the errors which had been committed by Manget in his *Théâtre Anatomique.* This work, which was completed and published at Padua in 1719, was applauded by the greatest anatomists of the time, amongst whom may be mentioned Ruysch, Boerhaave, Heister, Winslow, Hoffman, Mead, Senac, and Meckel. Morgagni was now promoted to the first chair at Padua, and successively admitted a member of the Royal Society of London, of the Academy of Sciences at Paris, and of the academies of Petersburg and Berlin, besides several learned Italian institutions. Morgagni continued to labour till the close of his long and honourable career, which terminated on the 6th of December 1771, at the age of nearly ninety. The knowledge of Morgagni was not confined to the medical art. His vast erudition, embraced philology, criticism, history, and antiquities, as may be gathered from the following list of his works:—*Adversaria Omnia*, Padua, 1719, 4to; *Nova Institutionum Medicarum Idea*, Padua, 1712, 4to; *In Aurel. Cornelium Celsum et Quintum Serenum Samonicum Epistolæ quatuor*, Hague, 1724, 4to; *Epistolæ Anatomicæ duæ*, Leyden, 1728, 4to; *Epistolæ Anatomicæ xviii.*, Venice, 1749, 2 vols. 4to; *Miscellanea Opuscula*, Venice, 1763, folio; and, finally, his most celebrated work, *De Sedibus et Causis Morborum per Anatomen indagatis*, libri v., Venice, 1761, 2 vols. folio. This treatise is still a standard work of reference on pathology, and has been translated into most of the European languages. The works of Morgagni were collected and published by his disciple Antony Larber, under the title of *Opera Omnia*, Bassano 1765, 2 vols. folio; and his Life was written, first by Fabroni in the *Vitæ Italorum*, and next separately by Mossea, Naples, 1768, in 8vo.

MORGARTEN, a mountain slope in Switzerland, near Lake Egeri, on the borders of the cantons of Schwytz and Zug, memorable as the field of the earliest victory of the Swiss in their struggle for independence. This happened on the 15th of November 1315, when an Austrian army of 20,000 men, being entangled between the mountains and the lake, were totally defeated by 1300 Swiss mountaineers, totally unaccustomed to war. A chapel was erected on the battlefield, in which service is performed annually on the anniversary of the battle.

MORGHEN, RAFFAELLO SANZIO, *Cavaliere*, one of the most distinguished engravers of the eighteenth century, was born at Naples in 1758. His father followed the profession of engraver, and from him young Morghen received his earliest instructions; but in order more profoundly to initiate him in the art, he was afterwards placed as a pupil under the celebrated Volpato. He assisted this great master in engraving the famous pictures of Raphael in the Vatican, and the print which represents the miracle of Bolsena is inscribed with his name. He married the daughter of his master, and being invited to Florence to engrave the masterpieces of the Florentine gallery, he removed thither with his wife in 1782. All the works which he produced on this occasion were admirable; one in particular, the copy of Raphael's "Madonna della Seggiola," is considered not only as the most excellent in the collection, but as a *chef-d'œuvre* of art. His reputation now became so great as to induce the artists of Florence to recommend him to the grand duke as a fit person to engrave Lionardo da Vinci's noble composition of the "Last Supper," which adorns the wall of the refectory in the Dominican convent at Milan. This picture is not only itself dilapidated, but the drawing which was made for Morghen being unworthy of the great original, the print, although an admirable production, fails to convey a correct idea of the style and merit of Lionardo. His fame, however, soon extended over Europe; and the Institute of France, as a mark of their admiration of his talents, chose him as an Associate in 1803. In 1812 Napoleon invited Morghen to Paris, and paid him the most flattering attentions. A list of this great artist's works was published at Florence in 1810; the number comprised 200 compositions; but subsequently to this period he produced a considerable variety of admirable prints. Amongst the most remarkable of Morghen's productions, besides those already mentioned, may be noticed the "Transfiguration," from Raphael; a "Magdalen," from Murillo; a "Head of the Saviour," from Da Vinci; the "Car of Aurora," from Guido; the "Hours," from Poussin; the "Prise of Diana," from Domenichino; the "Monument of Clement XIII.," from Canova; "Theseus vanquishing the Minotaur;" portraits of Dante, Petrarca, Ariosto, Tasso, and a number of other eminent men. Morghen died in 1833, at the advanced age of seventy-five.

MORHOF, Daniel George, a learned German philologist, was the son of a notary, and was born at Wismar, in the duchy of Mecklenburg-Schwerin, in 1639. From the academy of Stettin he removed in 1657 to the university of Rostock to study law. His attention, however, was also given to elegant literature, and his Latin and German verses introduced him to public notice. He was in consequence appointed professor of poetry at Rostock in 1660; and after visiting the universities of Holland and England, he commenced his new duties in the following year. His zeal as a teacher, his extensive scholarship, and his poetical talents, in a short time led to his further promotion. In 1665 he was chosen professor of eloquence and poetry in the newly-founded university of Kiel. This chair was exchanged in 1673 for that of history. The office of librarian to the university was added in 1680, and was peculiarly acceptable to so eager a student and so voluminous an author. Morhof fell into a dangerous malady in 1690, and died in 1691 at Lübeck, on his way back from the mineral waters of Pyrmont. Of his numerous works the only one that is still valued is his survey of universal literature, under the title of *Polyhistor Literarius, Philosophicus, et Practicus*. The best edition is that of Albert Fabricius, 2 vols. 4to, Lübeck, 1747.

MORIER, James, an eminent traveller and novellist, was born in 1780. In his youth he made an extensive tour through the East, of which he published an interesting account, entitled *Travels through Persia, Armenia, and Asia Minor*. He revisited Persia in 1810 as secretary to the British ambassador; and during the six years of his residence there he became thoroughly acquainted with the character of the natives. The first and best of his eastern novels, entitled *The Adventures of Hajji Babá of Ispahan*, appeared in 1824 in three volumes. Its genuine oriental tone, and its racy and truthful descriptions, soon secured a wide popularity. The author was thus induced in 1828 to publish a continuation in two volumes, containing an account of his hero's adventures in England. Of the same stamp, and nearly as successful as *Hajji Babá*, were his two novels *Zohrab* and *Ayesha the Maid of Kars*. Morier died at Brighton in 1848.

MORLAIX, a town of France, capital of an arrondissement of the same name in the department of Finistère, is situated at the head of the joint estuary of the rivers Jarleaux and Kerlent, which here unite their waters, 34 miles N.E. of Brest. The valley in which it stands is entirely occupied by the water, with only a line of quays and a single street on each side; while the hills, covered with gardens and woods, rise steeply close behind the houses. The streets are irregular, and the houses antique and fantastic, with the upper storeys overhanging the lower. The town has a large square, surrounded by handsome buildings; and the principal edifices are two churches and a court-house. Linen, oil, and candles are the chief manufactures; and there is a national tobacco manufactory, the tobacco of which is said to be the worst in Europe. The harbour is safe, but difficult of entrance; and the trade is considerable in live stock, hides, linen, paper, corn, wine, brandy, &c. Pop. (1851) 11,698.

MORLAND, George, a famous painter, was a lineal descendant of Sir Samuel Morland, and was born in the Haymarket, London, on the 26th June 1763. Before the age of six he had taken to the pencil as if by instinct, and was producing drawings which were sold without any difficulty. His father, an ignorant man and an indifferent artist, undertook the entire superintendence of his training. He denied him every recreation, shut him up in a garret, forced him to produce sketches for sale, and incited him to progress in his studies by pampering his boyish appetites and vanities. Under such discipline the young artist simultaneously improved in painting and degenerated in morality; so that by the time he was sixteen he was alike precocious in talent and in vice. In his seventeenth year he threw off the paternal thraldom, and rushed with eagerness into gaiety and dissipation. His facile and masterly pencil was incessantly plied to defray the expenses of the most thoughtless prodigality. Even in the very heat and excitement of conviviality, he dashed off sketches of rural economy, notable for their elegance and quiet truthfulness. His representations of pigs and asses were especially unrivalled. He might now have realized a handsome competence, and have risen into the esteem of the learned and the great. But his affections were perversely fixed, and his money was freely lavished upon such companions as prize-fighters, hostlers, and pot-boys. Even a virtuous and attractive wife, and the pleasures of a comfortable home, failed to charm him away from his haunts of gross gratification and uproarious merriment. During all this time, when his painting was supplying money for his pleasures, his pleasures were supplying subjects for his painting. He was depicting taprooms and hedge-alehouses with that delicate tact of genius which, in handling an object, selects all those properties that are essential and picturesque, and rejects all those that are accidental and coarse. Such pictures as these raised his fame without increasing his fortune. He was continually infested by swarms of accomplished swindlers, who decoyed him on in his giddy round of dissipation, supplied him with money to pay for his prodigality, and exacted in return sketches far exceeding in value the sums that had been advanced. In course of time Morland became a squalid debtor, skulking in obscure alleys, and straining all his cunning to escape from tipstaffs. He was arrested; but by the intercession of his friends he obtained the Rules of the Bench. There his light-headed dissipation was indulged, and his felicitous sketches were produced as incessantly as ever, until he was set free by the Insolvent Debtor's Act. By this time his constitution was irrecoverably shattered. In his thirty-ninth year he was struck with a palsy; an arrestment for debt followed, and he was lodged in a spunging-house in Eyre Street. He died there in 1804. (See Cunningham's *Lives of British Painters*, &c.)

Morland, *Sir Samuel*, a skilful mechanist, was the son of a clergyman, and was born at Sulhamstead-Bannister in Berkshire about 1625. He was educated at Winchester school and at the university of Cambridge. Several years afterwards he became assistant to Thurloe, the secretary of Cromwell. His exertions in behalf of the fund for the persecuted Piedmontese first brought him before the notice of the public. He acted as commissioner extraordinary for the distribution of the collected money; and published in 1658 the *History of the Evangelical Churches of Piedmont*. In 1659 he is said to have discovered and betrayed a plot formed by Cromwell, Thurloe, and Sir Charles Willis, for alluring Prince Charles over to England, and overthrowing the royalist cause by one blow. His services in behalf of the King were rewarded after the Restoration by several honours and dignities. He was created a knight and a baronet, was appointed master of mechanics to his Majesty, and a gentleman of the royal privy chamber, and received a pension of L.400. About this time he seems to have become thoroughly engrossed with his mechanical studies. His invention of the speaking-trumpet was divulged to the world in 1671, in a treatise entitled *A Description of the Tuba Stentorophonica*. Two years afterwards he published an account of an arithmetical machine which he had invented in 1666. He also improved the fire-engine, capstan, and especially the pump and the water-engine. The cost of these inventions and improvements ruined his fortune, previously diminished by misfortune and imprudence. Blindness was added to his calamities; and he spent the last three years of his life subsisting almost entirely on the benevolence of Archbishop Tenison, and giving vent to his

serious reflections in a work entitled *The Urim of Conscience*. He died about 1696. An unpublished autobiography of Sir Samuel Morland is in the library at Lambeth Palace.

MORMONISM, the name given to that system of faith maintained by the Mormons, or Mormonites, or Latter-day Saints, a religious sect which has sprung up in the United States of America during the present century, and whose progress has been attended with surprising success. Mormonism is unquestionably one of the greatest religious impostures of this or of any age; and the evidence which has been adduced of the unblushing effrontery and blasphemous lies employed to give it currency is so cogent and overwhelming, that no one but a fanatical dupe of the delusion could give credence for a moment to such a tissue of deceptions.

The author of the Mormon imposture was one Joseph Smith, who was born in the town of Sharon, Windsor county, Vermont, U.S., on the 23d December 1805. His father, who was a small farmer, removed afterwards with his family to Palmyra, New York, where they lived a sort of idle, vagrant life, and were principally known as money-diggers. The elder Smith was notorious for his incantations, delusions, and lies; and he soon discovered that his son Joseph concealed under a guise of dulness and sloth a decided genius for "second-sight." Accordingly, when a money-digging excursion was projected, young Joseph was chosen guide; and by looking through a peculiar stone, which he placed in his hat, he "saw into the depths of the earth," and decided where tne money-seekers should begin to dig. Dig they did, but unfortunately always blundered in the process; so that no gold was found, and yet the correctness of Joseph's vision remained unchallenged. Despite the want of success which attended their ostensible profession of money-digging, the Smiths contrived, by whatever means, to be nearly always idle and very generally drunk. In addition to those accomplishments, they practised that of lying. A number of the most respectable residents in their neighbourhood solemnly declared upon oath that "no credit can be given to any one member of the Smith family." These general traits of the family character were all to be met with in the person of Joseph Smith junior, only in fuller development and richer growth. Indeed, these early personal vices were afterwards publicly admitted by "the Prophet," and dexterously turned to his own advantage. In short, the founder of Mormonism had, at the period of his finding the Golden Bible, a well-authenticated character for dexterous knavery, astute lying, and gross drunkenness: a very limited moral capital certainly on which to commence business as a founder of a new religion. Nor were his literary qualifications of a much higher order. He could read tolerably, write imperfectly, calculate with difficulty, and, as his inspired productions afterwards showed, blundered sadly in spelling, and held all grammar in abhorrence. Yet to a man who sees "remarkable visions," and is favoured with an occasional visit from John the Baptist, what may not be possible?

According to the testimony of Mr Peter Ingersoll, who was a neighbour of Smith's from 1822 to 1830, taken under oath in 1833, the future "Prophet" came in one day with a joyful countenance to the deponent, and communicated to him the following piece of information:—"As I was passing yesterday across the woods after a heavy shower of rain, I found in a hollow some beautiful white sand that had been washed up by the water. I took off my frock, and tied up several quarts of it, and then went home. On my entering the house I found the family at table eating dinner. They were all anxious to know the contents of my frock. At that moment I happened to think of what I had heard about a history found in Canada, called the *Golden Bible;* so I very gravely told them it was the Golden Bible. To my surprise, they were credulous enough to believe what I said. Accordingly, I told them I had received a commandment to let no one see it; for, said I, no one can see it with the naked eye and live." The deponent then goes on to state:—"Notwithstanding he [Smith] told me he had no such book, and believed there never was any such; yet he told me that he actually went to Willard Chase to get him to make a chest in which he might deposit his Golden Bible." In September 1827, *after* this interview with Ingersoll, Smith went to Chase and asked him to make him a chest, for he expected soon to get the Golden Bible. Shortly after, Smith returned to the workman, and said that he had been directed to a hill in the neighbourhood, where he found the book deposited in the ground, and hid it in a tree-top. The elder Smith's tale of this wonderful discovery was highly embellished with the marvellous, and was at the same time perfectly characteristic. The book was marvellous; it had been found in a marvellous way; it required marvellous qualifications to obtain it; and it was marvellous to an unparalleled degree in the influence it had exerted over the faith of the family of Smith. No one had seen the book, indeed, but the inspired Joseph; but then its disclosure to the eye of mortal was prohibited by a special revelation of the book itself. The origin of the Golden Bible, however, is a genuine historical fact, and is briefly explained.

In the year 1809 one Solomon Spaulding, a graduate of Dartmouth College, and who had for some time been a clergyman, having relinquished his profession in favour of mercantile pursuits, removed first to Cherry Valley, New York, and subsequently to Conneaut in Ohio. Being a man possessed of a sort of literary taste, he occupied his leisure hours in writing a fabulous account of the origin of the North American Indians, who at that time were alleged by some to be the descendants of the lost ten tribes of Israel. He laboured for three years upon this religious fiction, which he entitled *The Manuscript Found.* Two of the leading characters in the book were Mormon and his son Moroni, who figure so largely in Joseph Smith's Book of Mormon. To give the work a fictitious origin, he resolved to bring it forward as having been found in a cave; and, to lend it an air of antiquity, he adopted the style employed in the common translation of the Scriptures. Spaulding made no secret, moreover, of the curious task on which he was engaged. On the contrary, as his work progressed, says his widow, "the neighbours would come in from time to time to hear portions read, and a great interest in the work was excited among them;" which, among other things, showed how exceedingly easily the honest folks were pleased; for in point of dreary dulness and stupidity a more notable MS. never came from the pen of man. Solomon's brother John was "perfectly familiar with the work," and afterwards recognised it at once when it had been converted into the Golden Bible. "He was amazed and afflicted that it should have been perverted to so wicked a purpose." The evidence of Spaulding's brother, and that of Lake his partner, as to the identity of the Book of Mormon and *The Manuscript Found,* was given publicly upon oath, and is thus far conclusive. (See *Exposé of Mormonism,* by John Bennett, Boston, 1842.) Spaulding completed his volume about 1813; and there appeared an announcement in the newspapers of the day that it consisted of a translation of the Book of Mormon, recently discovered, containing a history of the lost tribes. The manuscript was placed in the hands of a printer or bookseller, named Patterson, at Pittsburgh, Pennsylvania, who was much pleased with the work; but before any definite arrangements could be come to respecting its publication the author died. The manuscript remained in the possession of Patterson, who lent it to one Sydney Rigdon, a compositor in his employment, and who combined with his calling of printer the functions of preacher to some

Mormonism.

sect of religionists. Whatever may have been Rigdon's ultimate design, it is at least alleged that he deliberately copied out the manuscript of Spaulding. How Joseph Smith and this person became connected is not known; but at all events, by taking advantage of the rage for religious excitement then current in various parts of the States, the idea originated between them of making a new Bible out of Solomon Spaulding's historical novel. But how was the imposture to be palmed upon the world? This required considerable address; and a consummate amount of craft and brazen-faced impudence were brought to the task. In the authorized Mormon chronology of the most important events which have transpired in their church we find the first three entries as follows:—"1820. Early in the spring, J. Smith jun. had his first vision. 1823. September 21, J. Smith jun. had a second vision, in which was revealed to him the existence of the plates from which the Book of Mormon was translated. The next day he opened the place where the plates were deposited, and saw them. 1827. September 22, J. Smith jun. obtained possession of the plates of the Book of Mormon, the Urim and Thummim, and Breastplate." Now, this is skilfully done: there is no undue haste or precipitation displayed; the mind of Joseph had to undergo a gradual preparation before he could be deemed worthy to be made the vehicle of a new revelation. The progress of events have also another aspect. Nothing could be made of Spaulding's manuscript during Patterson's life; and hence "the plates" could not be obtained possession of till 1827, a few months after the worthy printer died. All this falls in admirably, the one part with the other. The way is now clear, and Joseph's long-expected Golden Bible makes its appearance. He found it deposited in the ground, the characters beautifully engraved on plates of gold, fastened together by rings of the same metal. Joseph was a mean scholar, but he was inspired to execute the task of translating this mysterious language into English. He set to work accordingly, in conjunction with Rigdon and one Oliver Cowdery, who acted as scribe, and interpolated at judicious intervals in Spaulding's manuscript certain religious maxims, prophecies, &c., garbled from the sacred Scriptures, and engrafted upon the original romance—not itself a miracle of correctness—in a manner so illiterate and clumsy as at once to betray the ignorance of the interpolator. But all errors are admitted by the Mormons. With them no amount of anachronisms or contradictions can invalidate the plenary inspiration of the Book of Mormon. Joseph Smith was a chosen vessel, and it was not necessary that he should write correct English. The inspired translator, however, despite all his money-digging, was a poor man, and his coadjutor Ridgon, printer and preacher, was little richer. Money must be had to carry on the divine task; for Joseph was only inspired to translate Egyptian hieroglyphics, not to discover the philosopher's stone. Martin Harris, a farmer, more wealthy than wise, and a man who had already gone through all the phases of faith within his reach, was fixed upon as a fit subject on which to operate. Simple Martin proved an easy prey: the revelation which said, "impart it [*i.e.*, thy property] freely to the printing of the Book of Mormon" (sec. 44 of *Doctrines and Covenants of the Latter-day Saints*, Nauvoo, 1846) he could neglect only at his peril; and so the dollars of the honest farmer began gradually to slide through his fingers, with little immediate prospect of recovering them. His faith began to diminish as well as his purse, and something required to be done to increase it. He was accordingly despatched by Joseph Smith, with what the credulous farmer was led to believe to be a fac-simile of a portion of the golden plates, to Anthon of New York, the well-known editor of various classical works, to test the learning of the professor on the Golden Bible. The scholarship of the classic was at fault: the Book of Mormon was beyond his comprehension. "It consisted," Anthon afterwards wrote to Mr Howe in 1834, "of all kinds of crooked characters, disposed in columns, and had evidently been prepared by some person who had before him at the time a book containing various alphabets, Greek and Hebrew letters, crosses, flourishes, &c." "I began to regard it," he says, "as part of a scheme to cheat the farmer of his money, and I communicated my suspicions to him, warning him to beware of rogues." Harris returned to "the Prophet," who doubtless turned the professor's apparent ignorance to good account. The printing of the Golden Bible commenced, and Harris was loud in his praises, to the printers, of the wonderful wisdom of the translators of the mysterious plates. The printers had their suspicions, however, and they were not to be duped. To bring this vaunted wisdom to the test, after putting one sheet in type, they laid it aside, and told Harris it was lost, and must be replaced. "After two or three weeks," says Mr Tucker, who was connected with the office, "another sheet was produced, but no more like the original than any other sheet of paper would have been, written over by a common school-boy after having read, as they did, the manuscripts preceding and succeeding the lost sheet." The Book of Mormon was ultimately published; and among other revelations of the will of God, Smith was declared to be his "Prophet," with all power, and entitled to all obedience. He soon found himself at the head of a small but rapidly-increasing body of ardent followers. The first conference of the sect as an organized church was held at Fayette on the 1st June 1830, when the numbers of the "Saints," including the family of the Smiths, amounted to thirty. During the same year a revelation was made to Joseph, styling him "Seer, Translator, Prophet, Apostle of Jesus Christ, and Elder of the Church," and enacting that "the church shall give heed to all his words and commandments which he shall give unto you; for his word shall ye receive as if from mine own mouth, in all patience and faith." (*Doc. and Cov.*, &c., sec. 46.) Joseph began boldly and openly to baptize his disciples in a neighbouring stream; but the inhabitants of Fayette knew too much of the swindling money-digger and his fraternity to tolerate such a pitch of blasphemous audacity, and accordingly employed language and threw out hints by no means flattering to "the Prophet." He judged it prudent to transplant his new religion elsewhere, and accordingly removed to Kirtland in Ohio, a revelation having been duly promulgated to that effect. This place continued to be the residence of "the Prophet," and the ecclesiastical seat of the sect, till 1838, when they migrated to Missouri. In 1831, after their removal to Kirtland, a revelation was promulgated that they should consecrate all their property to God. Joseph accordingly set up a mercantile house and a bank, appointing himself president, and Rigdon, the *fidus Achates*, cashier. This speculation had only a temporary success, however. Joseph had perhaps forgotten, or not sufficiently considered, the revelation of his earlier career—"In temporal labours thou shall not have strength, for that is not thy calling." (*Doc. and Cov.*, sec. 9.) At all events, in 1837 the bank stopped payment, and "the Prophet" was induced to depart secretly in the night for Missouri, leaving his creditors to their own shift. He probably had a "revelation" for this movement also. Kirtland did not prove a Zion to the Mormonites: "the Prophet" was tarred and feathered by the mob; and his followers had to submit to numerous indignities at the hands of the "Gentiles." The history of the sect for the next three years after their removal to Missouri is one of strife and contention with their unrelenting enemies. Not a few of the "Saints" themselves showed signs of disaffection and declension, and a great schism broke out in 1838, when Joseph found it necessary to denounce his chosen confederates, Cowdery, Harris, and Rigdon. The Mormons presumptuously claimed the entire

country as theirs by spiritual right, and the people of the neighbouring districts, not fully appreciating the validity of the claim, and dreading the fanatical ambition of the "Saints," commenced a series of outrages upon them, which ended in sheer massacre and bloodshed, and the final expulsion of the Mormons from Missouri. It must be admitted, however, that they were most cruelly treated by the Missourians; and, considering the slight causes of aggravation, the conduct of the people of Far West was altogether reprehensible.

A few months after their compulsory departure from Missouri, the Mormons, amounting in all to 15,000, found refuge in Illinois, where they founded the city of "Nauvoo," and appointed Joseph Smith mayor. The recent reverses which the sect had undergone had tended, if possible, to exalt "the Prophet" still higher in their estimation. His unflinching courage in the most perilous circumstances commanded their admiration; and his constant reliance on the ultimate triumph of his cause inflamed their fanaticism, and inspired them with the most extravagant hopes. The organization of the sect was gradually becoming more complete, and the Mormons had already begun to display that steady industry and judicious frugality on which their subsequent success has so much depended. New converts or wandering adventurers flocked from all parts of the Union, and even from England, to cast in their lot with the followers of "the Prophet," and add a stone to the temple of the "Holy City." The darling dream of the impostor's ambition was now becoming realized. His supremacy was undivided, and his word was law. He was both temporal and spiritual head of his people, and not only enjoyed the titles of "Prophet," "President," and "Mayor," but also rejoiced in the military distinction of "General" Smith, in virtue of his command over the Nauvoo Legion, a body of militia which he had recently organized. The period of the "Saints'" residence in Missouri was not at all rich in "revelations." Their hold upon the territory was too insecure to warrant any likelihood of success in the prophetic art. Joseph thought, with Epimenides and Bacon, doubtless, that in these circumstances it was safer to prophesy after the thing had happened. Affairs had now assumed a more settled aspect in Illinois; and a "revelation" was made known to the faithful of "Come ye with all your gold and silver," &c., to build a "boarding-house;" and "let it be built in my name, and let my name be named upon it, and let my servant Joseph Smith and his house have place therein from generation to generation, for ever and ever, saith the Lord." Joseph was always duly provided for in all the revelations. In this "boarding-house," it is said, the "revelator" kept a tavern, which proved a very successful speculation. But the great undertaking of Nauvoo was the building of the Mormon temple, on which it is said the sect expended nearly a million of dollars. The foundation of this splendid edifice was laid with great pomp on the 6th of April 1841. The rapid growth of the "Holy City" was quite surprising; and the spiritual pride of the "Saints" kept pace with their prosperity. In 1843 Joseph aspired to the presidency of the United States, and published a statement of his views. He did not succeed; but he soon discovered that all his presidential authority was required among his own disciples at home. Their former presumption towards the "Gentiles," and their own private dissensions, were again renewed. Sidney Rigdon, who had been re-admitted into the confidence of "the Prophet," introduced a novelty called the "spiritual wife" doctrine, which led to great scandal, and ultimately to an unexpected catastrophe. Smith, though he discountenanced the practice in public, seems to have been himself a warm patron of polygamy, and is said to have rivalled Mohammed in the number of his favourites. But Rigdon outdid "the Prophet" here, and had "revelations" of his own, in which he blasphemously claimed the sanction of Heaven for systematic seduction. Whether justly or unjustly, Smith himself was charged by certain of his own followers with countenancing and even practising this abominable doctrine; and in attempting to extinguish this alleged scandal by violent measures, "the Prophet" brought himself within the power of the legal authorities of the county. He was imprisoned, with his brother Hyrum and certain of his confederates, in Carthage, to take their trial for riot. The governor pledged his word to protect them against threatened violence; but on the evening of the 27th of June 1844, "nearly two hundred men with blackened faces" rushed into the prison where the obnoxious sectaries lay, and instantly fired upon them. Joseph and Hyrum were both shot dead on the spot, but the rest escaped.

Thus fell this singular character, who, from a position of poverty, ignorance, and vice, had, in the short space of twenty years, raised himself, by the most unblushing imposition and blasphemous fraud, to be the acknowledged head of 100,000 ardent followers, and the author of a creed which had already found zealous teachers and ready believers over half the globe. Whether in his later years he continued the vulgar and ambitious impostor of his earlier career, it is difficult to say. There are not a few incidents in his later life which would favour the supposition that he really believed what he asserted. It would seem that, by a whole life of falsehood and deception, he had so habituated himself to assumption and imposition, that a lie became the only possible truth for him. But however this may be, he was certainly one of the most notorious men of modern times.

On the death of Smith, addresses and proclamations were issued to the "Saints;" and Brigham Young, an English Mormon, succeeded, after expelling Rigdon, in securing the leadership of the sect. After a short period of transient prosperity, new troubles and hostilities arose between the "Saints" and the "Gentiles." A battle ensued between the Mormon forces and the state militia, which ended in the final expulsion of the former from the "Holy City" and the Illinois territory. Some went to the western border of Iowa, and formed a temporary settlement on the Missouri River. A large body sought a permanent refuge in the Great Salt Lake Valley, between the Nevada and the Rocky Mountains,—"a remarkable pilgrimage," says Dr Mackay (*The Mormons, or Latter-day Saints*, 1856), "which has not been paralleled in the history of mankind since Moses led the Israelites from Egypt." The pioneers of this great and perilous expedition entered the Great Salt Lake Valley on the 24th July 1847. Their persecutions, which they had suffered manfully and with surprising patience, being now over, they devoted themselves to the labours of the field with extraordinary industry and success. Since the period of their arrival, a large and flourishing city, called the "Great Salt Lake City," has arisen at the foot of the splendid mountains which surround the valley; and the long arable reaches of land in the neighbourhood are skilfully cultivated, and are yielding rich and abundant crops. A "perpetual emigration fund" was organized in 1849, to enable the poorer converts to Mormonism to reach the promised land. From all parts of Britain, and from many cities of the Continent, and especially from Germany, thousands of proselytes to the new faith are annually flocking to the land of Utah. Polygamy, which was at first concealed under the doctrine of the "spiritual wife," is now openly practised, and even inculcated as a Christian duty, and is leading to the worst of consequences. (See *Patriarchal Order, or Plurality of Wives*, by Orson Pratt, Liverpool, 1853.) The inequality of the sexes is at once a religious doctrine and a rule of life among the "Saints." Women must obey their husbands in all things, whether

right or wrong. Numerous cases of desertion are said to be daily occurring; and from an account given of the state of Mormon affairs at head-quarters, by twenty-six of their number who had escaped in June 1857 to San Francisco, it would appear that instant death is the doom of all apostates. A band of blood-thirsty ruffians, called the "Destroying Angels," has been instituted for the extermination of all deserters and apostates from the faith. So utterly are many of their deluded adherents disgusted with the bestiality practised in the Holy City, that it is confidently alleged, that if the government of the United States were to afford them protection from the persecution consequent on desertion, one-half of the inhabitants of the Great Salt Lake Valley would seek a residence elsewhere. Brigham Young, a clever, audacious blackguard, is the political as well as the spiritual head of his people; and he has recently preached open rebellion against the United States, of which Utah since 1850 has formed a territory. Such a system is a virtual treason against the laws of human society; and the government of the United States is at present (Nov. 1857) contemplating an armed expedition to Utah to reduce the "Saints" to sounder views of territorial obedience. Lieutenant Gunnison, however, affirms that, with their 8000 militia, who are under excellent discipline, the Mormons could defy the whole 10,000 of a standing army possessed by the United States. (*History of the Mormons*, by Lieutenant Gunnison, Philadelphia, 1852.)

The first Mormon mission to England was begun in 1837; and in 1843 the converts throughout different parts of Britain amounted to upwards of 10,000. They were almost entirely drawn from the illiterate among the working-classes,—Wales furnishing a larger proportion than any other part of Great Britain. From authentic returns published by an American paper in August 1856, it appears that the Mormons number in America 68,700; of whom 38,000 are in Utah, 5000 in New York, 4000 in California, 5000 in Nova Scotia and Canada, and 9000 in South America and the Sandwich Islands. Europe contains 39,000; of whom 32,000 are in Great Britain and Ireland, 5000 in Scandinavia, 1000 in Germany and Switzerland, 500 in France, and 500 in the other countries of Europe. In Asia they are said to number 1000; in Australia and Polynesia, 2400; in Africa, 100; on travel, 1800. There are in addition 8500 schismatics, including Strangites, Rigdonites, and Wightites. Their aggregate amount is above 120,000; and it is supposed that the whole sect cannot exceed 126,000. These statistics are considerably below those published by the "Saints" themselves; but it is alleged by those who have visited the Great Salt Lake, that, from some cause or other, the faithful are greatly given to exaggeration on this point. Their number, as at present estimated by themselves, is upwards of 300,000.

The precise religious creed of the Mormons cannot be easily ascertained. They profess to believe in the word of God recorded in the Bible, also in the Book of Mormon, and the Book of Doctrine and Covenants, which in their opinion completes the Scriptures, and forms the fulness of the gospel. Their mode of interpreting Scripture, however, is often somewhat peculiar. They describe God in their symbolic books as "a material, organized intelligence, possessing both body and parts." They maintain that the gift of prophecy and the power of working miracles have not ceased, and that many of their number can work miracles and cast out devils. They hold that the end of the world is near, and that they are the "saints" mentioned in the Apocalypse, who will reign with Christ in a temporal kingdom in this world. The seat of this kingdom, they allege, will be either Missouri or their present location in Utah. They hold, that in order to be saved men must comply with four conditions:—They must believe in Christ's atonement; they must repent of their sins; they must receive baptism by immersion, administered by an apostle of Christ's appointment; they must receive the laying on of hands for the gift of the Holy Ghost, by duly authorized apostles. They recognise two orders of priesthood, called the "Aaronic" and the "Melchizedek;" and are governed by a prophet, twelve apostles, "the seventies," bishops, high-priests, deacons, elders, and teachers. (See *A Compendium of the Faith and Doctrines of the Church of Jesus Christ of Latter-day Saints*, by F. D. Richards, 1857, *passim*.)

The first cause of the rapid and vigorous growth of Mormonism which strikes the attention is the alleged possession of a living visible prophet, and a direct and permanent inspiration. Its votaries are thus saved the trouble of wrestling with those problems of life which demand solution from all earnest minds who do not pin their faith to any outward authority. They accordingly inform us in their authorized organ (*Millennial Star*, vol. xiv., p. 444), that "Latter-day Saints *know* that the Lord has spoken in this age; they *know* that angels do now converse with men; they *know* that the gifts of the Holy Ghost are manifested in these days by dreams, &c." In the second place, the skilful organization of the sect has enabled it to direct the energies of its votaries to the best purpose. They have made a very religion of industry. Thirdly, we may ascribe very much of the success of Mormonism to the discontent which prevails among the working-classes against the rich. To many such the voice of the Mormon apostle sounds like that of Moses to his oppressed brethren in Egypt, inviting them to fly from oppression and slavery to that promised land where the poor are lords of the soil, where social equality is the rule, and universal brotherhood the grand maxim of life. This cause has doubtless operated more extensively in making converts to Mormonism among our operatives in this country than is generally supposed. Another cause, which cannot be overlooked, is the premium held out upon sensualism by elevating some of its grossest practices into direct Christian duties. But while these causes may serve in some degree to explain the rapid extension of the Mormon delusion, have we any reason to suppose that any or all of them will be sufficient to secure its permanent stability? While any answer to such a question must be to a great extent conjectural, it is nevertheless tolerably obvious that Mormonism contains within itself more than one element of weakness and decay. The present zeal for proselytism must to some extent pass away when the necessity for increasing the population has ceased, by the requisite 60,000 elevating the present Utah *territory* into a *state* of the Union. Secondly, the rooting of the sect to a single spot will tend—if future "revelations" prevent not—by localizing it, to limit its ultimate extension, and neutralize its vaunted catholicity. Thirdly, the theocratic and democratic elements, which are at present merged together, will be in constant danger of being confounded. The death of a president may lead to a violent disruption any day. And, in the last place, it is alleged by those who have resided in Deseret that the rising generation of the "Saints" is growing up faithless and false,—the younger citizens laughing in their sleeve at the "martyr" Joseph with his plates and prophesyings. If this be so, we shall have the old cycle of the world's history again repeated (*si licet parva componere magnis*), of an age of scepticism succeeding a generation of credulity,—of lazy luxury and gross sensuality following in the wake of earnest, manly industry and honourable prosperity. (Conybeare's *Essays*, p. 280.)

(For further information respecting the rise, progress, and present state of Mormonism, consult the *Prophet of the Nineteenth Century*, and the *City of the Mormons*, by Professor Caswall of Missouri, London, 1843; *Census of the Religious Worship of Great Britain*, 1851, by Mr Horace

Mornay — Morocco.

Mann; *The Mormons or Latter-day Saints, with Memoirs of the Life and Death of Joseph Smith, the "American Mahomet,"* London, 1852; *The Mormons, or Latter-day Saints, a Contemporary History*, by Charles Mackay, LL.D., London, 1856; Olshausen's *Geschichte der Mormonen*, Göttingen, 1856, 8vo; *A Visit to Salt Lake, being a Journey across the Plains, and a Residence in the Mormon Settlements at Utah*, by William Chandless, London, 1857.

MORNAY, PHILIPPE DE, *Seigneur du Plessis-Marly*, was born at Buhy or Bishuy in Upper Normandy, in France, in 1549, and was educated at Paris. He made rapid progress in the belles-lettres, in the learned languages, and in theology, which was then thought a prodigy in a gentleman. He was destined for the church by his father, who was a zealous Roman Catholic; but the principles of the Reformation, which he had imbibed from his mother, effectually excluded him from the ecclesiastical preferments to which, by his interest, abilities, and birth, he would have been entitled. After the horrible massacre of St Bartholomew, he travelled Italy, Germany, England, and the Low Countries; and after his return joined the King of Navarre, at that time leader of the Protestant party, and since so well known by the name of Henri IV. This prince sent Mornay,—who employed his whole abilities, both as a soldier and a writer, in defence of the Protestant cause,—to conduct a negotiation with Elizabeth, Queen of England. He was left wholly to his own discretion in the management of that business, and was successful in almost every negotiation. He tenderly loved Henri IV., and spoke to him upon all occasions as to a friend. When he was wounded at Aumale, he wrote to him in these words:—"Sire, you have long enough acted the part of Alexander; it is now time you should act that of Cæsar. It is our duty to die for your Majesty. It is glorious for you, Sire, that I dare venture to tell you it is your duty to live for us." This faithful subject did everything in his power to raise Henri to the throne; but when he deserted the Protestant faith he reproached him in the bitterest manner, and retired from court. Yet Henri still loved him, and had occasion afterwards to give evidence of his continued attachment to this tried servant. Mornay's knowledge, probity, and valour made him the soul of the Protestant party, and procured him the contemptuous appellation of the "Pope of the Huguenots." He defended their doctrines both by speech and writing. One of his books, *Un Traité de l'Institution de l'Eucharistie*, published in 1598, having stirred up the Catholic divines, he refused to make any reply to their censures and criticisms except in a public conference. This was accordingly appointed to be held in the year 1600 at Fontainebleau, where the court then was. The two champions were Duperron, Bishop of Evreux, and Mornay. After a great many arguments and replies on both sides, the victory was adjudged to Duperron. He had boasted that he would point out to the satisfaction of every one five hundred errors in his adversary's book, and he partly kept his word. The Calvinists did not fail to claim the victory on this occasion, and they still continue to do so. But this conference, instead of putting an end to the differences, was productive of new quarrels amongst the controversialists, and of much profane wit amongst the libertines. When Louis XIII. was making preparations against the Protestants, Mornay, who was governor of Saumur, wrote him a letter, full of enlightened freedom, dissuading him from such a measure. But these remonstrances produced no other effect than the loss of the government of Saumur, of which he was deprived by Louis XIII. in 1621. He died two years afterwards, on the 11th November 1623, aged seventy-four, in his barony of La Foret-sur-Seure in Poitou.

Moro — Morocco.

His principal works are,—*Un Traité de l'Eucharistie*, 1604, folio; *Un Traité de la Vérité de la Religion Chrétienne*, 8vo; *La Mystère d'Iniquité*, 4to; *Un Discours sur le Droit prétendu par ceux de la Maison de Guise*, 8vo; curious and interesting *Memoirs*, from the year 1572 to 1629, 4 vols. 4to; *Letters*, written with great spirit and good sense. David des Liques published a Life of De Mornay, in a quarto volume; and additional information regarding him will be found in the *Lives of the Ancient Seigneurs of Mornay*, by R. de Mornay de la Villetertre, 1689, 4to. The greater number of his works were translated into English during his own time.

MORO, ANTONI, or SIR ANTHONY MORE, an eminent portrait-painter, was born at Utrecht in 1512, according to some, but in 1525 according to Van Mander, in his *Het Leven der Schilders*. He studied his art under Jan Schoorel; and after making a professional visit to Italy, he commenced to paint portraits in the style of Hans Holbein. His rise to eminence was rapid. In 1552 he was invited to Madrid by the Emperor Charles V. to execute a likeness of Prince Philip. Two years afterwards he was in London painting the portrait of Queen Mary. For this picture an annual salary, and, as some suppose, the honour of knighthood, were conferred upon him. He was also employed to sketch the likenesses of several of the English nobility. On the death of Mary in 1558 Moro returned to Spain, and lived there for two years in great honour with the Emperor Philip. He then repaired to the Netherlands, and was received into the service of the Duke of Alva. His death took place at Antwerp about 1581. "Moro's style," says Stanley in his *Dutch and Flemish Painters*, "so much resembles that of Holbein as to frequently create a doubt to which of them a portrait is to be attributed; but he is not so clear and delicate in his colouring (perhaps from having painted so much in Spain) as that master."

MOROCCO.

MOROCCO, or *Marocco*, an empire in the N.W. of Africa, called by the natives *Moghrib-el-Acsa*, or the Extreme West, lies between 28. and 36. N. Lat. and between 1. 20. and 11. 30. W. Long. It is bounded on the N. by the Straits of Gibraltar and the Mediterranean, E. by Algeria, S. by the Sahara, and W. by the Atlantic. Area estimated at 222,560 square miles.

Mountains. The natural features of this extensive country present mountains, plains, and valleys in the utmost variety. The country is traversed from N.E. to S.W. by the Atlas Mountains, which consist of several parallel chains rather than of a single range. The southern portion of these mountains is known by the name of the Greater, and the northern by that of the Lesser Atlas. The north-eastern extremity of the latter approaches the Mediterranean at Cape dell' Acqua to the W. of the mouth of the Mulwia; and a branch called the Er-Riff Mountains stretches westward, and terminates at Ceuta, opposite to Gibraltar. The most celebrated of these is the craggy limestone mountain known by the modern name of Apes Hill, the *Mons Abyla* of antiquity, and one of the Pillars of Hercules. Towards the Atlantic on the S.W. the Greater Atlas consists of two ranges, one of which ends at Cape Gher and the other at Cape Nun. On the N.W. of the main ridge there is a plain stretching towards the Atlantic, and on the S.E. another stretching towards the Sahara. The whole of Morocco consists of two mountainous and two lower regions. Of the mountainous regions, the most extensive, though not the most elevated,

Morocco. is that of Er-Riff, which lies along the coast of the Mediterranean, consisting of barren, rocky heights, with narrow valleys. The other mountainous region consists of the Atlas itself, with the adjacent table-lands and inferior ridges. The mountains of this chain present in general a broad and rounded appearance; but the extreme summits are often bold, steep, and inaccessible. The highest point is believed to be Mount Hentet, which is about 13,000 feet above the sea; and Miltsin, which is situated to the S. of the town of Morocco, attains the height of 11,200 feet. Of the geology of the Atlas Mountains little is known, except that the lower portions, as far up as 3000 or 4000 feet, consist of secondary limestone, and no traces of volcanic agency have been observed. The north-western plain is for the most part level, and slopes gradually towards the sea. The soil is naturally rich and fertile; and although there are in some places large forests of underwood, and tracts of undulating ground, the uniformity of the surface is in general broken by few trees or eminences. The lowlands, which lie to the S.E. of the Atlas, are of a quite different character from those of the N.W.; for the plains and valleys here are rocky and barren; but there are in many places large clumps of date palms, so that the region to which these districts belong has obtained the name of *Bilud-ul-Gerid*, or the "country of palms." The coasts of Morocco present as much variety of appearance as the surface of the interior. On the Mediterranean, along which this country extends for 230 miles, the coast is bold and rocky, corresponding to the mountainous character of the inland regions in this part. The most remarkable promontories are those of Ceuta, opposite Gibraltar in Europe, which rises to a considerable elevation; and Cape Spartel, a little further west. The same sort of coast continues beyond the Straits, as far south as the 35th degree of latitude; but about that point a remarkable change takes place. The coast here consists of low sand-hills, behind which there are two lakes, the larger being about 20 miles in length by 1½ in breadth. Further to the south the coast is again bold and rocky; but between the extremities of the two branches of the Atlas it is generally low and sandy. The principal headlands on the Atlantic coast of Morocco are Cape Nun in the extreme S., and Cape Blanco in N. Lat. 33. 8., W. Long. 8. 40.

Rivers. The mountain range of Atlas separates those rivers of Morocco which enter the Atlantic from those which water the south-eastern lowland, and either fall into the Mediterranean or are lost in the sands of the Sahara. The furthest north of the Atlantic rivers is that of El Khos, which rises in the mountain of Er-Riff, and has a length of about 100 miles. The Seboo rises in the Lesser Atlas, flows westward through a rich and fertile plain, and after a course of 230 miles, falls into the Atlantic. From the same mountains, and in the same direction, flows the Bu-Regreb, a small river only 100 miles in length. The Oom-er-Begh, which flows in the same direction farther to the S., is the largest of the rivers that fall into the Atlantic, being supposed to be upwards of 300 miles long. The Tensift and the Sus also fall into the Atlantic. The Draha, which rises on the E. of Mount Atlas, and was formerly supposed to lose itself in the Sahara, is now believed to fall into the Atlantic, 32 miles S.W. of Cape Nun. On the same side of the mountains rise three rivers,—the Fileli, Ziz, and Ghir, which flow southwards into the Sahara; and the Mulwia, which, rising in the south of the Lesser Atlas, flows northward into the Mediterranean, and has a length of 400 miles. The last of these forms in the lower part of its course the boundary between Morocco and Algeria, but comparatively little is known of the character of the country through which it flows.

Climate. The western part of Morocco enjoys a very temperate climate, and the heat does not vary more than from 40° to 90° in the course of the year. This arises on the coast from the cooling sea-breezes, which blow here with great regularity; while in the interior the mountains shelter it from the hot winds of the desert. The year consists of a wet and a dry season; the former of which nearly corresponds to our winter, and continues from November till March, during which time showers frequently fall, with short intervals of dry weather. The other part of the year, on the contrary, is generally dry, showers being unfrequent. Towards the south, also, less rain falls than in the rest of Morocco. On the south-east side of the mountains it is not so well known what is the nature of the climate; but it is probably more extreme in heat and cold, especially the former, on account of its proximity to the Sahara. On this account, also, no rain falls in the south-eastern part of Morocco.

Productions. The mineral resources contained in the Atlas Mountains are believed to be great. Of these, copper forms the principal part, and is obtained near Teselegbt, on the southern slope of the mountains. Gold and silver are also found in some parts, but not in any great abundance. There are said to be iron mines in the interior; and sulphuret of antimony, which is used by the native ladies for painting their eyebrows, is obtained from Tedla. Lead, tin, and rock-salt are the chief of the other minerals of Morocco. The soil produces many useful and valuable vegetables; but agriculture is in a very backward state, so that the full advantage is not derived from the fertility of the soil and the mildness of the climate. Wheat, barley, rice, maize, and durra grow in the level regions in great abundance, and the last of these forms the chief article of food to the people. Besides these, pulse of various kinds, cotton, tobacco, hemp, saffron, and sesamum are also grown; and in the neighbourhood of the towns vines are raised, but only for the sake of their grapes and raisins. The trees of Morocco comprehend most of the fruit trees of Southern Europe, such as figs, pomegranates, lemons, oranges, &c. The forests of Er-Riff contain many kinds of oak, among which are the cork oak, and that which bears edible acorns. The north-western slopes of the Atlas are covered with forests of cedar, pine, juniper, olive, walnut, and other trees; while the only trees found on the slopes looking towards the desert are the date and dwarf palm.

Of wild animals there are in Morocco a great number, especially in the southern parts. Lions, panthers, hyenas, wild boars, gazelles, and antelopes abound, especially among the mountains; and ostriches are hunted on the southern borders of the country. Morocco is also sometimes laid waste by locusts. The domestic animals are numerous; and the inhabitants are more extensively employed in rearing cattle than in the culture of the ground. The Moorish horses were formerly highly esteemed; but the breed has now much degenerated, as the best of them are always appropriated by the Sultan, and the exportation of them is prohibited. The number of horses is estimated at 400,000. Horned cattle are more numerous, amounting to 5,000,000 or 6,000,000; and bulls are largely employed in field labour. The sheep amount in number to 45,000,000, and are highly valued on account of their wool. The goats are very numerous; and camels, mules, and asses are also reared.

Inhabitants. The population of Morocco consists of many different races, which have never amalgamated or united, but remain quite distinct from one another. The most ancient race seems to be that of the Amazighis or Mazighis, a nation widely spread over the north of Africa, and believed to be the descendants of the ancient people mentioned by Herodotus under the name of Mazyes. Those who inhabit Morocco occupy the mountainous regions, and are divided into two tribes,—the Berbers, who live in the mountains of Er-Riff, and the Shelluhs, in the Greater Atlas. The former are middle-sized, well-proportioned, strong, and fair in com-

Morocco. plexion, and live by hunting and rearing cattle. Their habitations are tents or caves in the mountains. Those on the coast are also much addicted to piracy. The Shelluhs are less robust than the Berbers, and have a sallow complexion resembling the Portuguese. They live in houses built of stone, and employ themselves in agriculture and various handicrafts. Altogether they are more civilized than the Berbers. It has been questioned whether the languages of these two tribes are distinct, or merely different dialects of the same. The latter opinion seems the more probable; and it is believed that these are dialects of one language, which is spoken throughout the north of Africa, from the Nile to the Atlantic. The level portions of Morocco are chiefly inhabited by Arabs, of which there are two races,—the Arabs proper, and the Moors. The Arabs, properly so called, are the descendants of those who settled here on the first spread of the Mohammedan religion, and they retain the manner of life of their forefathers in the deserts of Arabia. They live in tents, follow pastoral avocations, and speak a corrupted form of the language of the Koran. The Moors form the most numerous and the dominant race in Morocco. They are sprung from the Mohammedan conquerors of Spain, who were expelled from that country after the conquest of Granada in 1492. These people originally consisted of Arabs, mingled with the aboriginal Amazighis and with the Vandals. When they returned to Africa, however, after their expulsion from Spain, their kinsmen refused to have any intercourse with them, regarding them merely as foreign invaders. The Moors now inhabit the towns and villages, and the country near the coast, so that it is with them only that the Europeans have any intercourse. They are of middle size and very stout; pride and indolence are their chief characteristics; and their manners and customs resemble those of the Egyptians. They speak a dialect of the Arabic, mingled with many words from the Amazighi and Spanish languages. Among all these tribes many Jews are to be found, especially in the places of trade. They are oppressed and despised by the other races, but notwithstanding this, they frequently amass great riches. Their condition, however, is somewhat better among the Berbers than among the other tribes. There are also Negroes, who are brought as slaves from Soudan, and are very numerous in the southern districts. They are treated with considerable mildness, and frequently obtain their liberty.

Government. The empire of Morocco is divided into four territories, which were formerly independent kingdoms, but are now subject to the sultan. These are,—Fez, occupying the northern portion, between the Oom-er-Begh and the Mediterranean; Morocco, occupying the centre, between this river and the Atlas; Suse, occupying the south; and Tafilet, occupying the country to the east of the Atlas. The subdivisions of these are not at all distinctly marked, though they were formerly believed to consist of several provinces, the names of which were derived in some cases from the natural features of the country, and in others from the tribes that inhabit it. For administrative purposes, Fez and Morocco are each divided into fifteen *ammala* or districts, while three more are made up by the other territories. These districts sometimes comprise no more than a single town, and sometimes extend over a large tract of country. Each is under the dominion of a *kaid*, who collects the taxes from his subjects. The Sultan of Morocco, over those tribes which are really subject to him, has unlimited power. He is supreme both in civil and ecclesiastical matters, and has titles which signify "Lord of the Faithful," and "Viceroy of God on earth." His power is not limited, as in Turkey, by councils or ministers, but he is himself the sole lord of the life, liberty, and property of his subjects. There is no law in Morocco but the will of the sultan and his subordinates; the inferior officers plunder the people, and are in their turn plundered by the sultan. Wherever he happens to reside, he gives audience personally four times a week, for the administration of justice, and sentence is always pronounced without any delay. The dominion of the sultan, however, only extends over the plains; for the Amazighis, who inhabit the mountains, have never been brought into subjection to the Moors, and have a sort of republican government among themselves. The only standing army in Morocco consists of 5000 Negroes, who form the sultan's body-guard. There is also a sort of militia, who are occasionally called out, but receive no pay, except a horse, and a small present when they visit the capital. They are good horsemen and marksmen, but quite undisciplined, and therefore not very effective. The empire is hereditary, and confined to males; but it is not always the eldest son who succeeds, and the succession is frequently disturbed by bloodshed and civil war. The revenue is chiefly derived from taxes on corn and cattle, which are paid in kind, and a poll tax on the Jews; but it is very fluctuating, and has often to be raised by force of arms from the Arab tribes.

Religion. The religion of the country is for the most part Mohammedan, and the rites and ceremonies of that creed are observed with the most rigorous strictness; the Jews are everywhere despised, and the only Christian establishment in the country is a Franciscan convent at Tangiers.

Education. The number of elementary schools is great, and in them the children, who go at the age of six, are taught reading and writing, and learn by rote passages from the Koran. There are also upper schools preparatory to entering the university, or "House of Science", as it is called, at Fez. In that institution the principal branches taught are grammar, theology, logic, rhetoric, geometry, and medicine. The art of printing is unknown; but many persons are employed in transcribing the Koran and other books; and writing is much cultivated and esteemed. Arts and sciences are in a very low state; and the only musical instruments are a rude pipe and drum. The people have, however, some taste for music, and among the Shelluhs some plaintive melodies are sung.

Manufactures. In the country districts of Morocco manufactures do not form a separate branch of employment, but each family is supplied with the necessaries of life by the labours of its own members. All the women are able to spin woollen and cotton thread, which is woven into cloth by the men. More extensive manufactures are carried on in the towns, and among these tanning occupies the most important place. In this art the workmen of Morocco surpass those of Europe; for they are able, by means of two plants found in the mountains, and not known to Europeans, to render the skins even of the lion and panther extremely soft and white. They have also the art of producing very brilliant colours in leather, which are believed to be inimitable in Europe. Of the fine leather known by the name of Morocco, the yellow kind comes from Morocco proper, the green from Tafilet, and the red from Fez. Fez is also remarkable for the woollen caps known by that name, which are manufactured here, and dyed of a bright-red colour by means of a berry found in the neighbourhood. Silk stuffs and girdles are also made at Fez; and the inhabitants are very skilful as goldsmiths and jewellers. In the city of Morocco silks and embroidered goods are also manufactured; and in that province, and the province of Suse, those carpets are made which are called in Europe Turkey carpets. Besides the articles already mentioned, gun-barrels, pottery, and ropes are manufactured at various places, but not to any great extent, nor of good quality.

Commerce. The commerce of Morocco is carried on chiefly through three channels,—viz., 1. By sea, with Europe; 2. By means of caravans to Mecca, with the shores of the Levant; and 3. Across the Great Desert, with Soudan and the other states

Morocco.

of Central Africa. The trade with Europe by sea is believed to have been begun in 1551 by an Englishman named Thomas Windham; and at the present day two-thirds of the entire trade is in the hands of Great Britain. It is carried on in the seaports along the coasts of the Mediterranean and the Atlantic. The following table shows the amount of the exports and imports of the chief ports of Morocco, from the most recent returns:—

Ports.	Exports to British Ports.	Exports to Foreign Ports.	Total.	Imports from British Ports.	Imports from Foreign Ports.	Total.
	L.	L.	L.	L.	L.	L.
Laraiche, 1856	...	...	21,738	...	...	76,801
Dar-al-Baida (average of five years)	...	...	62,174	...	...	...
Mogadore, 1855	228,112	55,965	284,077	136,496	31,223	167,719
Rabat (average of five years)	...	...	34,770	...	...	...
Tangier, 1856	63,380	13,983	77,364	101,773	33,733	135,506
Tetuan (average of five years)	9,000	...	...	19,000	...	...

The exports consist principally of wool, hides, skins, grain, pulse, wax, cattle, sheep, leather, ostrich feathers, &c.; and the principal imports are,—cotton, linen, muslin, sugar, tea, coffee, hardware, &c. The means of inland communication in Morocco are very defective, as there are no roads except in the neighbourhood of the towns, and wheeled vehicles are entirely unknown. Goods have therefore to be conveyed by means of mules, horses, and camels. Few of the rivers have any bridges, and the fords are often impassable in the rainy season. The trade with the East is carried on chiefly by means of the annual caravans, which proceed to Mecca at the time of the great festival there. They leave Fez seven months before the time of this festival, and the length of time thus spent in the journey affords ample opportunities for traffic at the various towns on the way. The principal articles exported by these caravans are,—cochineal, indigo, leather, woollen cloth, and ostrich feathers; while the imports are Persian and Indian goods, spices, &c. Another way of performing the pilgrimage to Mecca is by a coasting voyage from Tangier to Egypt, which is also favourable to commerce. From 1500 to 2000 pilgrims annually embark at Tangier for Mecca by this route. The commerce with the interior of Africa is also carried on by means of caravans, which cross the desert from Tafilet to Timbuctoo. The principal articles exported are,—salt (which is obtained in the desert), woollen cloth, sashes, Turkish daggers, &c.; and they import by this channel ivory, ostrich feathers, gold-dust, indigo, and slaves. The profits of this branch of trade are enormous, being sometimes as much as ten times the capital laid out; but the cost of carriage across the desert is very great.

History.

The present empire of Morocco, along with part of Algeria, was known to the ancients under the name of *Mauretania*. The authentic history of the country begins from the time when the Romans first became acquainted with it, an event which did not take place till toward the end of the second Punic war. But though they then became acquainted with Mauretania, it was a long time before they conquered that country; and its monarchs were of considerable importance in the foreign and domestic wars of the Romans during the intermediate period. At the time of the war with Jugurtha, the throne of Mauretania was occupied by Bocchus, who, under the pretence of friendship, betrayed Jugurtha to the Romans, and in return for this treachery, was confirmed in his kingdom and received into alliance with Rome. On his death, the kingdom was divided between his two sons, Bogudes and Bocchus. In the first civil war of Rome, both these monarchs supported the party of Cæsar, who allowed them to retain their power; but in the war between Octavius and Antony, Bocchus assisted the former, and Bogudes the latter. Bocchus in consequence, usurped the whole kingdom while his brother was absent in Spain, and retained possession of it till his death in 33 B.C., when Mauretania passed into the hands of the Romans. In the year 25 B.C. Augustus gave Mauretania to Juba II., King of Numidia, in exchange for his own country, which was then made a Roman province; and that prince seems to have raised the country to a high degree of prosperity, and to have introduced among the natives much of the civilization of Greece and Rome. In the year 40 A.D. Mauretania came for the second time under the power of the Romans, and in 42 A.D. was divided by Claudius into two provinces,—Mauretania Tingitana, nearly corresponding with Morocco; and Mauretania Cæsarienses, comprising part of the modern Algeria. Numerous Roman colonies were founded here, among which Tingis, the modern *Tangier*, was the most important, and gave its name to the western province: but the Roman power was never firmly established here; and the Moors joined with the Vandals on their invasion in 429. The power of the Vandals was destroyed by Belisarius in 534; but the Moors still continued independent, and made continual inroads on the more civilized portions of the country. In the latter part of the seventh century the Arabs first penetrated into Mauretania as far as the ocean and the Great Desert; and the natives of the country were either driven to the mountains, or joined with their invaders, and adopted their religion, language, and manners. For a long time after this conquest the country remained in a state of great confusion, and was not united under a single government. After the lapse of a century, however, Edris, a descendant of Mohammed, obtained so much influence over the Moorish tribes as to be recognised by them as sovereign of the northern part of Morocco; while the southern was still occupied by independent chiefs. This monarch was succeeded by his son of the same name, who founded the city of Fez in 807. In 1055 Abu Bekr, the chief of a sect of warlike fanatics, first assumed the title of sovereign of Morocco, and his grandson and successor founded the city of Morocco, and made it the royal residence. This dynasty, however, came to an end in 1202, when Fez and some of the other provinces asserted their independence. The Mohammedan conquerors of Spain were driven back to Morocco in 1492; and in the next century the territory was again united under a single emperor. This empire, however, which was extended, under Al Mansor, as far as the confines of Timbuctoo, fell to pieces in the beginning of the seventeenth century. Another dynasty was established in 1648 by Mulai Sherif-el-Fileli, King of Tafilet, whose descendants are still the reigning family. In 1844 Abd-el-Kader, the ameer of Algiers, stirred up the Moors to a war with France, which led to the bombardment of Tangier and the occupation of Mogadore; but peace was concluded, and that town evacuated, in the same year. In more recent times the tranquillity of the empire has been disturbed, and the power of the sultan weakened, by internal disorders. The depredations of the Riff pirates have been recommenced; and Prussian and French vessels, as well as a Spanish establishment on the coast, suffered in 1855 and 1856 from their outrages. The French government, however, obtained in 1856 compensation from the sultan; which was the first instance of such redress being peaceably granted.

The population of Morocco is variously estimated, but it does not probably exceed 6,000,000.

MOROCCO (Arabic *Marakash*), the capital of the empire of that name, is situated on the northern side of a rich plain, 4 miles S. of the River Tensift, the principal mosque standing in Lat. 31. 37. 40. N., and Long. 7. 36. W. It is surrounded by a strongly-built machicolated wall of tapia-work, 30 feet high. The foundations are of strong masonry; square towers are placed at intervals of fifty paces; there are eleven strong double gates; and the whole is 6 miles in circumference. This area, however, is far from

Moron.

being entirely occupied with buildings; it also comprehends large gardens and open spaces from 20 to 30 acres in extent. Of the eleven gates of the city, that called Beb-el-Rom, which conducts to the palace, is by far the best in point of architecture. It is a Moorish horse-shoe arch, richly sculptured in arabesque work, and is said to present a very fine appearance. The streets of Morocco are narrow and irregular, seldom wider than the lanes of European cities; and in many cases the lines of houses on either side are connected by arches with gates, possibly intended for defence in case of attack. Several open spaces, which scarcely deserve the name of squares, are used as market-places, and for other purposes. The houses, which are generally one storey high, have flat roofs and terraces, the side towards the street being plain and whitewashed. As an apology for windows, there are here and there narrow unglazed openings; but the interior disposition of the tenements is much in the Spanish style. Many of the doors are of cypress wood, and highly sculptured. The rooms, which are long and narrow, open into a court surrounded in some cases with arcades, and having a fountain in the centre. With the exception of a mat and a cushion or two, they are destitute of furniture. On the outside of the southern wall of the city, and facing the Atlas, stands the palace of the sultan. It is encircled by a wall equal in strength to that which surrounds the city, and occupies an area 1500 yards in length by 600 in breadth. The whole is portioned into squares laid out in gardens, round which are detached pavilions, forming the imperial residence. The floors of the rooms are tessellated with variously-coloured tiles, but otherwise they are quite plain, the furniture consisting only of a mat, a small carpet at one end, and some cushions. The walls are painted in the arabesque style, inscribed with numerous verses of the Koran in Arabic, and hung round with arms. Within the city there are nineteen mosques, two *emdrasas* or colleges, and one hospital. El Koutubia, the principal mosque, stands in an open place of 20 or 30 acres, and is conspicuous above all the others by its lofty square tower, which rises to the height of 220 feet without diminishing, and thus produces a striking and singular effect. It is divided into seven storeys, and its height is apparently about seven times its diameter. This tower resembles two others, which are believed to have been built towards the end of the twelfth century,—the Sma Hassan at Rabat and the Giralda at Seville. Next in height, and coeval in erection, although modernized and well painted, is the mosque of Beni Yussuf. It has a college of *talebs*—that is, seekers or students—attached to it; and a saint's tomb stands opposite its southern door, formed of three arches, and surmounted by a cupola, delicately wrought with rich Saracenic tracery. El Moazin, said to be the most ancient sacred edifice, is very large, and has several courts opening into each other. The Moorish horse-shoe arches intersect each other in various directions, and have a very rich effect. The mosque of Bel Atlas, the patron saint of Morocco, is surmounted by a cupola covered with green tiles. It contains the tomb of the saint, and has an hospital attached to it for 1500 patients. The college and mosque, called Emdrasa del Emahia, stands near the south wall of the city.

Morosini.

The Great Bazaar, called El Kaisseria, is a long range of buildings, protected from the weather, and divided into numerous shops or stalls. The articles exposed for sale are,—silk scarfs, shawls, and handkerchiefs from Fez; clothes and carpets from Ducaila; cloth, linen, hardware, tea, and sugar, from London; almonds, raisins, and cosmetics, from Suse; corn, beans, and the like, from Shragna; dates from Tafilet; and boots, slippers, saddles, coarse pottery, mats, cord, &c., of domestic manufacture, together with embroidery in gold and silver, in which the inhabitants particularly excel. There are two or three markets, the principal of which is held near the north gate of the city, and is well supplied with home manufactures. There is another for the sale of horses, camels, mules, horned cattle, sheep, and other animals. There are several tanyards in the city, one of which is believed to employ 1500 persons.

The Millah, or Jewish quarter, which is situated at the S.E. corner of the city, is a walled inclosure of about 1¼ miles in circumference. It is densely peopled, but filthy in the extreme. All the Jews pay a capitation tax to the sultan, and are treated with the greatest contempt. The Jews exercise several arts and professions, and are the only goldsmiths, tinsmiths, and tailors in Morocco. The Moors, however, are the shoemakers, carpenters, masons, blacksmiths, and weavers.

The city is supplied with water by several subterranean aqueducts. Some of these are 10 or 12 feet in depth, and stretch across the plain to the foot of the Atlas, but the most of them are in ruins, and consequently out of use. This is the strongest evidence which can be produced in support of the fact, that the population of this country was far greater formerly than it is at present, and also that the arts were then more cultivated than they are now. Cemeteries extend beyond the walls, both north and south; and there is one to the east of very considerable dimensions. The city was formerly surrounded with gardens and plantations extending to a great distance, but these have now for the most part disappeared. A few, however, still remain; and the sultan has three of about 15 acres in extent within the city, and two of about 20 acres each 2 miles distant from the walls. Every variety of fruit-tree enriches these gardens,—olive, orange, pomegranate, citron, mulberry, walnut, peach, apple, pear, vine, fig, date, apricot, and the like; whilst trees of beautiful texture or foliage,—the cedar, poplar, acacia, the solemn cypress, and the stately palm,—together with a profusion of flowers and flowering shrubs, form a picturesque scene, where the unchecked luxuriance and beautiful wildness of nature add a charm to the studied elegances of the more regular ornaments of art. The grounds are well supplied with water by means of the conduits already mentioned. The population is variously estimated at from 30,000 to 100,000, but it is probably about 80,000.

MORON, or Moron de la Frontera, a town of Spain, in the province of Seville, is situated on an irregular slope near the Guadaira, 32 miles S.E. of Seville. The town is irregularly built, for in some parts the streets are narrow, crooked, and lined with low buildings; and in others they are wide and straight, and the houses lofty. It contains a handsome church, several monasteries and nunneries, nine schools, three hospitals, and a town-house. The inhabitants are chiefly employed in agriculture; but there are manufactories of hats, soap, oil, earthenware, linen, &c. The chalk of Moron is much used for making whitewash, for which the town is famous throughout Spain. There is also some trade carried on in wool and oil. To the east of the town stand the remains of an old Moorish castle of great strength, which was blown up by the French on their retreat in 1812. Pop. 10,192.

MOROSINI, Francesco, Generalissimo and Doge of Venice, was born in that city, of an illustrious family, in 1618. At the age of twenty he signalized himself in an attack upon the pirates that infested the Archipelago. Then began his series of services against the Turkish fleets which raised him gradually and steadily to the highest offices. He was appointed commander of the naval force in 1651, and generalissimo not long afterwards. In this latter capacity

he was sent in 1667 to defend the island of Candia against the Grand Vizier Coprogli. For twenty-eight months his skill, prudence, and valour repulsed the overwhelming hordes of the Turks, and rendered the siege renowned throughout Europe. At length, when his force had been wasted and weakened by pestilence and the repeated onslaughts of the enemy, he accepted honourable terms of capitulation. This treaty, concluded without the authority of the senate, was the cause of his arraignment on his return to Venice in 1669. His honour, however, was triumphantly vindicated; and on the renewal of the Turkish war in 1684 he was appointed generalissimo for the third time. He captured the island of Santa Maura at the end of sixteen days, and subdued the Peloponnesus after two campaigns. Landing at the Piræus, he took Athens, but not until the Parthenon had been partially destroyed by the explosion of a powder-magazine. Such signal success raised him to the highest honours in his native republic. The title of *Peloponnesiacus* was added to his name; his statue was erected in the hall of the Council of Ten; he was elected Doge in 1688; and he was welcomed to Venice in 1689 by the acclamations of the assembled populace. A decree of the Senate created him generalissimo for the fourth time. In 1693 he once more led the fleet of the republic against the Turks. The enemy retired before him; and ere he had an opportunity of winning fresh laurels, he died at Nauplia in January 1694. His remains were interred at Venice, in the church of San Stefano. The Life of Francesco Morosini was written by Graziani, in 4to, Padua, 1698; and by Arrighi, in 4to, Padua, 1749.

MORPETH, a municipal and parliamentary borough and market-town of England, county of Northumberland, on the north side of the River Wansbeck, 15 miles N. by W. of Newcastle. It is irregularly but not ill built, and is nearly surrounded by the river, which is here crossed by a handsome stone bridge of three arches, and also by a suspension-bridge. The two principal streets meet in the market-place, in the centre of the town, where there is a square tower with a clock and a chime of bells. The parish church, which stands on the side of the Wansbeck, half a mile out of the town, is a fine old building of the fourteenth century. There are also churches belonging to Presbyterians, Independents, Wesleyan Methodists, and Roman Catholics. Morpeth has a free grammar school, founded by Edward VI. in 1552, which had 80 pupils in 1853; besides national and infant schools, and two others which are supported by subscription. There is a town-hall, erected in 1714 by the Earl of Carlisle, after designs by Sir John Vanbrugh; and the county jail, a large and handsome building on the south of the river, was built in 1829, at the cost of L.70,000. Near the latter building the gateway and a few other remains of the old castle of Morpeth are still to be seen. The town has a public library, a mechanics' institution, a dispensary, and a union poor-house. Tanning, iron-founding, brewing, and the manufacture of woollen stuffs are carried on here; and five annual fairs are held. Morpeth was burned by its inhabitants in 1215, in order to harass King John in his operations against the insurgent barons; and it was again injured by fire in 1689. It is remarkable as the birthplace of Turner the botanist, and of Morrison the Chinese missionary. The borough is governed by a mayor, 3 aldermen, and 12 councillors; and formerly returned 2 members to Parliament; but by the Reform Act the number has been reduced to one. Pop. (1851) of the parliamentary borough, 10,012; of the municipal, 4096.

MORPHEUS, the god of dreams, is represented as the son of Sleep. His office, as his name (a derivative of the Greek word μορφή) implies, was to construct visions in the brain of the sleeper. He is painted in a reclining posture, with a crown of poppies around his head. Ovid (*Met.* xi. 635) was the first who mentioned him.

MORRIS DANCE, a peculiar kind of dance practised in England and other European countries during the middle ages; and which, while varying considerably in the manner of its performance, was usually executed with castanets, tambours, &c., by young men in light dresses, with bells fixed to their feet, and parti-coloured ribbons or streamers tied round their arms and shoulders. The English morris-dance is generally supposed to have had its origin in the *morisco* or Moorish dance, adopted by the Spaniards from their conquerors the Moors, and which still delights the natives of the Peninsula under the title of the *fandango*. Strutt, in his *Sports and Pastimes*, &c., contends that the English morris-dance is not of Moorish origin; but Douce succeeds, in his "Dissertation on the Ancient English Morris-dance," appended to the 2d vol. of his *Illustrations of Shakspeare*, in turning the argument against Strutt, from a passage cited by the latter from the play of *Variety* (1649), in which the Spanish morisco is mentioned. According to Junius [Du Jon], in his *Etymologicum Anglicanum*, the Spanish morisco was also danced at puppet-shows by a person dressed like a Moor, with castanets, the dancers usually blackening their faces with soot to make them look like Moors. Peck, in his *Memoirs of Milton*, p. 135, supposes that the morris-dance was first brought into England during the reign of Edward III., on the return of John of Gaunt from Spain; but Douce, who is unquestionably the highest authority on the subject, thinks it much more probable that we had it "from our Gallic neighbours, or even from the Flemings." (Vol. ii., p. 439.) It is doubtful whether any vestiges of it can be traced beyond the time of Henry VII., during whose reign and that of his immediate successor, as we can gather from the accounts of the churchwardens, this pastime played a very important part in the rustic festivals of the parishes of England. In some places the May-games of Robin Hood, which were principally instituted for the encouragement of archery, were accompanied by morris-dancers, as a subordinate part of the ceremony. In like manner, other festivals had their morris—as Holy Thursday, the Whitsun-ales, the Bride-ales or Weddings, and the pageant called the Lord of Misrule. Laneham, in his *Letter from Kenilworth*, in his usual quaint fashion, speaks of "a lively moris dauns, according to the auncient manner: six dauncerz, Mawdmarion, and the fool;" and the Puritan Stubbs (*Anatomie of Abuses*, p. 107), whose "loud ravings against the fashionable excesses of his countrymen," have at once scandalized with their bitterness, and delighted with their minuteness, the antiquarian mind of Douce, gives a rough and ready picture, possibly as one-sided as it is graphic, of "those execrable pastimes" the morris-dances, and of the "terrestrial furies" who indulged in them. A similar tirade by Fetherston (*Dialogue agaynst light, lewde, and lascivious Dauncing*, 1582) is valuable from its minute description of "your morice dauncers," who, if they occasionally practised all the abuses laid to their charge by this old worthy, "of dauncing naked in nettes," and other unmentionable doings, on May-day mornings, it was little wonder that they excited the hostility of the honest Puritan. It is to be observed, however, that the charges here introduced against it are not directed against the simple ceremony of the morris-dance, but against other hilarious festivities to which it was occasionally attached. The genuine morris-dance was, in Warner's days (*Albion's England*, 1612, p. 121), celebrated about the time of Easter and before the May-games; for he tells us,—

> "At Paske began oure Morrise, and ere Penticoste oure May,
> Tho' Roben Hood, liell John, Friar Tuck, and Marian deftly play."

Douce, however, is of opinion (vol. ii., p. 445) that, when the practice of archery declined, and the May-games of Robin Hood were discontinued, the morris-dance was transferred to the celebration of Whitsuntide.

The oldest as well as the most curious and complete representation of an English May-game and morris-dance is given by Douce. The dresses and costumes of some of the figures are supposed to belong to the reign of Edward IV. (Steevens's *Shakspeare,* note to King Henry IV., pt. i.) Another curious print of a morris-dance, executed about 1460–70, is given by the same writer. The May-games and morris in those days consisted of Robin Hood, Little John, Friar Tuck, Maid Marian, the Queen or Lady of the May (sometimes personated by a boy in female attire), the fool, the piper, and several morris-dancers, habited in various modes, with handkerchiefs in their hands. A hobby-horse, constructed of pasteboard, and a dragon, were subsequently added. With respect to the collective number of the morris-dancers, it seems to have constantly varied. In one print they are nine; in another, eleven; in a third, twelve; and from different accounts it appears that they were not unfrequently limited to five. All that is known respecting Robin and his friend Little John will be found in Ritson's *Robin Hood;* and as for "Tuck, the merry friar, which many a sermon made," as Drayton has it (*Polyalbion,* song xxvi.), his history is very uncertain. The origin of the epithet *Tuck* may be guessed at from Chaucer's Reeve—for "tucked he was, as is a frere aboute." The Maid Marian is said to have represented Robin Hood's mistress; but there is no mention of the alleged prototype of the May Queen in any authentic record of the outlaw. There can be no doubt, however, that the Queen of the May existed long before the games of Robin Hood; and when he received a place in these merry-makings he was in all probability assigned the most honourable position of protector of the fair lady. The fool, with the exception of the bells tied to his arms and ankles, was in point of dress the same as the English domestic fool of the fifteenth century. Morris-dancers are now unknown in England. Waldron informs us that he saw in 1783, at Richmond in Surrey, a troop of morris-dancers; and Ritson alleges that during his time they were annually seen in Norfolk and Lancashire. About the beginning of the present century a company of them was seen at Usk in Monmouthshire, where they professed to have kept up the ceremony for 300 years. (In addition to the works already specified, the reader may consult Brand's *Popular Antiquities,* vol. i., and Gifford's *Ben Jonson,* vol. ii. The fullest discussion of the subject, however, is that of Douce, appended to his *Illustrations of Shakspeare.)*

MORRISON, Robert, D.D., the first Protestant missionary to China, was born of Scottish parents at Morpeth in January 1782. After receiving an elementary education from his maternal uncle at Newcastle, he was apprenticed at an early age to his father's trade of lastmaking. But his predilection was for the office of the ministry, and his spare hours were devoted to the eager perusal of religious books. In 1801 he began a regular course of study under a Presbyterian minister, and in 1803 he was received into the Independent theological academy at Hoxton. It was in 1804 that he was seized with the desire of proceeding on a mission to the Chinese. His services were immediately offered to the London Missionary Society, and were accepted. After attending the Mission College of Gosport, and studying the Chinese language under a native teacher, he set sail for China in January 1807. On his arrival at Canton in September of the same year, he commenced to perfect his knowledge of the language of the country with an intense application, which for some time imperilled his health. At the same time he was living in the dullest solitude, maintaining the strictest economy, and guarding with incessant circumspection against exciting the unreasonable jealousy of the natives. His domestic discomfort was relieved in 1808 by his marriage, and by his simultaneous appointment to the office of translator to the East India Company's factory at Canton. By this time he had constructed a Chinese grammar, was compiling a Chinese dictionary, and was preparing for his great work of translating the Scriptures. He did not suffer his official duties to divert him from his studies. In 1814 his translation of the New Testament and his Chinese Grammar were printed. He then commenced to translate the Old Testament, with the assistance of Mr Milne, who had been sent out by the London Missionary Society. Separate portions of the Bible, and several small devotional treatises, were in the meantime printed, and were secretly distributed among the natives. He also published in 1817 an English treatise entitled *A View of China for Philological Purposes.* In the same year the university of Glasgow recognised his services in the cause of learning by conferring upon him the degree of D.D. He completed his translation of the Bible in the following year. His next enterprise was the establishment of an Anglo-Chinese college at Malacca, for "the reciprocal cultivation of Chinese and European literature." This institution was founded in November 1818, was furthered by liberal contributions from Great Britain, India, and America, and was opened in 1820. In 1821 the Chinese Dictionary was published by the East India Company at an expense of L.15,000. Dr Morrison, worn out by long and continued mental exertion, now proposed to visit his native country for the sake of his health. He accordingly left China at the close of 1823, and arrived in London in the following March. He was greeted by the respect and esteem of all classes. George IV. honoured him with an interview; the Royal Society elected him one of their number; and wherever he went to advocate the cause of the Chinese mission he was received by large and enthusiastic audiences. After spending two years in attempting to interest his countrymen in the project to which he had devoted his life, he returned to China in 1826. He now set himself to promote education, to write a commentary on the Scriptures in Chinese, and to superintend the distribution of books and tracts. These labours were beginning to yield some visible fruit, when they were brought to a close by his death, at Canton, on the 1st August 1834. His remains were interred at Macao.

His *Memoirs,* compiled by his widow, were published in 2 vols. 8vo, London, 1839.

MORS, an island of Denmark, in the province of Jutland, the largest of those in the Lymfiord, being 24 miles long by 11 broad, and 283 feet above the sea in the centre; area 120 square miles. It is for the most part fertile, except in some sandy and rocky parts where the ground is covered with heath, and in some marshy places. There are, however, very few trees. The capital is Nykjöbing, with about 1000 inhabitants, and the population of the island is 13,500.

MORSHANSK, a town of European Russia, capital of a district in the government of Tambov, is situated on the right bank of the Tsna, 805 miles S.E. of St Petersburg, 358 S.E. of Moscow, and 58 N. of Tambov. It has manufactories of linen, sail-cloth, tallow, vitriol, and paper; besides a ropework, and fulling and saw-mills. An active trade is carried on in grain, honey, and live stock. Pop. (1851) 10,638. The district has a fertile soil, rich pastures, and is well wooded.

MORTAGNE, a town of France, capital of an arrondissement of the same name in the department of Orne, is situated on the summit and sides of a hill, 20 miles E. by N. of Alençon. It is well built, with a square in the centre; the principal buildings being the church, court-house, and prison. Linen, pottery, and leather are manufactured; and a considerable trade is carried on in linen, hemp, grain, and live stock. Mortagne was formerly the capital of Perche, and, from its strong position, a place of some importance. Pop. (1851) 4848.

MORTALITY, HUMAN.[1]

Mortality, Bills of.

We shall consider this very important, as well as curious subject, under two distinct heads; the first of which will treat of the History and Formation of Bills of Mortality; the second, of the Law of Mortality.

I. MORTALITY, BILLS OF.

Bills of Mortality are abstracts from parish registers, showing, as their name imports, the numbers that have died in any parish or place during certain periods of time, as in each week, month, or year; and are accordingly denominated weekly, monthly, or yearly bills. They also include the numbers of the baptisms during the same periods, and generally those of the marriages.

Objects of this article.

The objects of the present article are these:—First, to give a brief history of the principal things that have been done in this way, which may suffice for such as are not disposed to go further into the subject, and may at the same time indicate the best sources of information.

As both mortuary registers and enumerations of the people are much more valuable when combined than when separate, we shall also notice some of the principal enumerations, the results of which have been published. We shall then point out some of the principal defects in most of the published registers and enumerations; and, lastly, shall submit some forms for registers which will be easily convertible to useful purposes.

History.

The ancients do not appear to have kept any exact mortuary registers, at least no account of any registers of that kind, with the ages of the deceased, have come down to us; and although in the Roman *census*, first established by Servius Tullius, both the ages and sexes of the people were distinguished, we have no exact account of these particulars. Indeed the principal object of the *census* among that warlike people, was the levying of men and money for the purposes of conquest; the duration of human life appears to have occupied very little of their attention, and their proficiency in the science of quantity was not sufficient either to show them the necessary *data*, or to enable them to draw just inferences from them. A good account of what the ancient Romans did in this way, with references to the original authorities, may be found in the Italian translation of M. Demoivre's *Treatise of Annuities on Lives*, by Gaeta and Fontana, Milan, 1776. (*Discorso Preliminare*, parte 2.)

The keeping of parish registers commenced in England in 1538, in consequence of an injunction issued by Thomas Cromwell, who, after the abolition of the Pope's authority in this kingdom, in the reign of Henry VIII., had been appointed the king's vicegerent in ecclesiastical affairs. Some parish registers in Germany appear to have commenced with the sixteenth century; and in the *Göttliche Ordnung* of Süssmilch (t. iii., s. 23), we are informed, that at the time of Lord Cromwell's injunction, they had already old registers of that kind both at Augsburg and Breslau. However, the extracts there given from the Augsburg registers do not go back further than the year 1501, nor those for Breslau beyond 1555. About the beginning of the seventeenth century, such registers appear to have been established in most parts of Europe; but it was not until the year 1662 that they began to attract public notice, and to be considered as the sources of valuable and interesting information.

Mr Graunt.

In that year John Graunt, a citizen of London (afterwards an officer in the trained bands of the city, and a fellow of the Royal Society), published his *Natural and Political Observations on the Bills of Mortality*, principally those for London. The London bills, or accounts of baptisms and burials, appear to have been occasioned by the plague, and to have been begun in the year 1592, a time of great mortality. They were afterwards discontinued, but were resumed in 1603, after the great plague of that year. They have ever since been continued weekly, and an annual bill also has been regularly published. In 1629, the number of deaths by the different diseases and casualties, were first inserted in them, also the distinction of the sexes; and these have been continued ever since. But it is in the totals only of the baptisms and burials that the sexes are distinguished in these bills. They do not shew how many of each sex died of each disease, neither have they, since 1728, when the distinction of the ages of the dead was first introduced, shewn how many of each sex died in each interval of age, but only the total number of both sexes.

This book of Graunt's, although the first, is also one of the best that have been published on the subject. It contains many judicious observations on the imperfections of the bills, on the proportions of the deaths from different diseases and casualties, and on their increase and decrease, with the probable causes of such fluctuations. He also observed, that "the more sickly the years are, the less fecund or fruitful of children also they be."

Besides the London bills, he gave one for a country parish in Hampshire, in the first edition of his book; and, in an appendix to the later editions, two others, one for Tiverton, the other for Cranbrook in Kent, with a few observations on foreign bills. He almost always reasons justly from his *data*; but, as these were very imperfect, in his endeavours to draw more information from them than they could supply, he has sometimes fallen into error.

Even in this enlightened age, when a much greater proportion of the people devote a portion of their leisure to the acquisition of knowledge than in Graunt's time, subjects of this kind have but few attractions for the generality even of reading men, who cannot endure the fatigue of thinking closely for any length of time. The author, accordingly, expected his readers to be rather select than numerous, and was ambitious of that distinction, as appears by the motto he prefixed to his work,

> ——Non, me ut miretur turba, laboro,
> Contentus paucis lectoribus.

The book was, however, favourably received by the public, and went through five editions in fifteen years, the two first in 4to, the three others in 8vo; the last of them, published in 1676, two years after the author's death, was edited by his friend Sir William Petty, who, in consequence of having sometimes spoken of this edition as his own, has by some writers been erroneously considered as the author.

Graunt's observations, like all others of a similar kind, by shewing the usefulness of parish registers and bills of mortality, contributed to form a taste for these inquiries amongst thinking men; and, consequently, to improve both the registers and the bills derived from them; so that, from his time, the subject has been continually cultivated more and more. Parish registers, in most parts of Europe, have been kept with more care; and a succession of works of considerable merit have been published on the subject, containing an

[1] The present article on HUMAN MORTALITY, written for a previous edition of this work by the late Joshua Milne, has been allowed to stand in the present edition, from a regard to the high authority of the writer on the subject, and from the acknowledged excellence of the article itself. The principle, moreover, which is followed in the article, of giving the relative proportion of mortality to the actual population, renders the following discussion of the subject as valuable still as when it was written. The more recent statistics on mortality are given in an Appendix.

Mortality, Bills of.

important part of the natural and political history of our species, and affording valuable materials for the science of political economy.

The principal of these works we shall proceed to give a short account of, in the order of their publication.

As the ages at which the deaths took place were not inserted in the London bills till 1728, Captain Graunt could not avail himself of that important information, but made a fruitless attempt to determine the law of mortality without it.

Dr. Halley. The Breslau bills appear to have been the first wherein the ages at which the deaths took place were inserted, and the most important information which bills of mortality can afford was first drawn from them by Dr. Halley; who, in 1692, constructed a table of mortality for Breslau from these bills for the five preceding years, and inserted a paper on the subject in the *Philosophical Transactions*, (No. 196.)

Dr. Davenant and Gregory King. In 1699, Dr. Davenant, in *An Essay upon the probable Methods of making a People Gainers in the Ballance of Trade*, published some extracts from *Natural and Political Observations and Conclusions upon the State and Condition of England*, by permission of their author, Mr. Gregory King, Lancaster herald, who had completed them in 1696, though they still remained in manuscript; and the whole of

Chalmers. this very curious production was published by Mr. Chalmers at the end of his *Estimate* in 1802. Mr. King derived his information from the poll-books; from actual observations in particular places; from the assessments on marriages, births, and burials; and from the parish registers. Many of his conclusions agree surprisingly well, considering the time he wrote, with those which are the results of a hundred years of further observations and inquiries. He had access to much better *data* than Graunt, and his conclusions are more accurate; but he does not explain so fully how he arrived at them.

M. Kersseboom. From the publication of Davenant's essay, above mentioned, nearly forty years had elapsed without any thing further being done in this way, when M. Kersseboom published an essay, in the Dutch language, on the probable number of people in Holland and West Friesland, which he deduced from the Bills of Mortality, Hague, 1738, 4to; and two others in 1740 and 1742. (See Law of Human Mortality.)

J. P. Süssmilch. In 1742 was published the first edition of the celebrated work, entitled *Die Göttliche Ordnung in den Veränderungen des menschlichen Geschlechts aus der Geburt, dem Tode und der Fortpflanzung desselben erwiesen von* Johann Peter Süssmilch. The second edition appeared in 1761, enriched with the materials which had been laid before the public through various channels in the interim; the third in 1765, and in 1775 a fourth edition of the two volumes of

J. Baumann. Süssmilch was published by Christian Jacob Baumann, to which this editor himself added, in 1776, a third volume, consisting of additions to the other two, and remarks upon them, with many new tables, and a copious index. The last edition of this work was published in 1798, but it does not appear to have been augmented or improved since 1776. It contains long dissertations on every thing not mathematical connected with the subject, and, besides original information, includes the substance of all the other publications on it previous to 1776; with an immense collection of materials, which, when borrowed, are often better arranged and rendered more convenient for reference, than they will be found to be in the works they were extracted from; besides, the original sources of information are always referred to, and these advantages, with that of a full index, render it a valuable work for occasional reference. The three thick octavo volumes contain upwards of two thousand three hundred pages, closely printed with a small type, and the tables alone occupy three hundred and thirty pages.

M. Deparcieux. In 1746 was published the *Essai* of M. Deparcieux, which has been already mentioned in the historical introduction to the article Annuities. Information much wanted on this subject, was there given in a very clear and popular manner, and the work no doubt contributed greatly to the advancement of the science. It probably had some influence in promoting the establishment of what is called the *Tabellvärket* in Sweden, which took place in 1749, and of which we shall have occasion to take further notice presently.

Dr. Short. In 1750 appeared, in octavo, *New Observations natural, moral, civil, political, and medical, on City, Town, and Country Bills of Mortality; to which are added, large and clear Abstracts of the best Authors who have written on that subject; with an Appendix of the Weather and Meteors*, by Thomas Short, M.D. which he had "had on the anvil" for eighteen years, as he informs us in the preface to his *History of Air, Weather, &c.* This author, with incredible labour collected extracts from the mortuary and baptismal registers in a great many market-towns and country parishes in England, chiefly in the northern counties, in almost every variety of soil and situation, and reduced them into tables in various ways, so as to enable him to draw useful inferences from them.

He informs us that Lord Cromwell's injunction in 1538 was but little regarded in many places till the year 1559, when another was issued for the same purpose by Queen Elizabeth; nevertheless, he had procured several exact country registers, commencing with 1538, and continued without one chasm, for more than two hundred years; and the registers before 1644, he considered to be much more valuable than afterwards, on account of the increase of dissenters from that time. He likewise procured both the numbers of families and of souls in seven of the market towns, and fifty-four of the country parishes, for which he had registers; and thus arrived at satisfactory information on several points, which, till then, had been very imperfectly understood. But the sexes were not distinguished in his enumerations; neither were the ages, in any of the enumerations or registers he has given accounts of, except in the London Bills of Mortality, and what he has taken from Dr. Halley, respecting those for Breslau.

Although Dr. Short took so much trouble in collecting materials, and has generally reasoned well upon them, he has shown but little skill, and does not appear to have taken much pains in communicating his information to his readers; so that it costs them considerable labour to find what they want, especially in his tables; and when found, to understand it.

Mr Morris. In 1751 was first printed a tract by Corbyn Morris, entitled, *Observations on the past growth and present state of the City of London*, with the most convenient and instructive tables of the London bills that have been printed; they contained the annual baptisms and burials from the year 1603, the number of annual deaths by each disease from 1675, and of each age from 1728; all brought down to the year 1750. This tract was reprinted in 1758, with a continuation of the tables to the end of 1757; these also contain useful annual averages and proportions. Mr. Morris's observations are generally very judicious, but he was one of those authors who appear to have laboured under much misconception with regard to the evils to be apprehended from the mortality of London, and what they considered to be its baneful effects in drawing recruits from the country. These writers did not perceive, or did not sufficiently consider, that the natural procreative power is much more than adequate to supply any waste of that kind, and that the real obstacle to the increase of the people, is the limited means of subsistence. This had been observed by Dr. Halley in his *Further Considerations on the Breslau Bills of Mortality, (Phil. Trans.* 1693,) though it there also appears, that he had not sufficiently considered the mode of its operation: this was first fully illustrated by Dr. Franklin in his excellent *Observations on the Increase of Mankind, Peop-*

ling of Countries, &c. written in Philadelphia in 1751, the same year in which Mr. Morris's pamphlet was first published. The author also pointed out in that pamphlet, material defects in the Bills of Mortality, and proposed a better method of keeping them, not only in London, but throughout the kingdom. This gave occasion to a paper by Mr. James Dodson, which was inserted in the *Philosophical Transactions* for that year (1751,) wherein he showed the importance of their being so kept as to afford the means of valuing annuities on lives, and proposed other alterations which appeared to him calculated to fit them for the purpose.

Mr. Dodson

Nicolaas Struyck.

Nicolaas Struyck of Amsterdam, who, in his *Introduction to General Geography*, published there in 1740, had inserted *(Gissingen over den staat van 't Menschelyk Geslagt,) Conjectures on the State of the Human Species;* published at the same place in 1753, a quarto volume, the first half of which is astronomical, the other (216 pages) is entitled *(Nader Ontdekkingen noopens den staat van het Menschelyk Geslagt,) Further Discoveries concerning the State of the Human Species.* It contains statements of actual enumerations of the people in many Dutch villages, principally in North Holland, wherein the sexes are distinguished, and the numbers in childhood, celibacy, marriage, and widowhood; but with respect to their ages, it is only stated for each sex, how many were under ten years, and how many of the unmarried were above that age; except in two instances, wherein the number of each sex is given in each interval of five years of age, from birth to the extremity of life: they amount altogether to 2728, of whom not one was above the age of eighty-five, and only four above eighty.

He generally gives, for each place, the names and professions or occupations of the persons who made the enumeration, and the precise day on which it was made; or if it occupied the parties more days than one, those on which it was commenced and completed are given; a practice which shows a laudable solicitude about particulars, and a title to our confidence, the want of which we have great cause to lament in too many other writers.

Extracts from many parish registers are also given; in these, too, the ages are seldom noticed; but in a few cases they are given very minutely, especially in that of West-zaandam, for which, the numbers who died in each interval of five years of age, from birth to the extremity of life, are given; also the number in each year of age under fifteen, the number in each month of the first year of age, even the number that died in the first hour from birth, in the first twenty-four hours, and in each day of the first week of their age. During a term of nineteen years, the whole number of deaths thus registered was 3328; but the sexes were not distinguished under fifteen years of age, which Struyck himself lamented. The work also contains much information respecting the population and parish registers of *Amsterdam*, *Haarlem*, &c. with some accounts of other countries, and of other works on the subject.

Dr. Birch.

In 1759 was published at London, in 4to, *A Collection of the yearly Bills of Mortality, from 1657 to 1758 inclusive, together with several other Bills of an earlier date;* to which were subjoined Captain Graunt's *Observations; Another Essay in Political Arithmetic*, by Sir William Petty; the *Observations of Corbyn Morris, Esq.;* and *A Comparative View of the Diseases and Ages, with a Table of the Probabilities of Life for the last thirty years*, by J. P. Esq. F. R. S. This is a valuable compilation, and has been generally attributed to Dr. Birch, the Secretary and Historian of the Royal Society; the preface is very judicious, and contains a good deal of information. For the following history of this publication, the author of the present article is indebted to the kindness of Dr. Heberden:—

"The bills were collected into a volume by his father, the late Dr. Heberden. He procured, likewise, observations from several of his friends, rectors of some large parishes, or others likely to give him information; particularly from Bishop Moss, Bishop Green, Bishop Squire, and Dr. Birch. These, together with some of his own remarks, were thrown into the form of a preface; and the whole was committed to the care of Dr. Birch. To make the calculations which appear at the end of the book, Dr. Heberden employed James Postlethwayt, Esq. a very distinguished arithmetician."

M. Messance.

In the year 1766, this branch of knowledge was enriched with new materials, of more value than all that had previously been laid before the public. These were contained in three publications, of which we shall first notice the *Recherches sur la Population des généralités d'Auvergne, de Lyon, de Rouen, et de quelques Provinces et Villes du Royame.* Par M. Messance, Receveur des Tailles de l'Election de Saint Etienne.

Most of the political writers in France, for some years previous to the date of this publication, had asserted confidently that the kingdom was depopulated, but without producing any proofs. The object of M. Messance was, to enable his readers to judge of the merit of such assertions, and to pronounce less vaguely on a subject in itself so interesting, the knowledge of which can only be obtained by a great number of facts and actual observations. The work, accordingly, is filled with tables, exhibiting the results of actual enumerations of the people, and of extracts from the parish registers. They show, for each sex, how many were under fourteen, or in celibacy above that age; those in the states of marriage and of widowhood; and the number of domestic servants. The numbers of families are also stated; and the enumerations of the ecclesiastics, properly classed, are given separately; but no other information respecting the ages of the living is given than that mentioned above. A great many statements are also inserted of the numbers that died in different parishes and more extensive districts, under five years of age, between five and ten, and in each interval of ten years, from thence to the age of one hundred; during different periods of from ten to forty years or more, generally ending about the year 1760; but in these the sexes are not distinguished.

In all cases, he has given the general results of his tables, and the proportions they afford, very distinctly stated; and among these results, the increase of the population during the preceding sixty years, to which his researches were generally limited, is clearly ascertained.

The work also contains many interesting tables, in which the rate of mortality and the produce of manufacturing labour, are compared with the contemporaneous prices of grain, in various places, generally for periods of twenty years each.

M. Muret.

In the same year was published, at Yverdon, in octavo, the work entitled *Mémoire sur l'Etat de la Population, dans le Pays de Vaud, qui a obtenu la prix proposé par la Société Economique de Berne.* Par M. Muret, premier Pasteur à Vevey, et Secretaire de la Société Economique de Vevey.

The Pays de Vaud contains 112 parishes, and the population at that time was about 113,000 souls. M. Muret wrote for information to all the clergymen in the country, who made him returns of the numbers of baptisms and burials in their respective parishes, for different periods, from ten to forty years, in many of which both the ages and sexes were distinguished; and from about two-thirds of them he obtained also the numbers of marriages and families actually subsisting; also the number of souls, "or at least of communicants," in their parishes: but neither the ages nor sexes were distinguished in any of the enumerations of the living.

This performance does much credit both to the author's industry and judgment, but it has also material defects. He gave upwards of fifty tables, by which he intended to show the probabilities and expectations of life till five years of age, and at every fifth year after that, in different parishes

and places, under various circumstances of soil and situation, and for people of different habits and occupations; also for the two sexes separately. These must have cost him a good deal of labour, and would have been extremely valuable had they been correct; but, unfortunately, he did not understand the construction of such tables, and they are not to be depended upon. He also took considerable pains to determine the rates of mortality among married and single women, considered separately, and thought he had proved that it was less among the married; but the proofs he adduced were not conclusive. Some of his observations on the state of the population, and the plans he recommended for encreasing it, also show, that he did not understand the principle on which its progress depends.

It is with much reluctance that we make, on so respectable an author, remarks which apply equally to almost all his predecessors in these inquiries; but this we consider to be rendered necessary, by the *Memoir* generally, and the Tables in particular, having been praised for their extreme accuracy, in a very good abridgment of them, inserted in the second volume of a book, entitled *De Re Rustica*, or the Repository, Lond. 1770, 8vo.

The disadvantages of her soil and climate necessarily keep Sweden thinly peopled in comparison with the countries which, in these respects, are more happily circumstanced; and since the year 1748, the state of the population has been an object of anxious solicitude with the government; which, in 1749, established what, in this country, would probably be called a Board of Population, but is there denominated *Tabell-Värket*, that is, *Table-Establishment*, for reducing into convenient forms the extracts from the parish registers, and the returns from the magistrates of the numbers of the people, which the governors of the different provinces are required to state to the commissioners appointed for these purposes. The extracts from the registers are made and transmitted annually, but the enumerations only once in three years.

Printed forms, with proper blanks, distinguishing the ages and sexes, both of the living and the dead, with the diseases the deaths were occasioned by, are distributed throughout the country, to enable the people to make these returns correctly and uniformly; and the information thus acquired, respecting the state of population and mortality, is much more correct and satisfactory than what has been obtained in any other place of considerable extent; but from causes which we have not room to explain here, the results were not laid before the public until some years after the returns were made.

M. Wargentin.

M. Wargentin who was one of the Royal Commissioners of the Tabell-Värket, inserted in the Transactions of the Royal Academy of Sciences at Stockholm for the years 1754 and 1755, six papers on the usefulness of annual registers of births and deaths in a country; which, like all his other productions, were written with much judgment and modesty; but, to illustrate the subject, he was generally under the necessity of borrowing materials from the writings of others; as, at that time, he was only in possession of the results of complete Swedish returns for the years 1749 and 1750. In the same Transactions for the year 1766, he inserted a paper on the mortality in Sweden, in which he gave Tables exhibiting the number of the Living of each six in each of the following intervals of age:—between birth and one year completed, between one and three, between three and five, and then in each consecutive period of five years of age till ninety, the last including all those above ninety years of age; at the three enumerations of the people which were made in the years 1757, 1760, and 1663; with the annual average number of still-born children and of those born alive, also the number of deaths that took place in each of those intervals of age, during each of the periods of three years, which ended at the times of these three enumerations, the sexes being always distinguished. These particulars he gave both for all Sweden and Finland, and for Stockholm separately; with other interesting results of the registers and enumerations, and many judicious observations on them. The ages of the living at the different enumerations, and those at which the deaths took place in all the subsequent publications of them, have been given for the intervals of age stated above.

This paper of M. Wargentin is more valuable than all that had previously been published on the subject; it is also to be found in the French abridgment of the Stockholm *Transactions*, in the eleventh volume of the *Collection Académique (partie étrangère)*, which abridgment was also published separately in 4to at Paris, in 1772.

Condorcet in his *Eloge* of M. Wargentin states, that he had collected the results of his labours as Commissioner of the Tabell-Verket in a great work which he had not time to publish; but in that statement, there is probably some mistake. In the Stockholm Transactions for the first quarter of the year 1801, M. Nicander informs us, that M. Wargentin at his death, left in manuscript a continuation of the observations published in 1766, consisting of four statements similar to those just mentioned; the first for the years 1765, 1766, and 1767, the second for the two following years, the third for the year 1772 alone, and the fourth for 1774, 1775, and 1776; and having taken the mean of all the seven, he sent it a little before his death to Dr. Price, who published it in the fourth edition of his "*Observations on Reversionary Payments*," which appeared in 1783, the same year in which Wargentin died.

In 1767, Dr. Short published, in quarto, *A Comparative History of the Increase and Decrease of Mankind*, in which the tables are printed more intelligibly, and there is more information respecting foreign Bills of Mortality, than in his *New Observations*.

Dr. Price.

The first edition of Dr. Price's *Observations on Reversionary Payments* appeared in 1771, and contained "Observations on the expectations of lives, the increase of mankind, the number of inhabitants in London, and the influence of great towns on health and population," which had been published in the *Philosophical Transactions* for 1769, and added considerably to the information on those subjects which had been previously before the public; also observations on the proper methods of constructing tables of mortality.

Drs. Haygarth and Percival.

In the *Philosophical Transactions* for the years 1774 and 1775, were inserted two excellent papers by Dr. Haygarth of Chester, in which he gave the Bills of Mortality for that city, for the years 1772 and 1773 respectively, in a form calculated to exhibit, at one view, the most useful and interesting information such bills can afford without calculation, and presenting to the calculator *data* that are essential to the solution of the most important questions respecting the state of the population. Three papers by Dr. Percival (also of considerable merit) appeared in the same *Transactions* about this time, relating principally to the population of Manchester and its neighbourhood.

Dr. Moehsen.

The second part of Dr. Moehsen's "Collection of Observations for the better illustration of the great usefulness and value of Inoculation for the Small-pox,"[1] was published in 1775; in which he gave a good historical account of

[1] *Sammlung merkwürdiger Erfahrungen die den Werth und grossen Nutzen der Pocken-inoculation. Erstes Stuck, Lubeck* 1774; *Zweites und Drittes Stuck. Berlin und Leipzig* 1775. The third part, however, appears never to have been published, though stated in the title, and no doubt intended to accompany the second. Indeed at the end of the second part he gave notice that his remarks on his third table would be continued, and explanations of the remaining ones would be given, in the following part; which, however, is wanting.

the first institution of Registers of Births, Marriages, and Deaths, and of their gradual progress and useful applications down to his time; also twenty-six tables derived from the Berlin Bills of Mortality for a period of seventeen years, commencing with 1758, and ending with 1774.

For each of the seventeen years he gave in the text what he called a Year Table, shewing for that year the number of deaths by small-pox, which took place during each month, in each of the first five years of age separately, and also in each interval of five years of age above that, with the number during the whole year in each of those intervals of age, the total number in each month of the year and also in the whole year; so far without distinction of sex or condition. But he added in each of those tables, the distribution of the number who died in the year by the small-pox into the civil and military population, shewing for each of these classes how many of each sex were children and how many adults, taking the age of fifteen years as the limit between them, without noticing the month or the interval of age in which the deaths took place. And in an 18th table he gave the same information for the first half of the year 1775. At page 152, he gave a table shewing the number of deaths in Berlin during each of those seventeen years, from all causes without distinction, but distinguishing the civil from the military population, and the sexes in each case. Amongst these deaths the still-born are included, which it is important to notice here, as he did not mention it. At the end he gave seven other which he called Principal Tables; the three first are summaries of his Year Tables; the first exhibiting at one view the number of deaths by small-pox in each month of each of the seventeen years, also those in each month during the whole term, with the whole number during each year, and the total during the whole term of seventeen years, without distinction of age, sex, or condition. The second shews the number of those deaths in each year, and the sum of them in all the years, distinguishing the sexes, the civil from the military population, and children from adults. The third shews the number of those deaths in each interval of age that took place in each year, and also during the whole term, without noticing the particulars given in the two first tables. In the fourth table he gave the numbers of male and female children separately which were born in each month of each of the seventeen years, with the total number in each year, and the total number born in each month during the whole term of seventeen years, but without mentioning whether the still-born were included in these statements or not; it seems probable that they were, as he included them in the deaths.

Taking the numbers of births and deaths, as stated by Dr. Moehsen, without attending to the still-born, it appears that

	Males.	Females.	Both sexes.
The whole number born during the seventeen years was	33,915	31,718	65,633
While there died of the civil population	30,473	30,153	60,626
Of the military	11,166	9,341	20,507
Total	41,639	39,494	81,133
Exceeding the births by	7724	7776	15,500

His fifth table shews how many children were still-born, and how many died during each of those seventeen years, also during the whole term, by each of thirteen different diseases which are the most prevalent amongst "children and others," but without distinction of age, sex, or condition, and without including the small-pox, respecting which the same information was given both in his first and third tables; that makes fourteen, of which he has given this information. But two of them, *Rittlen* and *Masern*, appear to be only different forms or varieties of what we denominate measles, whilst of some other heads or denominations in the Berlin bills, probably each included several distinct diseases; as *disease of the chest* and *consumption*, both distinguished from *phthisis (Swindsucht)* which is given separately. But these Dr. Moehsen could only give as he found them in the Weekly Bills of Mortality, from which he states that he formed his Tables.

His sixth table shews the number of suicides that took place in each month of those seventeen years, and also during the whole term, in the five different divisions following, viz., by shooting, hanging, cutting the throat, drowning, and otherwise; also the number of deaths by accidents in forty-nine different ways, the whole number being 447; distinguishing the civil from the military population, males from females, and children from adults, but without stating the months in which the deaths took place. Amongst those causes of death, except drowning and sudden death, the numbers by which were ninety and one hundred and thirty-one respectively, the greatest number, thirty-nine, was of those who died by hunger and misery in the year 1772. Always excluding the still-born; the number of deaths in 1772 was 8314, whilst the annual average number of the remaining sixteen years was only 4339; so that in 1772 the mortality was nearly twice as great as on the average of the other sixteen years of the term, which shews how small a number of deaths is imputed in the bills to hunger and destitution in comparison with those which, although ascribed to other causes, were hastened and chiefly produced by want and misery.

The seventh table shews for the year 1774 alone, the number of the still-born, the number of deaths by unknown diseases, and the number of them produced by each of seventy-three different diseases and casualties according to the Berlin Weekly Bills, which took place in each month of that year and during the whole year, with distinction of the civil from the military population, males from females, and children from adults. The whole number of deaths, including the still-born in that year, was 4401; still-born 259, deaths by unknown diseases 276.

Dr. Moehsen states that the diseases were first introduced into the Bills of Mortality at Berlin in the year 1721. The sexton of every parish had some years before been ordered to leave at the senate-house, at the end of every week, a list of the names of all who had been baptized, married, or buried during that week; and in the case of the buried, the age at which, and the disease by which, each death took place, were also to be stated. But these orders were not properly attended to until 1733; from that year he made and preserved abridged extracts from them until 1753, when these were destroyed by fire. In 1757, he resumed his labours which we have here given an account of, more minute than in most other cases, but not more so than their value appears to entitle them to, whether for their useful applications or as examples worthy of being followed.

M. Moheau.

In 1778 was published at Paris, in octavo, the work entitled *Recherches et Considérations sur la Population de la France*, par M. Moheau. This book is agreeably written, in a way entirely popular, and will probably be perused with more pleasure by the generality of readers than most others on the subject of population. It contains a great number of tables, for many of which he was indebted to other writers, especially to M. Messance; but he has also given many that are original, derived from the Bills of Mortality and actual enumerations of the people, though without explaining in a satisfactory manner how he obtained his information, which, if it be correct, must have cost great labour. In his preface he says, "il est tel page de ce livre qui a coûté nécessairement deux mois de travail, et un volume de chiffres."

M. Krafft. The fourth edition of Dr. Price's *Observations on Reversionary Payments* appeared in 1783, and contained much new and valuable information on these subjects, as has already been stated above, and in the historical introduction to the article ANNUITIES.

In 1786 was published, at Petersburgh, in the *Acts of the Academy of Sciences* there, for the year 1782, an essay by M. Krafft, on the marriages, births, and burials, at St. Petersburgh, during a period of seventeen years, from 1764 to 1780, preceded by a general exposition of the uses such tables might be applied to, if the observations they record were extended over entire governments in Russia. This paper contains seventeen tables, which shew the number of deaths at each age, and by each of the principal diseases, together with the numbers of marriages and baptisms; the numbers in each case, being given for each of the seventeen years separately, as well as for the whole term; and the sexes are always distinguished; as are likewise foreigners from the native Russians.

These tables would have been rendered very valuable, had they been accompanied by statements of the numbers of the living of each sex in the different intervals of age; but for want of this information, it is difficult to apply them to any useful purpose, and many of the inferences M. Krafft has drawn from them are very uncertain.

Dr. Heysham. During a period of nine years, commencing with 1779, and ending with 1787, Dr. Heysham of Carlisle kept accurate registers of the births, and of the deaths at all ages, in the two parishes which comprehend that city and its environs; also the diseases or casualties which the deaths at each age were occasioned by; and the sexes were in all cases distinguished. These excellent registers were kept with great care and skill on the plan of Dr. Haygarth above mentioned, and included all dissenters within the two parishes. Dr. Heysham published them from year to year as they were made, and accompanied them with valuable observations on the state of the weather and diseases in each year. Their value was greatly enhanced by two enumerations of the people within the two parishes, one made in January 1780, the other in December 1787, in both of which the ages were distinguished, but not the sexes of each age, though the totals of each sex were. These documents, printed in convenient forms, with further information respecting them, and many useful tables deduced from them, may be found in Mr. Milne's *Treatise on Annuities*.

Mr. Barton. In the third volume of the *Transactions of the American Philosophical Society*, published in 1793, were inserted *Observations on the probabilities of the duration of human life, and on the progress of population in the United States of America*, contained in a letter from Mr. Barton, which had been read to the Society in March 1791; also a postscript to that letter, read in December following; the returns of an actual enumeration of the people of the United States having been made in the meantime. The information there given from the parish registers is of little value. In the enumerations the sexes were distinguished but not the ages, except the numbers of free white males under and above sixteen; but even that information with regard to the population of America is very interesting, whether we contrast the early with the more recently settled counties, or the whole of the United States with the population of Europe.

M. Nicander. M. Wargentin having died in 1783, M. Henrich Nicander was in the following year appointed his successor as astronomer and secretary of the Royal Academy of Sciences at Stockholm; and in 1791 as one of the royal commissioners of the Tabell-Verket, and their secretary. After the death of M. Wargentin, and perhaps for some time before, owing to his infirmities, the Tabell-Verket would appear not to have been duly attended to; no communications of the results having been made to the public for fifteen years after his decease. But other new commissioners were appointed at the same time as M. Nicander, and he commenced the performance of the duties of his office by forming a catalogue of the acts and tables in the archives of the commissioners, when he found so many deficiencies in the returns from different parts of the kingdom, and so little assistance was afforded him, that it was not until the year 1799 that he was enabled to commence the publication of the most important results for the term of twenty-three years ended with 1795, and he continued to insert papers on that subject in the same transactions for the remainder of his life; he died in 1815. The following statement will facilitate reference to those papers, eighteen in number.

In the vol. for the year.	No. of papers	Stating the results of observations made during the term of	
1799	2	23 years.	1773—1795.
1800	4		
1801	2		
1805	3	8 ...	1796—1803.
1809	3	5 ...	1801—1805.
1813	2	5 ...	1806—1810.
1814	2	2 ...	1811 and 1812.

The most valuable information contained in these papers is the mean number of persons living of each sex, in each interval of age during a certain number of years, and the annual average number of deaths of persons of each sex in the same intervals of age which took place during the same time; as these data are sufficient for determining the law of mortality for each sex separately, and also for the whole population without distinction of sex. That information M. Nicander has given for all Sweden and Finland in his first paper in the transactions for 1801, both for the whole period of twenty years, 1776–1795, and for each of the four consecutive periods of five years contained in the same term; also derived from these, the proportion of the annual average number of deaths to the mean number of the living of each sex in each interval of age. And in the volume for 1809, (tab. B,) he gave the same information as to the population and mortality during the term of five years ending with 1805. In the volume for 1813, he gave the number of deaths of persons of each sex, which took place in each interval of age during every one of the five years, 1806–1810; also the number of living persons of each sex in each interval of age at the end of the year 1810. In the volume for 1814, he gave the number of deaths of persons of each sex in each interval of age which took place in each of the two years 1811 and 1812. And in all cases the numbers born alive and still-born of each sex were also given separately, but the still-born were never included among the deaths.

Sweden having lost Finland by the war with Russia in 1808, the observations recorded by M. Nicander in the volumes of the *Stockholm Transactions* for 1813 and 1814, were made in Sweden alone. The operations of the Tabell-Verket never extended to Swedish Pomerania, the Isle of Rugen, or the town of Wismar.

In the sixth and last paper of M. Wargentin, in the *Stockholm Transactions* for 1755, he gave a table shewing the proportion of the whole number of deaths produced by each of about thirty of the principal diseases; in all Sweden, in Stockholm alone, within the London bills of mortality, and in Berlin. But at that time complete returns from the whole of Sweden had only been received for the two years 1749 and 1750; and from Stockholm for the five years 1749–1753. Forty-six years from that time had elapsed without any thing further having been published on the mortality from different diseases in Sweden, when M.

Nicander resumed it in his second paper in the *Stockholm Transactions* for 1801, where, in table T, he gave for each of the twenty-one years 1775–1795, the number of deaths produced by each of thirty-seven different diseases, besides these four other causes, child-bearing, the infirmities of age, unknown diseases, accidents and other violent deaths; with the annual average number by each cause, and the proportionate number produced by each cause, out of a total number of 10,000 deaths.

In table U he gave for each diocese in the kingdom, for Stockholm and for Carlscrona, each separately, also for the whole of the kingdom, the annual average number of deaths during the same period of twenty-one years, produced by each of the causes above mentioned, without distinction of the sexes, except for the whole kingdom taken together; for which the average was given from each cause for males and females separately, and also for the whole population, without distinction of sex. M. Nicander continued his papers on the mortality produced by different diseases in Sweden, in the same *Transactions* for the years 1805, 1809, 1813, and 1814, which appears in the tabular statement of his papers given above, for the term of years there set against their respective dates of publication. But in these four papers, the mortality produced by several kindred diseases taken together was given, without distinguishing that which was produced by each disease separately. In his paper published in 1809, besides the number of deaths produced in each of the five years 1801–1805, by each disease or class of diseases, the annual average number produced by each, in every month during the same term, was given, so as to shew the effects of the seasons in increasing or diminishing the mortality from each.

M. Nicander's papers contain much valuable information which, not coming within the scope of this article, it may suffice merely to mention here. Besides the statements above mentioned, of the births and deaths in the whole of the kingdom taken together, the numbers of them which took place in the city of Stockholm, and in each of the läns or governments the country is divided into, are given separately for the period between each two consecutive enumerations of the people, with the excess or defect of the births in each case, as compared with the deaths; and the difference is compared with the increase or decrease of the population in the same period, determined by actual enumerations at its extremities. The number of marriages contracted, and the number dissolved by death during given periods, are also stated; with the number of pregnant women delivered in each interval of five years of age, from fifteen to fifty, and those above fifty; the number of those women who were married, and who were single; the numbers of double, triple, and quadruple births, distinguishing those born alive from the still-born, the legitimate from the illegitimate, and males from females. In the enumerations, the number of married persons of each sex, the numbers of widowers and widows, and the numbers unmarried above fifteen years of age, of each sex; also the number of children of each sex under that age, were given.

The numbers of the people, classed according to their ranks, conditions, and employments, were stated, with distinction of the sexes, and the number of children vaccinated in each year, from 1804. In the volume for 1813, the number of families in each of the four following classes was given:—1. the opulent; 2. other persons of property; 3. those subsisting by their labour; 4. the destitute poor; which consisted of two persons, from two to five, from five to ten, from ten to fifteen, and of more than fifteen persons; with the whole number of families of each of those five magnitudes, and also the whole number of families of each class or condition. In addition to these, tables were given for 1802, and the subsequent years, shewing how many Swedish tons were sown of each kind of grain, also of pease, and of potatoes put into the ground, with the produce derived from each; the quantity of live stock of each kind; and the quantity of land under cultivation for each government of the kingdom separately.

Some of the most valuable parts of these papers of M. Nicander, with deductions from them, will be found under the second section of this article.

After the death of M. Nicander, which took place in 1815, no reports on the state of the population and mortality were inserted in the *Stockholm Transactions*, where they had always appeared previously; and as books, or any information concerning them, can hardly ever be obtained from Sweden through the London booksellers, it was not till the summer of 1836 that the author of this article learnt from Professor Nilsson of Lund, who was then in London, in what way they had been published; and to that gentleman and Mr. Charles Tottie, consul-general in London for Sweden and Norway, he is indebted for a manuscript copy of the 1st, 2d, and 3d tables, at the end of this article, which give the most important information on the subject; their authenticity he considers to be sufficiently guaranteed, by his having received them through Mr. Tottie, from M. John Ad. Leyonmarck, the successor of M. Nicander, as the secretary to the Tabell-Verket, or Registry Commission; also by comparing them with the printed tables under mentioned.

The principal printed documents on the progress of population in Sweden, since the death of M. Nicander, which the author has yet succeeded in obtaining are the following:—

1. An oblong folio pamphlet, consisting of forty leaves, (each twenty-one inches by eighteen), and containing forty-two lithograph tables, most of the pages being very much crowded with small figures, shewing all the particulars above stated with respect to M. Nicander's tables, not only for the whole of Sweden, but also for the city of Stockholm, and each of the *läns* or governments separately, which the kingdom is divided into, for the five years 1821–1825. The number in each of the usual divisions of age, at the enumeration of 1825, is given, with distinction of the sexes, and of the country people from those residing in towns. The following were the numbers for the whole of the kingdom:—

	Males.	Females.	Both sexes.
Country people,......	1,202,989	1,287,984	2,490,973
Inhabitants of towns,	129,981	150,298	280,279
Total,......	1,332,970	1,438,282	2,771,252

The numbers of the people in that year, classified according to rank or condition, profession or occupation, are also given. And the number of deaths in each of the five years (1821–1825) by childbirth, also those of each sex separately, by eleven different diseases, including the principal of those prevailing among children, and those by seven different kinds of violent deaths or casualties, are stated for the city of Stockholm, and each län in the kingdom separately.

For that city, and each of those läns separately, the numbers of the people in 1805 and 1810, without distinction of age or sex; and the numbers in 1815, 1820, and 1825, both with and without that distinction are given; with the numbers of births and deaths during the two quinquennial periods 1816–1820, and 1821–1825. The divisions are indeed much more minute than these; the population of the city of Stockholm is given for nine different districts separately, and the births and deaths for twenty; this arises from the population being divided into those districts for the purposes of taxation, and the twenty others are the different congregations or places of worship, where the registers of births, deaths, and marriages, are kept. But every län in the kingdom being divided into several districts, and each district into its separate parishes; the particulars above mentioned, are

given for each parish separately, and also the sum of those in each district, which shows the same things for it.

This is a very imperfect statement of the contents of these valuable tables, but sufficient it is hoped, to show those who take interest in such subjects, that they are worth being consulted and studied. The title is as follows: *The humble Report of the Royal Registry Commissioners to his Royal Majesty, on the Proportions of the Births and Deaths during the years* 1821–1825, *to the Population of the Kingdom in the last mentioned year; also on the observed Increase of the population of the Kingdom, during the last elapsed compared with the next preceding Decennium. Dated the* 10*th of May* 1828. Printed by the gracious command of his Royal Majesty.[1]

2. A quarto of sixty pages, with the same title, containing an abstract of the above, printed with types in the usual way, and observations and remarks which were absent from the larger tables. In it, the results of the observations made in that quinquennium (1821–1825) are compared with those of the preceding, by placing the corresponding numbers on the same line; those of the next preceding quinquennium (1816–1820) on the left; and those of the present (1821–1825) on the right of the page, with the explanation of their import between them.

These contain almost all the more important information in the larger tables, at least to persons residing out of Sweden, and are much more convenient to use. But this is defective in giving only the numbers of violent or sudden deaths, and those without distinction of sex, with hardly any information as to the numbers by different diseases, except stating in what parts of the country they produced the greatest mortality in different years.

3. A similar quarto of seventy-four pages for the quinquennium 1826–1830, with a similar title, was in 1833, handsomely printed with much larger and more beautiful types, especially the figures, which is important. The contents of the tables in possession of the Commissioners, twenty-five in number, are here stated, and then very satisfactory extracts from them are given. The number of deaths from childbirth and twelve different diseases are given; for the preceding quinquennium, the annual averages only; but for this, 1826–1830, they are stated for each year separately; but the annual average only for violent deaths, casualties, and unknown causes. As each of these gives the results of the preceding quinquennium, the two together give them for fifteen years, 1816–1830; and M. Nicander's papers in the *Stockholm Transactions*, gave the observations to the end of 1812; those for the years 1811 and 1812 being contained in the volume for 1814. So that only the observations for the three years, 1813, 1814, and 1815, are wanting to complete the series; and the most important parts of these and others are contained in the tables above mentioned, which are given at the end of this article. Whether two other quartos similar to those above mentioned, were published, with the observations made in the two preceding quinquenniums, 1811–1815, and 1816–1820, the author had not been able to ascertain when this article was printing, (in February 1837;) nor whether any other large folio tables, similar to those above mentioned, have been published; but it is probable there have not; for in the German translation of the second edition of *Forsell's Statistics of Sweden*, by the Rev. A. G. F. Freese, preacher to the royal court of Sweden, and rector of the German National Lyceum at Stockholm, (8vo, Lubeck 1835,) it is stated in a note at page sixty-seven, on entering upon the subject of the Swedish tables, that they are often quoted by foreign authors, and that the very large and instructive tables published in 1829, deserve much attention. There can be no doubt that these were the tables ordered by the king to be printed in 1828; although they might not have been published before 1829. Had there been any others of the kind, those probably would not have been so noticed, and as the translator must have had the best information on the subject, the obvious inference is, that no others existed in 1835.

4. A folio pamphlet of three sheets extracted from the Tabell-Verket, showing the number of persons carried off by epidemic cholera in Sweden in the year 1834.[2] It contains five tables, but we shall only notice the first and most important of them here; it shows the number of deaths which were produced by that disease in the year 1834,—in every län in the kingdom, and in every town and every subdeanery in each län, in each of the usual intervals of age till twenty-five, those between twenty-five and fifty, and the number above fifty years of age; also the number in each month, without distinction of age. The estimated number of the people in each place at the commencement of that year, and the proportion of them who died of the disease are also given, the sexes being distinguished throughout. This appears to be the first publication of the number of deaths in Sweden classed according to the ages of the deceased, as well as, and together with, the causes of death. For their assistance in procuring the last mentioned and other valuable books from Sweden, the author makes his grateful acknowledgments to Mr. George Warde Norman, and Mr. H. James Prescott; also to Mr. Norman, for a manuscript table showing the number of children of each sex born alive, and the number of the still-born, without distinction of sex; with the number of deaths of persons of each sex, which took place in each of the intervals of age there mentioned, in every one of the ten years 1824–1833, in the kingdom of Norway, the authenticity of which, that gentleman has no doubt of, and therefore, neither has the author of this. In the fourth table at the end of this article, the total of those numbers for the whole term of ten years are given.

It is gratifying to see this table from Norway, so similar to the excellent form of the Swedish. In every point in which they differ, the Swedish is entitled to preference; especially in the smaller intervals of age, in which the numbers of children are given in the Swedish; and it is to be regretted, that in giving the numbers of the still-born, the sexes were not kept distinct; as the great excess of still-born males above still-born females, is an interesting subject of inquiry. It is much to be desired that these should be continued in Norway, and that periodical enumerations of the people on the Swedish plan should also be made regularly. But the author has not yet succeeded in his endeavours to ascertain whether those have been made, or are intended or not.

In the year 1800 was published, at Paris, in octavo, under the title of *Essai de Statistique*, a memoir by J. A. Mourgue, on the births, marriages, and deaths, that took place in Montpellier during a period of twenty-one years, ending with 1792, with the ages at which the deaths happened, the sexes are also distinguished, and the population of the place appears to have been nearly stationary. The tables and observations of M. Mourgue appear to be more valuable than any others relative to the population of France, that had previously been published, except those of M. Deparcieux, which related only to select orders of the people. This memoir was read at a meeting of the French National Institute in 1795, and printed in the *Mém. des Sav. Etr. an.* 14.

[1] Kongl. Tabell-Commissionens underdaniga Berättelse till Kongl. Maj: t. angaende Nativitetens och Mortalitetens förhallande Aren 1821 med 1825, Rikets Folkmangd sistberörde Ar, samt Folkmangdens vundna tillökning under det sistförflunta, jämnförelsevis emot det nästforutgangna decennium. Daterad den 10 Maji 1828. Pa Kongl. Maj: ts nadiga befallning till trycket befordrad.

[2] Utdrag af Tabell-Wercket öfver de i Cholera-Farsoten uti Swerige aflidne personer Ar 1834. Stockholm 1836.

An enumeration of the people in Spain was made by royal authority in the years 1768 and 1769, and again in 1787; a minute account of this last was printed at Madrid, showing for each province separately, the numbers of parishes, cities, towns, villages, &c. &c. with the number of people in each class according to their ranks, professions, occupations, &c. and the monastic orders of both sexes were particularly distinguished: to these was prefixed a summary of the census of 1768 and 1769. In these two enumerations, the ages of the people were not distinguished with sufficient minuteness; they only showed how many were under seven, between seven and sixteen, sixteen and twenty-five, twenty-five and forty, forty and fifty, and above fifty. In both enumerations, together with the ages, the distinction of the sexes was given; in the first, the married were only distinguished from the single; but that of 1787 showed how many of each sex, and in each interval of age, were in the states of celibacy, marriage, and widowhood.

A third enumeration of the people in Spain and the Spanish possessions in Europe and Africa, including the Canary Islands, was made in 1797; and a full account of it, occupying nearly fifty large tables, was printed at Madrid in 1801. The distinction of the ages in this enumeration was still not sufficiently minute; under forty it was the same as in the two preceding; but after that age, the number of the living in each interval of ten years to one hundred was given, and the number above one hundred.

No information from the parish registers in Spain was given in any of these cases; although satisfactory extracts from them all, distinguishing the ages and sexes of the deceased, or even from those only which could be most depended upon, during the ten years that intervened between the two last enumerations, would have rendered the results of these incomparably more valuable, provided that the population of the places for which correct registers were given, could be distinguished from the rest. Those to whom the superintendence of these measures were entrusted in Spain, seem to have been well aware of this, and to have actually entered upon the formation of these necessary supplements to the enumerations, as appears by the following passage extracted from the introduction to the printed statement of the last census:

"Interin que se forman las tablas necrológicas, las de nacidos y casados, en que entiende el ministerio de Estado, y que son muy utiles para valuar casi geométricamente el total de la poblacion del Reyno, debemos contentarnos con las noticias que nos proporcionen los censos executados por el método que el presente." But these tables of births, deaths, and marriages, have not yet (in the year 1836,) been published, neither does it appear probable that they were ever formed.

In 1801 were published, in quarto, *Observations on the Increase and decrease of Different Diseases, and particularly of the Plague*, by William Heberden, junior, M.D. F.R.S., containing some tables, chiefly deduced from the London bills. In the advertisement prefixed to this valuable tract, we are informed that it had been intended to be subjoined to a new edition of the Bills of Mortality; which edition, however, was not published. We are also indebted to the same ingenious physician for other interesting observations on the mortality in London, inserted in the *Philosophical Transactions of the Royal Society* (for 1796,) and in those of the *London College of Physicians*, vol. iv.

In the same year (1801) was published another valuable work, entitled, *Reports on the Diseases in London, particularly during the years* 1796, 1797, 1798, 1799, *and* 1800, in 12mo, by Robert Willan, M.D. F.A.S. part of which had been previously inserted in some periodical publications. The author's observations were made both on the Bills of Mortality, and on the cases that occurred in his own practice.

Dr. Bateman commenced a series of similar observations and reports on the diseases of London with September 1804, which he continued till the end of August 1816. The subjects of those reports were, the cases that occurred at the Public Dispensary in London, in which he was a physician; they were first published quarterly in the *Edinburgh Medical and Physical Journal*, but the author collected them into a separate octavo volume, which he published in 1819, with an introduction, in which he gave a Historical Survey of the Diseases of London.

All of the three works last mentioned, are very interesting and instructive; but it would not be consistent with the objects of this article, to notice them further here.

By art. 1, sect. 2, of the constitution of the United States of America, it was provided that the representatives and direct taxes should be apportioned amongst the several states which should be included within the union according to their respective numbers. The first actual enumeration to be made within three years after the first meeting of the Congress of the states, and within every subsequent term of ten years, in such manner as they should by law direct.[1] In consequence of this, five enumerations of the inhabitants of the United States have been made, viz. in 1790, 1800, 1810, 1820, and 1830; statements of the first four are given in the American Almanac for 1832, and of the last in the same Almanac for 1833. In the first, as was stated above, no attention was paid to the ages, except the distinction of the numbers of free white males under and above sixteen years of age. In the enumerations of 1800, 1810, and 1820, the numbers of free white persons of each sex in five different intervals of age were ascertained; but three of the intervals were much too long to admit of the enumerations being available for determining the law of mortality; the first of those long intervals being all under ten years of age; the second, those between twenty-six and forty-five years; and the third, all above that age. Of these three enumerations, it was in that of 1820 only, that the free coloured persons and the slaves were classified according to their ages and sexes; and the intervals of age into which they were distributed, were longer than those for the free whites.

In 1830, the numbers of free white persons of each sex, in thirteen different intervals of age were determined; the four divisions under twenty years of age being of five years each; the eight between twenty and a hundred, of ten years each; and the thirteenth division included those of a hundred years of age, and upwards. The numbers of each sex, of free coloured persons, and of slaves separately of each sex, in each of the following divisions of age, were ascertained. Between 0 and 10, 10 and 24, 24 and 36, 36 and 55, 55 and 100, and above 100. These particulars were given for each state and territory separately, and also the totals for the whole of the United States. Statements of all the five enumerations from that of 1790 to that of 1830, both inclusive, may be seen in the American Almanac for the year 1832. That of 1830, with the ages of the living for each state and territory will be found in the same Almanac for 1833. No general returns of the numbers of births, marriages, and deaths, appear to have been required or made throughout the United States; and previous to the

[1] Dr. Seybert, in his *Statistical Annals of the United States of America*, published in 1818, (p. 17) makes the following statement: "The United States of America alone require an actual enumeration of the inhabitants to be made at regular intervals; as far as our knowledge extends, no other instance can be furnished from the history of mankind; our practice is worthy of being followed by other nations." And a statement to the same effect is made in the American Almanac for the year 1832, (p. 156) by which it would appear, that the writers were not aware of Sweden having set a still better example of that kind more than thirty years before.

Mortality, Bills of.

year 1820, but few births were registered there. Many marriages were till then, and probably still are, contracted before magistrates, whose records of them were seldom preserved.[1]

In the city and liberties of Philadelphia more attention appears to have been paid to these subjects than in almost any other part of the United States. In the first number of the *American Journal of the Medical Sciences*, published at Philadelphia in November 1827, in octavo, there is an excellent article (the 8th), entitled, *Medical Statistics: being a series of Tables, showing the Mortality in Philadelphia, and its immediate causes, during a period of twenty years, by Gouverneur Emerson, M.D.* Dr. Emerson states, that the subject of the diseases and mortality of Philadelphia, was first made one of regular record in the year 1807, through the influence and exertions of Professor James, and that "their authenticity may be regarded as resting on very solid grounds." From authority vested in the Board of "Health, this municipal power makes it obligatory upon physicians to give certificates designating the name, age, and sex, of all who die under their care; and sextons are bound by still heavier penalties, not to permit the interment of any dead body, until such certificate is obtained, which he returns to the health office on the last day of every week, for publication. The accuracy with which the diseases are designated in these certificates, rests chiefly upon the general intelligence of the medical profession in that city, the members of which are very much in the practice of testing their pathological opinions by autopsical examinations. For the purpose of ascertaining the number born, the various practitioners of midwifery are required to render an account at the health office of all births. With regard, however, to this department, there is some reason to suspect a deficiency in the returns, especially from the outskirts of the city and liberties. But the registry of the dead has, for the most part, been kept with a care and fidelity creditable to those who have had its superintendence."

Dr. Emerson after making some general observations on the topography and climate of Philadelphia, proceeds with his observations on the eleven valuable tables which are inserted at the end of the article.

The *first* shows the results for each calendar month of thermometrical observations made at Philadelphia, during the term of ten years, which commenced with March 1811, and ended with February 1820. The *second* is an abstract of the census of the city and county of Philadelphia, taken by order of the general government in 1820.

All the observations on the Mortality were made within the period of twenty years, which commenced with 1807 and ended with 1826; the still-born being always, as they should be, given separately, and not included amongst the deaths; except in Table IV., which shows the number of deaths in each month of each of the twenty years; the Board of Health having found it impracticable to make an accurate monthly estimate of them for deduction.

In the number stated in the Philadelphia bills to be still-born, the abortions are included. The fifth and eleventh of these tables are the most valuable. In the fifth are stated the numbers of deaths from the principal diseases during the whole period of twenty years in the following intervals of age, viz. between birth and one year completed, between one and two years, between two and five, between five and ten; then in each interval of ten years of age to a hundred and twenty; fifty-five deaths having happened between the ages of a hundred and a hundred and ten, and six between a hundred and ten and a hundred and twenty. After the columns set apart for those fifteen different intervals of age, in a sixteenth the number of deaths produced by each disease at ages not ascertained, is given; and in the seventeenth and last column, the total number of deaths produced by each of those diseases. The total number of diseases in the table is sixty-six, and the number of causes of death, old age being included, is sixty-seven.

A few cases of deaths occasioned by accidents and diseases of vague character, Dr. Emerson omitted, as tending rather to perplex than to elucidate the subject; and adopted the alphabetical arrangement in this table, as the most convenient.

The total number of deaths registered during the term of twenty years was 53,004, whilst the number included in this fifth table was 50,614; so that 2390 were excluded for the reason just stated.

Dr. Emerson's other tables and his observations on the whole of them, will be found well worth the attention of those who take interest in the subject.

In *Hazard's Register of Pensylvania* for July 30, 1831, (No. 5, vol. viij.) there is an elaborate paper entitled, Comparative Views of the population of the city and county of Philadelphia, from the time of the first census in 1790, till that of the last in 1830; in which the number of white persons of each sex in that city and county at the time of the census of 1830, in each of the thirteen intervals of age, stated above to have been adopted throughout the United States at that census, is given; and the same information is given as to the coloured population at that time, but distributed into the six intervals of age only, above stated to have been adopted for them. The number of whites was 173,345; of coloured persons, 15,595; total, 188,940.

A statement of the deaths which took place within the Bills of Mortality during the term of ten years 1821–1830, is also given for the whole population without distinction of colour or sex, and distributed into the following sixteen intervals of age in which they happened, viz. under one year, between one and two, between two and five, then in each of the three intervals of five years each to twenty, and the remaining ten intervals of ten years each between twenty and a hundred and twenty; thirty-two persons having died between a hundred and a hundred and ten years of age, and five between a hundred and ten and a hundred and twenty. The whole number of those deaths, which did not include the still-born, was 37,914.

The number of births of each sex in each of the ten years 1821–1830, is also given, including the still-born, but without distinction of colour; and the number of still-born for each year separately, but without distinction either of colour or sex.

The number of deaths in each of the ten years is stated separately, both with and without distinction of sex, but always without distinction of age; and it is only where the whole number of deaths of both sexes without distinction, in each of the ten years is stated, that the division of it into

[1] In consequence of the notice which was taken in the first edition of this article, published in the Supplement to the Encyclopædia Britannica, in June 1817, of the enumerations of the people, and the published extracts from the parish registers in the United States, with some suggestions for improving the best of them, those of Philadelphia, and increasing their usefulness, John Vaughan, Esq., the Librarian of the American Philosophical Society, had the goodness to communicate to the author in June 1818, most of the information given above, as to the state of things down to that time, both in the United States generally, and in Philadelphia in particular; with eight of the annual statements (all he could procure and part with,) of the Board of Health in Philadelphia, showing the number of deaths at every age by each disease or other cause, in that city and its liberties; and several American newspapers, showing the number of deaths in each of the same intervals of age, the number in each month of the year, and the number of deaths by each cause, without in this last case, stating at what ages they happened, in *Baltimore, Boston, Charleston, New York, Philadelphia, Salem,* and *Washington*; for which the author feels it incumbent upon him to acknowledge his obligations, and express his gratitude in this place.

the numbers of white and coloured persons is given; in these numbers of deaths without distinction of age, the still-born are included. So that these documents do not enable us to determine out of how many persons of each sex, one died annually during the ten years 1821–1830.

Taking the limits of the Bills of Mortality from Dr. Emerson's second table, where he stated the wards and districts from which the returns of interments were made, and the population of each at the census in 1820, amounting in all to 121,980; and assuming the limits of the bills to have been the same in 1830, the population within them at the census of that year, was, according to Hazard's Register, 171,212; and the mean number of the people during the intervening ten years, appears to have been 146,596.[1] The number of deaths in the same time, exclusive of the still-born, was, according to the statement with the ages, 37,914; according to that without the ages, 37,814; taking 37,864, the mean between these for the true number, we find that there died annually on an average of those ten years, one person for every (38·7165 or nearly) thirty-nine in the whole population. The number of persons in the city and county at the census of 1820 was 137,097, at that of 1830, 188,961, mean number during the intervening ten years, 163,029.

The following statement of the progress of population in the city alone of Philadelphia, appears to be sufficiently interesting to deserve a place here.

In the year	No. of the people.	No. of square feet for each person.	No. of persons to a sq. mile.
1790	28,522	1755	15,885
1800	41,220	1216	22,926
1810	53,722	933	29,880
1820	63,802	786	35,469
1830	80,458	623	44,749

The three first columns are taken from the article above mentioned in Hazard's Register; but since the numbers in the third are proportional to the rarity of the population at the five enumerations, those in the fourth have been added, as they measure its density at the times of those enumerations.

The whole population of the city and county of Philadelphia, without distinction of age, sex, or colour, was distributed as follows, at the times of the enumerations in 1820 and 1830.

	In the year 1820.	In the year 1830.
In the city....................	63,802	80,458
In the suburbs................	58,178	90,754
Total within the bills of mortality................	121,980	171,212
In the rest of the county	15,117	17,749
Total within the city and county............	137,097	188,961

(Hazard's Register, vol. viii. p. 65.)

Here the inhabitants of Blockley, amounting
in 1820 to 2655,
in 1830 to 3401,

are included within the suburbs and bills of mortality. It is much to be regretted that in the census of 1830, the coloured population were not distributed into the same intervals of age as the whites; also that the colours and sexes of those who died within the bills of mortality during the ten years, 1821–1830, were not distinguished in the published statements, as well as the ages. Dr. Emerson was of opinion that the rate of mortality amongst the coloured population was much greater than amongst the whites.

It is equally to be regretted that, while the bills of mortality extended only to the city and suburbs, of which the mean population during the ten years, 1821–1830, was 146,596, the enumeration of that portion of the population of the city and county distributed into the different intervals of age, with distinction of the colours and sexes, was not given separately. For with such documents as are before us, even if the enumeration of 1820 had been made exactly in the same manner as that of 1830; in attempting to determine the rate of mortality in any interval of age, we should only have the means of comparing the annual average number of deaths which took place in that interval within the bills of mortality, with the mean number of the people in the same internal of age in the whole of the city and county. But the mean population

within the bills of mortality was only............... 146,596
while that of the whole city and county was....... 163,029

that is.. 16,433

or about one-ninth greater.

The difficulty arising from this would not be great, if the population without the bills were known to be distributed into the different intervals of age in a manner similar to that within them; but there is no doubt of the distribution in the two cases being very dissimilar; for, excluding the still-born both from the numbers of the births and of the deaths, during the ten years ended with 1830,

The total number born within the bills of mortality was... 61,945
Total number of deaths in the same time...... 37,814

Increase of population, within the bills, by procreation.. 24,131
While the increase from all causes during these ten years, was.................................... 49,232

So that the increase by migration must have been.. 25,101

within the bills of mortality; that is, one twenty-fourth part greater than by procreation. The part of the county without the bills certainly could not have been increased in a like proportion in the same way; therefore the population without the bills must have been much more dense at early ages, and more rare at the advanced ones, in comparison with the population within them, than in proportion to the mean number of the people of all ages, without and within the bills respectively. Whence it is manifest that nothing but enumerations of the people in each interval of age, within the limits of the bills, at each extremity of the period for which the annual deaths at the different periods of life are given, can make either those enumerations or the registers of deaths, available for the most important purposes they can be applied to.

In pursuance of an act of Parliament (41 Geo. III. cap. 15), an enumeration of the people in Great Britain was made in 1801; also returns of the baptisms and burials in England and Wales, during the year 1700, and every tenth year after that till 1780, then for every year to 1800 inclusive, with the number of marriages in each year, from the commencement of 1754 to the end of 1800. Large and clear abstracts of the answers and returns to this act were printed

[1] Including the township of Blockley in the limits of the bills according to Dr. Emerson, although in the register it is removed from them and placed in the rest of the county. If the interments in or from Blockley were not included in the bills, the annual average mortality must have been one of 37·9167.

by order of the House of Commons in 1802, and occupy more than one thousand pages folio. In 1811, another act (51 Geo. III. cap. 6), was passed, "for taking an account of the population of Great Britain, and the increase or diminution thereof;" in consequence of which, returns were that year made to Parliament, of the number of persons in every part of Great Britain; also of the numbers of baptisms, burials, and marriages in England and Wales, during each of the preceding ten years; very satisfactory abstracts of these were also printed by order of the House of Commons, in 1812, with some preliminary observations, in which corrections of the preceding returns are given.

The sexes were distinguished both in these enumerations and extracts from the registers, but the ages in none of them; and the proportions of males to females among the living are not to be depended upon, a number of males in the army and navy, which it is difficult to estimate, not being natives of Great Britain, nor usually resident there. The returns of baptisms and burials were also defective, but few registers of Dissenters having been included in them.

These abstracts are, however, with respect to the objects they extend to, more minute and satisfactory, than any other accounts of the same kind that had previously been published; and it was very desirable that such returns should have continued to be made, and abstracts of them to be printed at regular intervals; for nothing is so well calculated to shew the influence of different causes on the prosperity of a nation, as the comparison of the different states of the population, and the rate of its progress or declension, under different circumstances; besides, the value of the abstracts, once obtained, will be much enhanced by the publication of others of a similar kind thereafter.

It is much to be regretted, that no information as to the ages of the living, or those at which the deaths took place, was required by either of the acts above referred to, nor any encouragement or facility afforded to those who might be disposed to collect such information; and, consequently, that none was given in the returns.

Without better regulations for the keeping of mortuary registers than those heretofore in force, without such as should extend to dissenters of every denomination, it would probably be better not to require returns of the ages of the deceased from all parts of the kingdom; for defective or inaccurate returns would only mislead; and, not to mention the difficulty and expense of procuring returns of the ages of all the living, they would be comparatively of little use, where those of the dead were wanting

But if government were to print forms for making returns both of the numbers of the living and of the annual deaths in proper intervals of age, throughout the extent of life; only sending these forms along with those now in use, to such as should apply for them; then persons who take an interest in such inquiries, and have the means of making correct returns, might do so with advantage. And a summary of all of that kind made from different parts of the kingdom, would convey much important information. Returns also, from such places only as were similarly circumstanced, might be collected into as many summaries as there were material varieties in the circumstances; and thus would afford the means of determining the different modifications of the law of mortality, which different circumstances produce. If the diseases that occasioned the deaths were also inserted, the greater prevalence of particular diseases in some circumstances than in others, would be apparent, with their effects, and the probable means of preventing them, or lessening their mortality.

But, *the population enumerated must always be precisely that which produces the deaths registered; the grand desideratum being, to determine the number of annual deaths at each age, which takes place among a given number of the living at the same age.*

Mr. Milne's *Treatise on Annuities and Assurances* was published in 1815, and contains clear abstracts of the most important statements of this kind that had been published between Dr. Price's time and the date of its publication; these will, we believe, be found to be much more valuable than any thing of the kind that was extant when that respectable author wrote, whose work had long been referred to for the best information on such subjects.

Since the first publication (in 1817[1]) of what has been stated above respecting the two first enumerations of the people in Great Britain, and the extracts from the parish registers of England and Wales, two[2] other enumerations have been made in 1821 and 1831; and abstracts of the answers and returns under the acts that required them, (1 Geo. IV. cap. 94, and 11 Geo. IV. cap. 30), have been printed by order of the House of Commons, (in 1822 and 1833 respectively.) The extracts from the parish registers, shewing in each case the numbers of births, marriages, and burials, returned for each of the ten years next preceding that of the enumeration. The principal difference between the queries put at the two enumerations of 1811 and 1821 was, that in 1811 no inquiry was made as to the ages of the people, while in 1821, after nearly the same questions had, according to the act, been put to the overseers in England, and to the schoolmasters in Scotland, the following instructions as to the ages of the people were given: "If you are of opinion that in making the preceding inquiries, (as to the number of families and persons), the ages of the several individuals can be obtained in a manner satisfactory to yourself, and not inconvenient to the parties, be pleased to state the number of those who are under five years of age," &c. The thirteen intervals of age into which the persons of each sex separately were to be distributed, being these: 4 of 5 years each from birth to 20 years of age; then 8 of 10 years each to 100; the thirteenth including all those above 100 years of age. Thus it was left optional with the returning officer whether this important question should be put, and with the party interrogated, whether it should be answered or not; from which it would appear that this part of the inquiry was not intended to be made with much correctness, and those whose onerous duty it was to put the question in populous places, might easily lighten the burden; accordingly, from such places the ages of a considerable part of the population were not returned. None were obtained from Manchester, Newcastle-upon-Tyne, or Sunderland. The proportion of the ages which were not returned was, in Birmingham, about $\frac{18}{30}$ths, in Leeds, $\frac{1}{4}$th, in Bristol, $\frac{1}{8}$th of the returned population. In Middlesex, $\frac{1}{3}$th, York, east riding, $\frac{1}{5}$th, north riding, $\frac{1}{7}$th, in Lancashire, $\frac{1}{6}$th, in Warwickshire, $\frac{1}{3}$d, evidently owing to the large manufacturing towns they contain, especially Birmingham, the population of which is more than a third of that of the county of Warwick. These deficiencies in the returns may reasonably be ascribed to the option which was offered to the overseers, who, however, performed the duty imposed upon them with great good will and attention, as appears by the complete return of ages where the obstacles were not too great.

That the people were not unwilling to state their ages, may be inferred from the complete returns of them from Hull, Liverpool, Portsmouth, Plymouth, and Great Yarmouth, as well as from every city in England, if we mistake not, except London, Canterbury, and Bristol. From the counties of Bedford, Chester, Rutland, and Leicester, nearly the whole were obtained; and from those of Lincoln, Norfolk, Suffolk, and Wilts, the deficiency was only on an aver-

[1] In the Supplement to former editions of this work.

[2] For the more recent statistics on mortality, see Appendix to the present article.

age about one-thirtieth, while from all Wales it was only a forty-second part of the whole.[1]

The following table may throw some light on the influence of large manufacturing towns, migration, and some other circumstances, in producing a more or less complete return of the ages of the people at that enumeration. It being borne in mind that from Glasgow the whole were returned.

Omitting the army, navy, marines, and seamen in registered vessels.

	Both sexes. 100 ages were not returned out of	For every million of each sex, the number whose ages were not returned, was, of		Excess of Females.	Excess of Females for every 100 males.	
		Males.	Females.		In the whole population.	Among those whose ages were not returned.
In England,	787	123,053	130,880	7,827	5·36	6·36
— Wales,	4164	23,776	24,240	464	4·70	1·95
— England and Wales,	827	117,359	124,512	7,153	5·32	6·09
— Scotland,	1531	61,016	69,139	8,123	12·85	13·31
— Do., omitting Glasgow,	1423	65,556	74,431	8,875	11·55	13·54
— Great Britain,	888	108,999	116,048	7,049	6·41	6·47

With regard to the extracts from the parish registers, the principal difference between the questions put in 1831 and at the three preceding decennial periods of enumeration, was, that in these no inquiry was made as to the ages at which the deaths happened, while in 1831 the officiating minister of every church or chapel was requested to state the ages of the individuals of each sex entered in his burial register, during each of the eighteen years 1813—1830, in consequence of which the ages of 3,938,496 persons buried during those eighteen years were returned, 1,996,195 males, and 1,942,301 females. The number of each sex separately, and of both sexes, who died in each year of age during every one of the eighteen years, in all England and Wales, according to the returns, were given in the preface to the *Enumeration Abstract*, (pp. 36–42); besides which, a similar table was also given for each county separately, and sometimes for its principal town, at the end of the returns from that county, in the *Parish Register Abstract*.

Omitting the army, &c., as above mentioned, the whole returned population in 1821 was 11,978,875 persons; but the ages of 10,530,671 only were obtained, the number of persons whose ages were not obtained having been 1,448,204. As the ages withheld were generally those of residents in large manufacturing towns, whilst those returned were from the rest of the population, and a considerable proportion of the former class had migrated from the latter, many of them probably about the age of puberty; there are good reasons for believing that the ages returned and those omitted were not similarly distributed, as to their numbers, into the different periods of life; so that, although the total number omitted be given, they cannot be interpolated in their proper places by calculation or otherwise, among the ages returned.

In the returns of burials at different ages, there are also omissions, which can only be guessed at. Thus it appears that these documents, after all the pains and expense they have cost, do not afford the means of determining the law of mortality, although that undoubtedly is the most important purpose to which enumerations and registers of these kinds can be applied.

The act 6 and 7 Wm. IV., cap. 86, passed in August 1836, is likely to secure satisfactory records of marriages, births, and deaths, in England; but the abortive and still-born should be distinguished from the children born alive, which does not appear to be provided for. They may, indeed, be entered as abortive or still-born, under the cause of death, in the register of burials; if that be done, they should be carefully excluded from the number of deaths, in making extracts or returns, and stated separately. And if, at the future decennial enumerations, the ages of the people be determined with corresponding accuracy, the values both of the enumerations and registers will be greatly enhanced, and the law of mortality, with much other important information, may be derived from them. The insertion of the *cause* of death, in the register of it, is of itself a great improvement.

As has already been observed in the article Annuities, (in volume iii.), it is much to be regretted that in the population returns of 1831, the people were not classed according to their ages, as in 1821; but without giving any option either to the party by whom or to whom the question on that subject was required to be put, as to putting or answering it. It appears highly probable that there would be no occasion to impose any penalty for refusing to answer that question, or for giving wilfully an incorrect answer; and in the few cases where it might be so given, or altogether withheld, if a memorandum were made of it, the desired information might afterwards be obtained nearly enough from other parties; if it came but within the right interval of age, that would be sufficient. It is true that in the present defective state of the returns of births and deaths, that would not have enabled us to determine the law of mortality in a satisfactory manner; but with the returns of 1821, and those of a similar kind to be made at the future enumerations, it would have been of great use. Indeed it must be obvious to all, that one of the greatest uses of such periodical inquiries into the state of the population, is to ascertain its progress, by comparing the returns at the several successive periods, which can only be done satisfactorily when the same method of proceeding is adhered to at each, or as nearly so as may be consistent with the introduction of improvements into it.

Dr. Robert Watt's *Inquiry into the Relative Mortality of the Principal Diseases of Children, and the numbers who died under ten years of age in Glasgow during the thirty years* 1783–1812, forming the appendix to his *Treatise on Chincough*, was published with it, in 8vo. in 1813.

He states, (p. 336,) that, "on inquiring into the state of

[1] Those above mentioned are only a few cases, others may be easily found in the Population Abstract. The ages of the inhabitants of London *within the walls* were very nearly all returned; those of Canterbury were deficient by $\frac{1}{6}$th part of the whole.

the Registers of the City, he found something of that kind had existed from a very remote period; but that it was only from the commencement of the year 1783 that they had been kept in a regular manner." The Bills extended to the suburbs as well as the city, and he stated that so early as the year 1798, more than half of the funerals were without the city. With the most laudable zeal and unwearied industry, he collected from the different registers of burials contained in fifteen folio volumes, for every one of those thirty years, the number of children under ten years of age who died in each month of that year, by each of eight different diseases, (counting fevers of all kinds as one disease only, designated by the term *fever*, according to the bills,) the number of the abortive and still-born, and the numbers of deaths under two years of age, between two and five, and between five and ten; and gave a separate table exhibiting those particulars for each of the thirty years; shewing also the total number of deaths during the whole of each year from each of the causes, and in each of the intervals of age above mentioned; with the whole number of deaths at all ages, and from all causes that took place in each year.

Then, dividing the whole term of thirty years into five periods of six years each, he gave a table (his 31st) shewing how many deaths took place in that period from each of the causes and in each of the intervals of age above mentioned, for every hundred in the whole numbers of deaths, including the abortive and still-born, which took place during the same period.

The following are four of the fifteen columns in that table.

Period of six years.	For every hundred in the total number of deaths during that period, there were caused by		
	Small-pox.	Measles.	Stopping or croup.
1783—1788	19·55	0·93	2·54
1789—1794	18·22	1·17	3·33
1795—1800	18·70	2·10	2·47
Gratuitous vaccination commenced in Glasgow in 1801.			
1801—1806	8·90	3·92	4·93
1807—1812	3·90	10·76	5·18

Dr. Watt, in common with almost all others who have well considered the subject, was an advocate for vaccination; and if he overrated the degree in which the reduction of mortality effected by it was counteracted by the contemporaneous increase of mortality from other diseases; he has given abundant proof that it was neither from the want of an earnest desire to discover the truth, nor of persevering industry in the pursuit of it.

At the conclusion of his work he recommended scarlatina to be thenceforward carefully distinguished from other fevers in the bills, and expressed his opinion that it had been a very considerable cause of mortality among children for some years previous to the date of his publication.

Medical men in general, both in London and in Glasgow, dissent from the opinion of Dr. Watt, that the mortality from measles had materially increased since the introduction of vaccination; but it is supported by the Bills of Mortality both of London and Sweden, as well as those of Glasgow; the increase has also been observed both in Cornwall and at Plymouth, although the numbers there are small.[1] Perhaps this increase of mortality may take place principally among the children of the poor, who, in such cases, seldom have proper medical assistance; and either from ignorance or necessity do not sufficiently protect the patients from cold whilst labouring under the disease.

The third edition of Dr. Cleland's *Statistical Tables relative to the City of Glasgow*, was published there (in 8vo.) in 1823, containing a good account of the population and mortality both of the city and suburbs down to that time; he there gave the bills of mortality of the city and suburbs for the year 1822, which appears to have been the first published, and continued to prepare these bills during fourteen years, 1821–1834, with great care and attention, and to publish them in the Glasgow newspapers, with the approbation of the magistracy, who cheerfully defrayed the expense.

These bills were similar to those published by Dr. Haygarth at Chester, and by Dr. Heysham at Carlisle; except that the intervals of age the numbers of deaths were given in under five years, were much less minute, and that the causes of death were not stated in Dr. Cleland's bills. That gentleman was also appointed to superintend the two enumerations of the people in the city and suburbs of Glasgow in 1821 and 1831; and having been appointed on this last occasion by the sheriff of Lanarkshire to superintend the enumeration of the county also, in a letter to the author of this article, dated February 15th 1831, he expressed his apprehensions that he should not be able to give a classification of the inhabitants of Glasgow and its suburbs according to their ages at that enumeration in the same manner as in 1821; but upon being informed, in reply, that in that case all the labour he had bestowed upon the parish registers during the ten years then elapsed would be fruitless, he answered, that, notwithstanding the extra trouble, he would prepare fresh schedules, and give the number of the people of each sex in each of the same intervals of age as in 1821, which he did accordingly; and that is the only instance, except the Carlisle enumerations in January 1780 and December 1787, of its having been done in this country.

In the year 1831, Dr. Cleland published, in a folio volume, his *Enumeration of the Inhabitants of Glasgow and Lanarkshire*, including all the details of his labours above mentioned, and, in 1832, a second edition of nearly twice the bulk; in the first, the bill of mortality for each year of the ten, 1821–1830, is given; but in the second, only those for the first and the last of them.

The following is an extract from the folio volume, (first edition, p. 11.) "From my official situation I am enabled to state, that the books of the church-yard wardens are kept with such perfect accuracy that every reliance may be placed on the number of burials in the city and suburbs."

Since the year 1834 the Glasgow bills of mortality have been prepared by Henry Paul, Esq. convener of the Committee of Churches and Church-yards, under the superintendence of a committee of the magistrates and town council, with some material improvements upon those of Dr. Cleland. The bill for 1835 contains six tables, besides *General Remarks*, the principal improvements are in the third and fourth tables, which were not given by Dr. Cleland, in both of them the sexes are always distinguished; in the third, the number of still-born children, and the number of deaths in each interval of age that took place in each month of the year is given separately; and the sum of the monthly numbers shews the same thing in each case for the whole year. But the fourth table, which is still more valuable, shews the number of deaths of each sex in each interval of age, by each of the causes most easily discriminated.

Part of these two bills have been published in the Glasgow newspapers; of that for 1836, in the *Scottish Guar-*

[1] *Sketch of the Medical Topography of the Hundred of Penwith, Cornwall*, by Dr. Forbes, part ii. p. 138, in *Trans. of Provincial Assoc.* vol. ii; and Dr. Blackmore on *the Rise and Decline of Particular Mortal Diseases*, 8vo. Plymouth 1829, from Trans. of Plymouth Institution.

dian of the 3d of February 1837; but only the contents of the first two of the tables above mentioned for that year had been published when this article was put to press, and the author acknowledges his obligations to Mr. Paul for the copies sent him by that gentleman of the papers already published. In these the intention of the council committee is announced, to improve as they proceed, the statements of the diseases by which the deaths were occasioned; also their intention to detail, in the future bills of mortality, the particular trades and professions of those who have died; and to give a table exhibiting the mortality among children from one month up to five years of age, with a statement of the various diseases which have proved fatal at those ages; all of which improvements are very desirable.

It is much to be regretted that only about one half of the births in Glasgow and its suburbs are registered, also that certain registers in the Barony Parish burying-grounds contain no record of the cause of death. The act passed in 1836, for registering births, deaths, and marriages, extends to England only; and the committee of the city council express their opinion that these defects cannot well be supplied without some legislative enactment.

In the bills of mortality for London, Glasgow, and too many other places, the still-born have been included among the burials, as the numbers are obtained from the burial registers; although, as was observed before, p. 525, col. 1, they never should be, for in that case they are generally included among the deaths in calculating the rate of mortality, in consequence of which, that rate comes out greater than the truth in the ratio of the whole number of the registerial burials to the number interred who had lived and breathed.

The *Observations on the Mortality and Physical Management of Children*, by Mr. Roberton of Manchester, were published (in 12mo.) in 1827; it is the first part only of that valuable work, namely, the observations on the mortality amongst children, which we have occasion to notice here; and we consider that no gentleman of the medical profession has treated it better, few, if any, so well. Mr. Roberton informs us that no bill of mortality is published in Manchester, and that, before the year 1812, the ages were not entered in the registers. He extracted, with great care, the numbers of deaths under ten years of age from the register of the collegiate church of Manchester, for the term of eight years, 1816–1823; and from the valuable register at the *Rusholme Road* cemetry there, for the term of four years, ended with April 1825. The results he has stated shortly, (p. 19.) with the proportion in each interval of age under ten, to the whole number of deaths in each register; and has given a valuable table, shewing, without distinction of sex, the number of children buried in the Rusholme Road cemetry during the four years 1821–1825, who died under one month old, between one and two, two and three, three and six, six and nine, and between nine and twelve months; also between one and two years, two and three, three and five, and between five and ten years old, with the total under ten; by each of forty-seven different diseases, and twelve other causes separately. The total number of deaths under ten having been 2056, and at all ages 3559.

We have already stated in the article ANNUITIES, (vol. iii. p. 203,) that Mr. Finlaison's Report to the Lords of the Treasury, on the mortality among government annuitants in this country, was printed by order of the House of Commons in 1829. Government having raised money at different times by the sale of life annuities, either by way of tontines, with benefit of survivorship, or otherwise; a separate register of the nominees or annuitants on whose lives the annuities depended, was on each occasion kept; the name, and consequently the sex, also the age, satisfactorily certified, of each nominee at the time when the annuity commenced, with the day of death, and the age attained, were entered in the register. For each of these classes of nominees generally, but in some instances for two or three of the smaller ones combined, Mr. Finlaison has given a table, showing for each sex, 1. The number enrolled at each age last completed, during the observations; 2. The number alive of each age when the observations terminated; 3. The number who died at each age during the observations; and, 4. The number who passed on from that to the next greater age.

Mr. Finlaison calls each of his tables above mentioned an observation, although each records several thousands of observed facts or occurrences. Of these tables he has given twenty-one, but the recorded facts, which alone we have occasion to notice here, are contained in six only of them, the other fifteen being combinations of two or more of the six, or of selections from them.

These six are the following:—

Table.	Observations on the nominees of the	No. of Lives.	No. of Deaths.
I.	English Tontine, which commenced in July 1693, the last died in 1783................................	1002	1002
	The observations in all the other cases terminated in January 1826.		
II.	Life Annuities issued at the Exchequer in 1745, 1746, 1757, 1766, 1778, and 1779............	2552	2396
III.	Three Irish Tontines of 1773, 1775, and 1778..........................	3557	1993
	Great English Tontine of 1789.		
IV.	*Selected* by the contributors........	3518	1315
V.	*Drawn by lot*, (Art. ANNUITIES, p. 207)............................	4831	1823
VII.	Life Annuities chargeable on the Sinking Fund, commenced in 1808..................................	6892	1548
	Totals,...............	22,352	10,077

In the article ANNUITIES (pp. 202 and 203) we mentioned the desire of the members of the Equitable Assurance Society to ascertain the law of mortality which had obtained among them; and that the late Mr. Morgan, their then actuary, had been able to form a table which had induced him to alter his opinion on the subject; accordingly, in February 1834, the Society printed for the use of the members a folio pamphlet of "Tables showing the total number of persons assured in the Equitable Society, from its commencement in September 1762, to January 1, 1829, distinguishing their ages at the time of admission into the Society, and exhibiting the number of years during which they have continued members of it, the periods of life at which their assurances have terminated, and the ages which the surviving members had attained on the first of January 1829. To which are added, Tables of the Probabilities and Expectations of the duration of human life, deduced from these documents; a statement of disorders (as certified to the Court of Directors) of which 4095 persons assured have died, in thirty-two years, ending December 31, 1832; and a Supplement, showing the mortality of the Society for the years 1829, 1830, 1831, and 1832." With an introduction by Mr. Arthur Morgan, who succeeded his father as actuary of the Society.

By these documents it appears that, of the persons whose lives were assured in the Society during the period of $66\frac{1}{4}$ years from its commencement, till the end of the year 1828,

The number then surviving and continuing insured, was... 6930
The number who went out of the Society during their lives, the assurances on them having been discontinued... 9324

Carry forward 16254

Brought forward 16254
The number who continued assured till death... 5144

And that the total number of lives insured was 21,398

The most valuable of these data are contained in a table, marked A, of the following form, the ages stated being those last completed:—

Age on admission.	Age 29. Attained the above age.	Age 29. Living Jan. 1, 1820, at the above age.	Age 29. Assurances discontinued.	Age 29. Died.	Age 30. Attained the above age.	Age 30. Living Jan 1, 1829, at the above age.	Age 30. Assurances discontinued.	Age 30. Died.	Age 31. Attained the above age.	Age 31. Living in Jan. 1829, at the above age.	Age 31. Assurances discontinued.	Age 31. Died.	Age on admission.
25	462	7	32	2	421	10	29	2	380	5	14	5	25
26	481	6	22	2	451	7	26	7	411	7	13	4	26
27	624	10	54	3	557	6	31	5	515	6	29	4	27
28	726	8	40	2	676	7	70	4	595	3	37	4	28
29	783	...	...	3	780	1	45	5	729	7	65	4	29
30	...	...	...	...	762	..	1	2	759	4	36	4	30
31	...	...	...	...	...	...	...	...	785	...	...	2	31

The number in each column on the extreme right and left shows the age at which the lives in the horizontal line passing through it were insured; and each large column, with the age written over it, gives in its four subdivisions the information there expressed for each age of admission separately

1. The number of lives who attained that over-written age.

2. How many of them were living of that age when the observations terminated.

3. How many went out of the Society alive, by discontinuance of insurance at that age, during the observations.

4. How many of them died insured during the same time.

And as none of the last three descriptions of lives could have entered into the next greater year of age during the observations, while all the rest of the lives of the first description must have done so; if the sum of the 2d, 3d, and 4th numbers be subtracted from the first, the remainder, being the number who entered on the next greater age, is inserted in the first division of the column for that greater age.

The numbers in each horizontal line of the table always begin with the number admitted during the observations at the age of admission standing on the same line in the marginal columns; and the number admitted is placed in the first division of the column with the same age at its head; from which it necessarily follows that the number of lives insured at any age, is always the last number in the first division of the column with that age written over it. Thus, the numbers admitted of the ages 29, 30, and 31, were 783, 762, and 785 respectively. 785, the number admitted at 31, that is, in the 32d year of age, is greater than the number admitted at any other age, which shows that to be the time of life at which assurances were most frequently effected in the Equitable Society previous to the year 1829, and may be taken as a proof that they are most generally wanted at that age, although no such inference could be safely drawn from the records of that or any other office, during a period of twenty years or more, commencing with 1829, on account of the great diversity in the rates of premium required for life assurance by different offices, and in the advantages held out by them, since about 1825 or 1830. The numbers admitted at the four ages 29–32, vary but little. The three first are given in the above specimen of the table, that for the age 32 was 780; they decrease gradually on both sides of that interval of age, so that from the commencement of the 30th to the end of the 33d year of age, appears to be the period of life in which most life assurances are applied for; probably also that in which most first marriages of men are contracted in this country.

There are in the table 70 ages of admission, beginning with 7, and ending with 88; but only ten lives were admitted after completing their 67th year. As the greatest age attained by any life assured, and that by one only, was 94 years completed, there are 88 columns with the ages from 7 to 94 written over them, each divided into four.

Thus, it appears, that in this very valuable table, which had long been wanted before it appeared, and is one of the many important benefits derived by the public from the Equitable Assurance Society; the progress of all the 21,398 lives through the different ages from seven to ninety-four, so long as they respectively remained insured, the respective ages at which they entered the society, and at which they went out of it, whether by death or discontinuance of assurance, are distinctly shewn, and the means of determining the law of mortality amongst the lives are given, even for determining it amongst those separately which were admitted at any one age, so far as their limited numbers will allow. Immediately after this, two other tables, undistinguished for reference either by number or letter, are given; the first exhibiting for each of the four divisions of every column with the age set over it, that age standing in the margin of this table on the same line, the sum of the numbers in that division set against all the ages of admission. The numbers in the first column of this table we consider to be of very little importance in comparison with those in the three other columns; they shew the number of observations of each kind obtained in each year of age, and consequently the different degrees of confidence the rates of mortality derived from them at different ages are entitled to. It shews, that between twenty and seventy-four years of age, the number of observations, or of lives passing into, and in whole or in part through each year of age, was always above 1,000; that number increased from the age of seven where it was forty, to the age of forty-three, where it attained its maximum of 7,725, and then decreased gradually to the age of ninety-four, where there was but one life left which did not reach ninety-five. But the same things were shewn, although not at one view, in table A, where the sum of the numbers in each column standing

against all ages of admission were given; therefore the numbers in that first column might well have been omitted, and the number of admissions at each age substituted for them; or if the first were retained, a column for the number admitted at each age should have been added, for then that table would have exhibited at one view, and in small compass, all the data necessary for determining the law of mortality.

The other small table merely gives the same information as the first, not for each year of age separately but for the interval between seven and ten, and then for every interval of five years of age between ten and ninety-five years.

A table marked B differs much from A both in its contents and value; it is stated to shew "the duration of the lives of those persons *only* who became members of the Equitable Society between September 1762 and January 1st 1829, and who either continued their assurances to the latter date or died during the intervening period;" all those lives the insurances on which were discontinued, having been omitted. But all of those omitted lives were, while insured in the society, subjected to the chances of mortality equally with the others which continued insured till they either survived the period in which the observations were made or became extinct. By the extract given above from table A, it appears that 783 lives were admitted at 29 years of age; but that table shews, that of these, 379 went out of the society during the observations by discontinuance of the assurances on them; the remaining 404 *only* are inserted in table B, as having been exposed to the chances of mortality in that year of age during the observations, and the three deaths which happened in the same year of age, are assumed to have taken place out of 404 instead of 783 persons admitted in the same year of age. The same number, 379 of those admitted at 29 years of age, also went out after the age of 30, which number being taken from 780, leaves 401; 334 of them went out after the age of 31, which, taken from 729, leaves 395; and in this manner table B has been formed from table A. The following extract from table B corresponds with that given above from table A.

Age of admission.	Age 29.		Age 30.		Age 31.	
	Living.	Died.	Living.	Died.	Living.	Died.
25	266	2	257	2	245	5
26	298	2	290	7	276	4
27	340	3	327	5	306	4
28	386	2	376	4	365	4
29	404	3	401	5	395	4
30	...	...	435	2	433	4
31	...	...	...	...	460	2

Let us now consider those lives only which were twenty-nine years of age when admitted, and since the number of deaths among them at that and each of the greater ages was the same according to both tables, whilst the number attaining the age 29, 30, 31
was, according to table A, 783, 780, 729,
——— B, 404, 401, 395,
it is manifest that the mortality, at each age according to table B, will be greater than according to table A, in the ratio of the number attaining that age according to table A, to the number attaining the same age according to table B;[1] that is, at these three ages nearly in the ratio of two to one. But the younger the lives are at admission the greater is the proportion of them who leave the society by discontinuance of insurance; and after the lapse of eight or ten years from the age of admission, the number of lives which leave the society in that way diminishes rapidly as the age increases, so that the two tables (A and B) approximate closer and closer as old age comes on, and differ but little after sixty.

It is also to be borne in mind that the numbers attaining the age of thirty, and dying of that age, are obtained by taking the sum of all the numbers in the first and last divisions respectively of the column in table A with 30 at its head, from seven, the least age of admission, to the age thirty, the mortality in which is the object of inquiry; and the higher in the column any number is, or the less the age of admission, the longer have the lives then thirty years of age been insured, both in table A and B. Hence it is evident that the error in excess of the mortality according to table B in any year of age (thirty for instance) will not be so great as among those lives only which were admitted at that age. And all that is shewn here, with regard to lives admitted at thirty years of age, and attaining that age, applies equally to those admitted at and attaining to any other age.

Those marked C and D are tables of mortality derived from A and B respectively; and two other tables, marked E and F, shew the expectation of life at every age from ten to ninety-seven years according to tables C and D.

After these a valuable table is given, shewing the number of deaths which took place amongst the persons insured in the society during the term of thirty-two years, 1801—1832, in each interval of ten years of age from ten to eighty and those above eighty, by each of forty-three different causes, as certified to the Court of Directors. The whole number of deaths during that term was 4,095, of which there were occasioned

By thirty-seven different diseases	3,449
Natural decay of age	566
Childbirth	4
Accidents	40
Suicide	29
Murder	3
Being slain in war	4
	4,095

This table shows the comparative numbers of deaths by each disease at different ages, and from different diseases in the same interval of age; but not the rate of mortality from each disease in each interval of age; for this purpose, the annual average number of insured lives existing in the society in such interval of age during that term of thirty-two years is necessary, but unfortunately wanting. Lastly, as a supplement to Table A, a small table is given, showing for the intervals of age between 7 and 10, 90 and 97, and in each interval of 10 years between 10 and 90, the numbers living and dying in each of those intervals of age during each of the four years. Upon comparing the numbers living in the same intervals of age at the end of the year 1828 given in Table A, with those in this supplemental table, we infer that it was at the end of the year placed at the head of the column in this table that the numbers stated in that column were living in those intervals of age. But the only information given on the subject, is the word "Living" placed at the head of the column of numbers.

In the year 1832 was published a compilation in 4to, by Mr. Marshall, entitled, *Mortality of the Metropolis*, containing the London Bills of Mortality to the year 1830 inclu-

[1] Here we omit the deduction shewn in the section on the LAW OF MORTALITY to be necessary for the number of lives entering the society remaining insured when the observations terminated, and leaving it by discontinuance of insurance at each age. To make and to explain it here might perplex some readers, and the false views of the subject table B is calculated to give, are here, we trust, sufficiently exposed without it.

sive; with various statistical details taken from the enumeration and parish register abstracts of this country, with a few short notices of a similar kind relating to Spain and Portugal, Prussia, the Netherlands and Sweden, but without any distinction of ages, except for Sweden, and even for that population, only the numbers of deaths in the single year 1820, under one year of age, between one and fifteen, and those above fifteen.

Dr. Forbes's very valuable *Sketch of the Medical Topography of the Hundred of Penwith, comprising the district of the Landsend in Cornwall*, already quoted in this article, was published in the second and fourth volumes of the "Transactions of the Provincial Medical and Surgical Association," in the years 1834 and 1836. It is divided into two parts; and it is only the first chapter of the second part, which is contained in the volume of the Transactions published in 1834, that we have occasion to notice here. The progress of the population is first treated of, and the information on that subject is taken from the population abstracts at the four decennial enumerations of 1801–1831; but keeping the mining parishes separate from the agricultural. There are twenty-five small tables; in the first seven, the numbers of marriages, births, and deaths, are given, and compared with those of all England, and with particular parts of it, without noticing the ages of the deceased; but in the eighteen others the number of deaths in each decade of age from birth to a hundred years, and those above a hundred are given. On these Dr. Forbes makes the following observation: "Abstracts of all the registers in the hundred were made by myself, with the utmost attention to accuracy."

The publication of bills of mortality in Paris commenced during the administration of Colbert, an epoch rendered memorable by so many useful establishments. That great minister proposed to the king to issue an order, that a bill for that city should be printed and published at the end of each month, containing in addition to what is usual elsewhere, the numbers admitted into the hospitals; there were also added short remarks on the character of the seasons, and the principal diseases which had prevailed; with the prices and weights of different kinds of bread, and some other objects of general consumption. The motive of this ordinance was thus expressed: "Estant important au public, pour la santé et pour la subsistance des habitans, d'en connoistre l'estat en tout tems, et d'observer soigneusement les causes qui augment ou diminue le peuple en chacqun des quartiers de Paris, il sera fait, tous les seconds jours du mois, une feuille qui contiendra le nombre des baptesmes, des mariages et des mortuaires du mois précédent et de chacune des paroisses en particulier."

This ordinance was attended to for fifteen years, 1670—1684, but after the death of Colbert, which happened in 1683, it was neglected during twenty-four years, 1685–1708;[1] the publication of the bills was resumed in 1709, and has been continued ever since, improvements having also been introduced into them from time to time.

This information is taken from a "Mémoire sur la Population de la ville de Paris depuis la fin du 17e siècle," in the second volume of a great and important work printed by the French Government, but not for sale, entitled, *Recherches Statistiques sur la ville de Paris et le Département de la Seine; Recueil de Tableaux dressés et réunis d'après les ordres de Monsieur le Comte de Chabrol, conseiller d'état, préfet du département.*

The first volume was published in 1821, in small octavo, and contains sixty-three tables; it is stated in the introduction, that lithography was made use of by the administration in the publication of the tables in that volume, to multiply the applications, and to encourage the exercise of that new art; probably this gave occasion to its being used as above mentioned in the large Swedish tables published in 1829. Three other volumes of this work have been published in quarto, with all the tables printed by types in the usual way; the use of tables for digesting and presenting the information collected is continued throughout the work, which, as is justly observed, admits of an immense number of results being brought together, excludes superfluous dissertations, and facilitates all comparisons. Topography, population, institutions, agriculture, manufactures, commerce, and finances; are all minutely detailed in so many separate chapters; but we have only occasion in this article to attend to the population; and on that subject shall notice principally those parts of the work, where the numbers of annual births, and the numbers both of the people and of the annual deaths, with the ages of the living and those at which the deaths took place, are stated.

An enumeration of the inhabitants of Paris was made in February 1817, and in the first volume, where the results of that enumeration are given; there is also given an extract from a report made to the minister of the interior, by the Count de Chabrol, dated the 3d of July 1818, explaining the manner in which it was effected. He states, that attempts had been made on several previous occasions to ascertain the population of Paris by an effectual enumeration; but that different circumstances had contributed to render the results very inaccurate. He gives reasons for which he considers it indispensable to obtain, not only for each house, but for each separate location, a distinct list with the christian and surname of each person of whatever age, the sex, (shown by the christian name), the state of celibacy, marriage or widowhood, and the condition, profession, or occupation of each; he explains minutely the measures that were taken to carry this into effect, and the checks used to ensure a great degree of precision. To avoid including the same person twice in the enumeration, the place of residence chosen for that of inscription was *the habitation during the night*, which rule was always strictly adhered to; to prevent the effects of changes it was desirable to complete the work as quickly as well might be; and in one month and ten days the enumeration of 657,172 persons was made at their places of residence in the manner stated above. This is called *nominative* enumeration.

But a part of the population from their continual change of place, could not be enumerated so correctly. These were foreigners, or native French subjects then resident in the capital, but without any fixed habitation, travellers, the inmates of twenty-seven hospitals,[2] civil and military, of ten prisons, of forty-three military establishments, of six hundred and ninety-two furnished hotels, of divers other establishments, and the persons with regard to whom the information obtained was insufficient; all of these persons are said to be numbered *collectively*, and no distinction is made either of their ages or sexes.

Of the persons enumerated nominatively, the number of each sex separately in each quinquennial interval of age from birth to thirty years completed, then in each decennial interval to a hundred, and of those above a hundred years of age was given. The whole numbers of them of all ages were these:

[1] As were also those for the three last months of the year 1684; and the bills for 1676 and 1677 are wanting; so that, altogether, there were twenty-seven years from the first publication of the bills, in which their publication was either interrupted or neglected, unless the two missing bills were lost, which is probable.

[2] Under which term we here include les Hospices et les Hôpiteaux.

Males.		Females.		Both Sexes.
Unmarried..	162,843	Unmarried..	175,210	338,053
Husbands...	128,589	Wives.......	129,596	258,185
Widowers...	13,815	Widows.....	47,119	60,934
Totals....	305,247	...	351,925	657,172
Those enumerated collectively amounted to...				56,794
and made the total population within the walls,				713,966
Adding to this the population of the *Hospice de Bicètre*, and of the *Maison de Retraite de Mont-Rouge*, which, though situated without the walls, belong to Paris......................				3,246
we have..				717,212

the whole population of Paris on the first of March 1817. An attempt was made to class according to their ages the persons who were only enumerated collectively, the ways in which the different estimates were made, are explained, and a table (No. 7.) of their results is given; but we consider them to be so uncertain, that we are not aware of any useful purpose they can be applied to, and therefore take no farther notice of them here.

It is also observed that the number of the living under five years of age, even in the nominative census, was much less than it should have been in consequence of the very great number of children which are sent to be nursed in the neighbouring villages, both by their parents and by public establishments, neither the mean number of them, nor the mean duration of their absence from Paris, could be ascertained, and any estimates that could be made on the subject were so uncertain that it would have been useless to state them.

The nominative census was also deficient in numbers after fifty years of age, on account of the number of aged poor who die in the civil hospitals. The approximations to the ages in these appear to be entitled to more confidence than in the rest of the collective census, and for those within the walls of Paris they are given in column sixth, whilst the numbers of the nominative census at the same ages are given in column seventh of table seven; and by them we find that the numbers were

In the nominative census.	In the civil hospitals.
At all ages................657,172	12,596, about $\frac{1}{52}$d part.
Above fifty years of age, 134,104	6,037, about $\frac{1}{22}$d part.

From what has been stated above, it will be evident to those who understand the subject, or who read the next article, that this enumeration, although performed with great skill and labour, does not afford the means of determining the law of mortality in Paris, even if we had the most satisfactory accounts of the numbers of births and of the deaths that took place at all ages.

Paris being for municipal purposes divided into twelve districts called *arrondissements*, distinguished by so many numbers from one to twelve, and each of these into four quarters, Table III. shows for each arrondissement and for each quarter of it (giving also the names of the quarters), the numbers of houses, of families,[1] and of persons, that were ascertained by the nominative census to be in it on the first of March 1817; also for each of the six descriptions of persons separately, mentioned above as those who were numbered collectively, how many persons were so numbered in each arrondissement and in each quarter of it. And in the last two columns of that table, the total number of persons in each arrondissement and in each quarter of it on the first of March 1817, is given; but there is no distinction of age or sex in this table.

Table IV. exhibits the number of the living ascertained by the nominative census to be then in each of the fourteen intervals of age above mentioned, with the distinction of sex and condition as to celibacy, marriage, or widowhood; the totals of which, omitting the ages, we have stated above.

Table V. shows for every 10,000 persons in each of the twelve arrondissements, how many were in each of the same intervals of age, but without distinction of sex or condition. The following tables to the tenth inclusive, relating to the numbers and proportions of the people, we do not think necessary to notice here particularly; the whole number of the tables relating to the population and extent of Paris is twelve, numbered from three to twelve, and including two as first and second supplements to table ten.

We now proceed to those parts of the work which exhibit what the French denominate the *mouvement*, but we call the *progress*[2] of the population; which is shown by statements of the numbers of annual marriages, births, and deaths, during a series of years, with the ages at which the deaths happened.

The volumes these documents are contained in, and the years in which the events recorded took place, are as follow:

No. of Vol.	Published in the year.	Years reported upon.	
I. 8vo.	1821	2	1817 and 1818
II. 4to.	1823	3	1819 — 1821
III. 4to.	1826	2	1822 and 1823
IV. 4to.	1829	3	1824 — 1826

There are able introductions and memoirs prefixed to all the volumes, which it would not be consistent with the objects of this article to notice further here; except the memoir already mentioned on the progress of the population of Paris during the 17th, 18th, and 19th centuries; which we now resume.

Before 1710 the numbers of foundling infants were, or at least can only now be found, recorded, for the years 1670, 1680, 1690, and 1700; but the publication of the bills of mortality having been resumed in 1709, the number of foundlings was stated in them for 1710, and every following year. The sexes were not distinguished either in the numbers of births, deaths, or foundlings, till the year 1745; after which it was always preserved; it was only from the year 1795 that the numbers of still-born children were recorded separately, and we are not informed whether they were previously included among the births or deaths, or both or neither of them. 1806 was the first year in which the illegitimate children were distinguished from the legitimate; they had previously been put together without distinction. This information is taken from the table in the second volume numbered 53, (and the notes that ac-

[1] The French word is *Ménage*, and to render *family* synonymous, we have, we believe, only to extend its meaning to the case of a single person residing and conducting all his or her domestic affairs alone; whether occupying the whole of a house or only a part of it.

[2] The *movement* or *motion* of the population would be the better term if it were admissible in English, as it applies equally whether the number of the people is increasing or decreasing.

company it) showing the numbers from the year 1670 to 1821, with the exception of twenty-six years above mentioned necessarily left blank, and another which was defective.

The progress of the population of Paris during each of the ten years 1817—1826, as exhibited in the four volumes above mentioned, is contained in ten tables. In the first six there is no distinction of ages.

The *first* shows the numbers of births, marriages, and deaths, that took place in each month of the year, without reference to place; and then those which took place in each of the twelve arrondissements of Paris, without reference to the months of the year which they happened in; the sexes being distinguished both in the births and deaths.

The *second* shows the same things in greater detail; the columns of the first table being subdivided in this, so as to show how many both of the births and deaths took place at home, and how many in the hospitals; also, of each of these two descriptions of births, how many of the children were legitimate and how many illegitimate.

The *third* is confined to natural children; and with regard to them, the same information is given as to the sexes, and the months and arrondissements in which they were born; but in addition to this, it is shown how many of them were acknowledged at their birth, and how many were not; also how many were acknowledged by celebration of marriage, and how many after birth, before a magistrate.

The *fourth* shows the number of still-born children of each sex, during each month, and in each arrondissement.

The *fifth* shows the number of marriages in each month and in each arrondissement, which were given without further particulars in the first table; but here, the number of marriages in each horizontal line of that table, is shown to consist of four different numbers of so many different kinds of marriages. Thus:

	1 Between Bachelors and Maids.	2 Widows.	3 Between Widowers and Maids.	4 Widows.	Total as in Table I.
The totals in the city of Paris in the year 1826, were,	6457	368	708	222	7755
In the arrondissement of St. Denis,	732	60	83	26	901
Arrondissement of Sceaux,	584	44	77	27	732
Grand Totals in the capital or department of the Seine.	7773	472	868	275	9388
	8245		1143		
	9388				

Hitherto for the sake of perspicuity, we have taken no notice of the rural arrondissements of Saint Denis and Sceaux; but we add them here, to show the way in which the numbers for them are introduced in all the first six tables, after the totals for the city of Paris are obtained; and by adding them to the totals for the city, the grand or general total is also obtained for the whole of the capital, or department of the Seine. The last four of the ten tables relate to the city of Paris only.

The *sixth* shows the deaths in each month and arrondissement, the same as the first; but each column in the first table is so divided in this, as to show how many of each sex died at home, also how many in the civil, how many in the military hospitals, and how many in prisons. In this and the first table of deaths, the dead bodies deposited at the Morgue within the year, are added to the sum of the deaths both in the different months of the year, and in the different arrondissements within the walls of Paris, to obtain the total number of deaths in the city.

The *seventh* table we consider as being the most valuable of the ten. It shows, for the city of Paris only, the numbers of deaths in the first and second quarters of the first year of age, also in the last half, consequently in the whole of that year; then in every following year of age separately, to that of ten years completed; and after that in every interval of five years of age to a hundred, and those above a hundred; always distinguishing the sexes, and showing the numbers who, in each interval of age, died unmarried, married, widowers or widows.

Were it not for the salutary practice of sending children born in Paris into the neighbouring villages to be nursed; as the numbers of births of both sexes are given, and also the numbers of deaths of both sexes separately in minute intervals of age under ten years; the law of mortality among them might be determined, even independent of enumerations of the living. But under the actual circumstances, that very desirable object cannot be attained.

The *eighth* shows the numbers of violent and accidental deaths, voluntary and involuntary, in each of various ways, which took place in the city of Paris in each month of the year, and in the whole year; the sexes being distinguished in each of the numbers for the whole year, but not for each month.

The *ninth* shows the number of suicides attempted during the year, in the department of the Seine; the number of those attempted which were effectuated, and the number of them which were prevented; with the means of destruction employed, and the presumed motives of suicide. The sexes are also distinguished, and the married from the unmarried.

The *tenth* shows the number of deaths from small-pox in each month of the year, and in each arrondissement in the city of Paris, without distinction of age; also the number of them that took place in each of the intervals of age employed in the seventh table, without distinction of months or arrondissements; the sexes being in all these cases distinguished. Then the number of gratuitous vaccinations during the year, in each arrondissement, is shown. The sexes of the vaccinated were distinguished for the years 1817 and 1818, but not afterwards. Each of the two tables here numbered 9 and 10, was, for the years 1817 and 1818, divided into two; so that the number showing the progress of the population in those two years, was twelve instead of ten.

In addition to these, a table numbered 37, in the first volume, is too curious and interesting to be passed unnoticed here. It was formed from extracts made by *M. Benoiston de Châteauneuf* from the statements of deaths prepared in the mayoralties of the different arrondissements; which statements were founded on the declarations made by the physicians and surgeons who certified the deaths.

The table shows, for each of the four years, 1816—1819, the number of deaths produced in the city of Paris, by each of the following pulmonary diseases: Asthmas, catarrhs, defluxions on the chest *(fluxions de poitrine)*, and consumptions *(phthysies)*; in the spring, summer, autumn, and winter of each year, without distinction of age; but also in each interval of ten years of age from birth to seventy years, between seventy and ninety, and between ninety and a hundred; without distinction of seasons. The total by each of these diseases in each of the four years is also

stated, with the total number of deaths in Paris from all causes during the same year; and the proportion of the mortality from each of those pulmonary diseases to the whole mortality; the sexes being distinguished throughout. No table of that kind, nor of the deaths by other diseases than the small-pox, was inserted in any of the other three volumes. Statements of the annual average progress of the population in each of the arrondissements of Paris during the five years 1817–1821 are given in the third volume, tables 42–50; and for the next following quinquennial period 1822–1826 in the fourth volume, tables 54–62. Table 102 of the second volume shows the comparative riches of the different arrondissements in the city of Paris; it was constructed from the register of personal taxes imposed in the year 1820; that table with the others above mentioned in the first three volumes, were the principal data on which M. Villermé founded his very valuable *Mémoire sur la Mortalité en France dans la classe aisée et dans la classe indigente*, in the first volume of the *Mémoires de l'Académie Royale de Médécine*, tome i. 1828.

In the introduction to the fourth volume of the *Recherches Statistiques* it is stated, that a fifth would terminate the work; and a short account is there given of its intended contents; but in May 1837, when this article was printed, that volume had not appeared.

Statements of the progress of population in Paris and in every department of France, are regularly published in the *Annuaire du Bureau des Longitudes*, also of the population of the different departments, and of their arrondissements and chief towns, but without any notice of the ages. The numbers of deaths in the city of Paris of each sex by the small-pox at the different ages, have also been inserted in the same work, for 1817 and every subsequent year; but not the numbers gratuitously vaccinated.

The ages at which the deaths happened are not given in any of the statements in the *Annuaire*, except those for the city of Paris.

In February 1835 was published at Troyes, the capital of the department of the Aube in France, *Recueil des principaux travaux des Conseils de Salubrité du département de l'Aube*, containing the same kind of information, given in the same manner, but rather more fully respecting the progress of population in Troyes, as is given in the *Recherches Statistiques* for the city of Paris; except that there is no mention made of still-born children, or of the deaths from small-pox, or of the numbers gratuitously vaccinated.

The statements of the deaths in all the intervals of age, are given not only for each year, but for each month of each of the ten years 1821–1830; also in one table, those in each month during the whole term.

These documents were derived from the bills of mortality by Dr. Patin, president of the council for the arrondissement of Troyes.

The population of the place at the commencement of the term was 25,076, at the end of it 23,749, of whom 10,626 were males, and 13,123 females. The ages of the people do not appear to have been distinguished at either of the two enumerations made at the commencement and at the end of the term; neither are the total numbers of the two sexes who were living at its commencement given separately. So that the law of mortality cannot be determined from the data obtained.

The three following tracts relating to the Netherlands, were all published at Brussels in 8vo:

1. In the year 1827 a Memoir on National Statistics, entitled, *Développement des trente et un Tableaux publiés par la Commission de Statistique, et relatifs aux mouvemens de la Population dans les Pays-bas, depuis la creation du Royaume jusqu'a 1824 inclus;* par Edouard Smits, *Sécrétaire de la Commission, &c.* &c.

The tables shew the numbers of persons on the first of January 1815, and on the thirty-first of December 1824, residing in the towns, and in the rural communes separately, for each of the nineteen provinces in the kingdom; with the numbers of them for the whole kingdom of the Netherlands taken together. They also show what the number of the people with the same distinction of town and country residence, was on the first of January in each of those ten years; with their mean number during the first and second halves of that period, and during the whole of the same period; but in these numbers of the people there is no distinction made either of age or sex; the number at the end of 1814 is stated (p. 2) to be *estimated*, and that at the end of each year after it, was found by adding the excess of the births above the deaths in the same year, to the population at the end of the preceding; so that the numbers of the people there stated, are not entitled to much confidence.

The progress of the population is also shewn by statements of the numbers of births, marriages, divorces, and deaths, and the differences between the numbers of births and deaths during each of the ten years for the whole of the kingdom; and for each province during the whole of the ten years, the inhabitants of towns being distinguished from those of the country, and males from females, in all that relates to the numbers of births and deaths. The proportion between the sexes in the numbers both of births and of deaths, and that of the annual births as well as of the annual deaths, and of the difference between them to the whole population, in the towns and the rural communes jointly and separately are given, for the whole term of ten years, the two periods of five years each, and for each year of the whole term.

2. In the same year (1827) *Recherches sur la Population les Naissances, les Décès, les Prisons, les Dépôts de Mendicité, &c. dans le royaume des Pays-Bas*, par M. A. Quetelet, *sécrétaire de la commission de statistique du Brabant-méridional, &c.* M. Quetelet (p. 2) states the population on the 1st of January 1825, to have been estimated at 5,992,666, which falls short of 6,013,478, stated by M. Smits, by 20,812; and that this estimate was founded on two partial enumerations of the people made previously, one under the imperial government, the other about the commencement of the then (in 1827) actual government; and that from these, and the numbers of annual births, the estimate was made in the manner proposed by Laplace.[1] He states that the data they then (in 1827) had, could only be considered as provisional and wanting rectification. There is little more in this tract that we can properly notice here, as it is chiefly on subjects not within the scope of this article; but the note A at the end, by M. Le Baron de Keverberg, contains some good observations on enumerations of the people.

3. In 1832, *Recherches sur la reproduction et la mortalité de l'Homme aux differens ages, et sur la Population de la Belgique*, par MM. A. Quetelet et Ed. Smits, *(premier recueil officiel).* An enumeration of the people in Belgium was made in November and December of the year 1829, but owing to the partial occupation of the provinces of Limburg and Luxemburg, the information obtained respecting them, especially the latter, was incomplete. The whole number of the people on the 1st of January 1830 was found to be 4,064,209, of whom 998,118 were resident in towns, and 3,066,091 in the rural *communes*. The people were throughout classed according to their residence in town or country, their sexes, and their state of celibacy, marriage or widowhood.

The authors state (p. 13) that in the tables of enumera-

[1] *Théorie Analytique des Probabilités*, p. 391, and *Essai Philosophique sur les Probabilités*, p. 45. It was first adopted by the French government in 1802.

tion the ages of the inhabitants were carefully specified; but although we consider this to be of much more importance than any other part of the inquiry, the information they have given on this subject is far from being satisfactory. In every other place of any considerable magnitude where this important and laborious operation has been performed; in Sweden, Spain, Carlisle, Paris, Great Britain, Glasgow, and Philadelphia, a distinct statement of the *absolute* number of persons found to be in each interval of age at the time of the enumeration has been published; and in some cases, as in those of Carlisle, Paris, and Glasgow, the manner of proceeding and the checks employed to ensure a considerable degree of accuracy have been explained. But in the case of Belgium, all information of this kind has been withheld, and the authors have only given us (p. 16) a table shewing the *relative* numbers of the people in the different intervals of age. For every million of them it shews for each sex separately, and for each of forty-seven ages from birth to one hundred years inclusive; how many were above that age, and also how many of these were in a state of celibacy, marriage, or widowhood.

Although the professed object of the authors was to treat of the mortality at the different ages of human life, they have given their readers no information whatever as to the ages at which the deaths took place; nothing in the form of bills of mortality, nor any abstracts from them; they merely state that the data from which they formed the table of mortality they have given (p. 36), were carefully collected during three years from the civil registers of the kingdom.

A very valuable memoir, the result of more than two years' labour, entitled *Recherches Historiques et Statistiques sur la Population de Génève, son mouvement annuel et sa longévité, depuis le 16me siècle jusqu'à nos jours* (1549—1833), by M. Edouard Mallet, was read to the *Société de Physique et d'Histoire Naturelle* of that city on the 18th of November 1834. It is divided into three parts; the first contains all that is known of the population of Geneva, and the successive enumerations of its inhabitants from the sixteenth century to the present time, with some details respecting the extent of the place, its habitations, its climate, and the industry of its inhabitants. The second exhibits the progress of the population from the commencement of the registers in Geneva, in December 1549, to the restoration of the republic at the end of December 1833, a period of 164 years, especially the meritorious but hitherto unpublished labours of Drs. Cramer and Joly; the progress of the population is given year by year, viz. for the deaths from 1549, for the marriages and births from 1693; and some theoretical inferences are drawn respecting the different elements of this population, the continual increase of its longevity and decrease of its fecundity. The third part presents the detailed results of the progress of population in Geneva during the twenty years 1814–1833, from the restoration to the end of the latter year. The necessary length of this memoir prevented the whole of it being published in the second part of the seventh volume of those above mentioned; he therefore gave in that place the third part of it only, but not even that without omitting an explanation of the steps he took in making, himself, extracts from the registers, to render them available for useful purposes. This third part being the result of his own labour, and containing new facts and discussions relative to the progress of the population during that term of twenty years, 1814–1833.

The above is nearly a literal translation of the short preface to that part; although read to the society in November 1834, it was not published till the end of the year 1836; and the whole of the memoir, including what was omitted in the first publication of the third part was inserted in the *Annales d'Hygiène Publique*, No. 33, (being tome xvii. *prem. partie,*) which appeared in January 1837.

M. Mallet shews, that at a remote period the legislature of Geneva considered an exact knowledge of the population of the city a matter of importance, and he has given it at nine different periods of enumeration; the first in the year 1589, when it was 13,000, the last in 1834, when it was 27,177, of whom 12,573 were males and 14,604 females; at the same time the population of the suburbs was 9052. In these enumerations the administration took no account of the numbers of locations or of families, nor of the proportions of the people in the states of celibacy, marriage or widowhood; neither do they appear to have taken any account of the ages of the people at any of the enumerations, which is much to be regretted, as that information would have greatly enhanced the value both of the enumerations and of the extracts from the registers of births, deaths and marriages; it would have enabled us to determine the law of mortality in Geneva, which has not yet been done, although repeatedly attempted and thought to have been effected satisfactorily.

The deaths are certified by a visiting surgeon, who gives an account of them every week to the hospital where the civil registers are kept; and it is from his statements that the general mortuary registers are formed. The births, marriages and deaths that take place in the suburbs are entered in the registers with those of the city till 1791 for the marriages and births, and till 1805 for the deaths. Since 1799 for the marriages, and since 1806 for the births and deaths, those only for the population of Geneva within the walls are stated. The population of the suburbs has seldom been ascertained or stated with that of the city. In the registers of births and deaths the sexes are always distinguished; the abortive and still-born are stated separately; but before the year 1814, at which period M. Mallet took up the bills twenty years afterwards, as in too many other bills of mortality, they were also added to the number of deaths, properly so called, which took place among the living, and were therefore likely to be included among them by incautious or unskilful persons in calculating the rate of mortality.

The mortuary registers of Geneva, as M. Mallet remarks, have been the object of a great and laborious work, which the celebrated economist M. D'Ivernois has lately discovered by chance.[1] This work, the fruit of immense researches in the old registers, for a period reaching so far back as the

[1] The author of this article happened accidentally to contribute to this. In his letter of the 20th March 1834, to Sir Francis D'Ivernois, he requested information respecting the extracts from the mortuary registers of Geneva made by the late Dr. Cramer, which M. Duvillard, in his work on small-pox and vaccination, stated were communicated to him by Dr. Butini; also respecting the labours and publications of Dr. Odier, and others there mentioned, p. 105. In answer, M. D'Ivernois was so obliging as to favour him with three letters dated respectively the 2d and 16th of April, and the 17th of May of that year, with satisfactory information as to where the publications of Dr. Odier on the subject are to be found. In the first is the following passage: "Quant aux ouvrages, ou plutôt aux notes du Dr. Cramer ce n'étaient que des notes manuscrites qu'il laissa à sa mort à son ami le Dr. Butini lequel les communiqua dans le temps à M. Duvillard." In the second; "J'en profite aussi pour vous remercie d'une découverte bien *précieuse* que vous m'avez fait *faire* en me demandant les ouvrages du Dr. Cramer, son petit neveu le C. Cramer, vient de découvrir dans les papiers de famille un manuscrit qui est surement sans parallèle nulle part, rien moins que près de 200 tables de mortalité tenues année par année, et avec une exactitude remarquable pour Génève ville depuis l'origine de nos registers jusqu' en 1768." The third was accompanied by a printed half-sheet, in 8vo, being *Proposition de M. D'Ivernois, lu au Conseil Représentatif dans la séance du lundi* 12 *Mai* 1834, in which he mentions the results of Dr. Cramer's labours as "consigné dans un manuscrit qu'un heureux hazard m'a fait découvrir depuis quelques semaines seulment." That third letter commences thus:

year 1549, and which, from 1560, when their representation of the progress of the population became regular, to the year 1760, contains no less than 115,777 deaths classed according to the ages at which they happened, was performed by Dr. Jean-Antoine Cramer. Periodical recapitulations and general tables give the results to the year 1760; Dr. Cramer continued the bills of mortality from that year till his death in 1775, and left then a continuation of them to the year 1770 inclusive. It was only from the year 1560 that the ages of the deceased were stated in the registers, and they were omitted during the twelve years 1568–1579, as were also those of 1648 individuals who died of the plague in 1615 and 1616.

Dr. Abraham Joly continued the inquiries of Dr. Cramer in the same manner during forty-one years, 1771–1811, and died himself in 1812.

Dr. Louis Odier published, in the *Journal de Génève*, for 9th July 1791, and in the *Bibliothèque Britannique*, for 1797, a *General view of the Mortality at Geneva*, which is nothing more than an abridged reproduction of Dr. Cramer's tables, but unfortunately left it to be inferred that they were the results of his own labours, and that was the impression produced.

But the most important work of M. Odier was a continuation of the labours of M. Cramer for the last forty years, 1761–1800, of the last century, and the first thirteen (1801–1813) of the present.

The other authors who have laboured in the same field of research, besides M. Mallet himself, are MM. De Candolle-Boissier, Serre, Dr. H. Lombard, M. Heyer.

Among many other useful and interesting tables, M. Mallet gives one which shews the progress of the population by giving the number of births, marriages, and deaths for each year, from 1549 to 1813, both inclusive, in the second part of his work; those for the next following period of twenty years in the third part.

We have here given a very imperfect account of this able memoir, which we consider highly creditable to the author's judgment and taste; almost all we have taken from it here is nearly literal translation, as we felt that we could hardly do otherwise without doing worse. Those who take interest in the subject will no doubt refer to the original, which, by being printed in the *Annales de Hygiène*, is easily accessible. We had gotten together the materials for a more lengthened notice of the labours of M. Odier, gathered from the *Bibliothèque Britannique*, but the opportune appearance of M. Mallet's memoir induces us rather to refer to it.

In M. Mallet's account of his own inquiries into the state of the population and mortality during the twenty years 1814–1833, we have the fullest information on every point, in the same manner and to the same extent for Geneva, as it has been given for Paris, in the *Recherches Statistiques*; but whilst these are generally confined to mere tabular statements of numbers and their proportions, with as few observations on them as can well be avoided; M. Mallet accompanies his tables with observations, reasonings, references to other authors, and the results of calculations very clearly stated, that greatly increase their value. As instances of the way in which he shows the uses of his tables, and assists his readers in drawing inferences from them, which will become much more interesting and instructive by being compared with those drawn in the same way from other tables of a similar kind; we give the two following statements: after a table showing the numbers of births of males and females separately, in each of the twenty years, and for the whole term; also distinguishing the legitimate from the illegitimate, he gives the following

Proportion of the sexes.

Boys...	5678	51·9725	100	108·21	13.
Girls...	5247	48·0275	92·39	100	12.
	10·925	100·0000			

M. Mallet justly observes, that the proportion of boys to girls in the births at Geneva, is high in comparison with other places, and higher there in the present than in the last century, when M. Cramer estimated it to be 18 : 17; whilst in France since the restoration, it has been 17 : 16. He also states, that "M. Poisson a fait remarquer qu'il y a dans la proportion des sexes une différence notable entre les enfans légitimes et les naturels: chez ceux-ci, les naissances des filles se rapprochent plus de celles des garçons que chez ceux-la. M. le Professor Prévost a même donné une explication, si non tout-à-fait satisfaisante, du moins très-ingénieuse de ce phénomène. La plus grande proportion des mâles dans les naissances légitimes n'est nulle part plus frappante qu' à Génève. En effet, on trouve:

Legitimate	Boys...	5128	52·151	100	108·99
	Girls...	4705	47·849	91·75	100
		9833	100·000		

Illegitimate	Boys...	550	50·366	100	101·48
	Girls...	542	49·634	98·54	100
		1092	100·000		

M. Mourgue, however, had stated the numbers of births of both sexes separately, with distinction of the legitimate from the illegitimate, in the first part of his valuable memoir on the progress of population in Montpellier, published in the *Mem. de la Soc. Roy. de Médécine, ann* 1780 *et* 1781; and the whole of the memoir was read at a meeting of the French National Institute as above mentioned in 1795; but he made no remark on the difference in the proportion of the sexes between the legitimate and illegitimate births. Mr. Milne in his *Treatise on Annuities*, published in 1815, (article 789) has stated the proportion of the sexes at birth for several places at different times and under various circumstances; with distinction of the legitimate from the illegitimate in Sweden and Finland, and in Montpellier; he also there expressed his opinion, confirmed by subsequent observations, that the difference depends principally upon the age of the parents; the younger the parents, the nearer the proportion of the numbers of their male and female children at birth approaching to equality. What the connexion is, between the cause and effect, is a curious and interesting problem, which has not yet been solved that we are aware of.

In Wales the pressure of the population upon the means of subsistence in a way suited to the wants and habits of the people, is such as, notwithstanding their great disparity in civilization and refinement, to produce great similarity

" Voici un discours dont je vous dois l'hommage car le première idée m'en est venue à la suite des renseignmens que vous m'aviez demandés sur le Dr. Cramer, et qui m'ont fait découvrir dans la poussière d'une grenier le recueil non interrompu de 200 tables de mortalité pour Génève. Il m'a paru mèriter d'être mis en evidence. Mais voilà tout ce que je puis vous envoyer des œuvres de ce modeste ecrivain."

We perfectly agree with M. Mallet in the opinion expressed by him in a note supporting it, from which the following is extracted: " Le travail de M. Cramer a été attribué à M. Odier par divers auteurs, MM. Prévost, Serre, D'Ivernois, Lombard. Pour rendre à chacun ce qui lui est dû, je dois dire qu'il est démontré à mes yeux, que le relevé mortuaire de 1560 à 1760, appartient en propre a M. Cramer. Le beau manuscrit qui le renferme est tout entier de la main de M. Cramer, comme je m'en sais assuré en le comparant à la signature du docteur, dans la registre de la faculté de médécine de Génève. A l'epoque où s'arrête les tables de recapitulation de M. Cramer en 1760, M. Odier n'avoit encore que 12 ans."

between the inhabitants of the principality and those of Geneve *intra muros*, in the proportion of the annual marriages to the population, and of the sexes at birth; which M. Mallet appears not to have been aware of. Whence we *infer* a similar resemblance in the advanced age of marriage, and the small average number of children to a marriage (in Geneva during these 20 years 2¾); the very defective state of the British registers of births rendering them of no use in this inquiry, except in determining the proportion of the sexes at birth, for which they may be used, as, however defective these registers may be, there is no reason to suppose they are more so for one sex than the other.

During the years.	No. of persons to one annual marriage.	No. of males born for every 100 females.
In Wales.		
1811 — 1820	141·636	109·500
1821 — 1830	143·039	110·916
1811 — 1830	142·334	110·207
In Geneva.		
1814 — 1833	141·593	108·990
In England.		
1811 — 1830	121·342	104·277

Dr. Casper's *Contribution to Medical Statistics*,[1] was published at Berlin in 8vo in 1825; it is divided into three parts: the first treats of suicide and its increase in our time; the second, of the poor and of the sick poor in Paris; the third, of the mortality among children in Berlin. The last part contains a variety of tables shewing the numbers of births in different years, distinguishing the legitimate from the illegitimate, and of the deaths that took place among them under fifteen years of age. The numbers of deaths by small pox, and a few other diseases of children, (but not each of those others separately,) both before and after the introduction of vaccination, are given; but no mention is made of their ages, and we need not notice them farther here.

A second volume by the same author was published at Berlin in 8vo in 1835 with two title pages, one being the same as that of the work above mentioned, published ten years before, with the addition of "vol. ii.;" the other, *An Inquiry into the probable Duration of Human Life amongst different classes of the people.*[2]

The second volume contains a great many tables in the text, and seventeen at the end; most of them copied from other works, but some that appear to be original; of which, those most material to notice here, are, 1st. The number of deaths in every year of age, from birth to 104 years completed, of males and females separately, which took place in Berlin during the twelve years 1818–1829, amounting to 36,895 males, and 32,467 females, of both sexes 69,362; these are given in his table of mortality for Berlin at the end of the work, numbered II. 2d. A table given in the text, (p. 106), showing the number of deaths that took place in Hamburg during the seven years 1819–1825, without distinction of sex, in the first and second years of age separately, then those between 2 and 5 and between 5 and 10; after that in every decade of age from 10 to 90, and those above 90 years of age. But the numbers of the people in the different intervals of age not being given in either of those cases, any tables of mortality constructed from the numbers of deaths alone, at the different ages, can be of no value.

In vol. i. part 1, of *The Transactions of the Statistical Society of London*, recently published, there is *A statistical view of the births and deaths in the Prussian States, during the fifteen years* 1820–1834, translated from the German of M. Hoffman, Director of the Statistical Bureau in Berlin, the numbers of births and deaths, with distinction of the sexes, and the mean number of the people without that distinction during that term of fifteen years are given; also the number of deaths during the same term, with distinction of the sexes, between birth and one year of age completed, between 1 and 3, 3 and 5, 5 and 7, 7 and 10, and then in each quinquennial interval of age to 90, and those above 90. But the intervals of age into which the people were distributed in the Prussian enumerations appear never to have been sufficiently minute to admit of their being available for determining the law of mortality. There is a good deal of interesting information in this paper; but the above is all we can with propriety notice here; especially as the translation must be easily accessible to most of our readers; and throughout this article it has been our object to give the most minute accounts of such interesting publications as, to many readers, may be difficult of access; that those who take interest in them may see whether it may be worth their while to procure the perusal of them; and also to assist others in perfecting similar labours which they may be engaged in.

In the first volume (which is statistical) of the work of the Baron of Sedlitz, *On the power of the Prussian Monarchy under Frederic William III.*[3] there is given (p. 284) for each of the seven years 1816–1822, including the military but excluding the inhabitants of Neufchatel, the number of inhabitants of the kingdom, the number of marriages, the whole number of births, and the number of illegitimate births separately, also the number of deaths; but without distinction of age or sex. He also gives the number of inhabitants for two of these years under 14 years of age, between 14 and 60, and above 60, which, however, are included in the statistical view of M. Hoffman.

One of the best bills of mortality we have seen, is prepared by the Board of Health at Hamburg, and published under the name of a Table of Mortality, covering all the four sides of a large folio sheet; and consist in fact of five tables regularly numbered.

I. The first shows the total number of interments and the daily average number, also the total number that took place at each of fifteen different burying places, during each month of the year separately, and during the whole year; without distinction of age or sex.

II. The second shows the same during each month for the abortive and still-born separately; then the deaths properly so called, which took place amongst the living, during each of the four quarters of the first year of age, in the second year, between the ages of 2 and 5, and of 5 and 10 years, then in each decade of age to 100, and those above 100; with the total for each month and for the whole year, of each sex separately, and for both sexes without distinction. There is also a column set apart for those whose ages were not known.

III. The third table consists of two parts, both of which are abstracts from the second; the first showing for each month the number of the abortive and still-born, and also of the deaths under and above ten years of age. The second,

[1] Beiträge sur medecinischen Statistik und staatsarzneikunde.

[2] Die wahrscheinliche Lebensdauer des Menschen, in den verschiedenen bürgerlichen und geselligen verhaltnissen, nach ihren bedingungen und hemmnissen untersucht vom Dr. J. L. Casper.

[3] Die Staatskräfte der Preussischen Monarchie under Friedrich Wilhelm III. 1ster band. Berlin, 8vo, 1828.

besides the number of abortive and still-born, shows the number of deaths in each of the above-mentioned intervals of age. The sexes are distinguished throughout.

IV. The fourth table, besides the abortive and still-born, shows the number of deaths of each sex, and of both without distinction, that took place within the year, both under and above ten years of age, by about eighty different causes, besides those by suicide in various ways, and other violent deaths.

V. The fifth table shows the number of children born in each month of the year, and during the whole year, both alive and dead at birth, with distinction of the sexes of those born alive, but not of the others; that, however, is given for them both in the 2d and 3d tables; the number of twin and triple births are also stated in separate columns.

The only fault we see in this bill of mortality, which, in in other respects, may well serve as a pattern for others, is the most improper practice of including the abortive and still-born children in the totals both of the births and the deaths; they should always be stated, but kept separate, both from those born alive, and from the deaths that took place among the living. The distinction of the legitimate from the illegitimate births with that of their sexes, would also be an improvement, if it could well be made; but we consider it to be much more curious than useful. The author is only in possession of one of these Hamburgh bills, which is for the year 1836. The totals were as follow:

Births.	Males.	Females.	Both sexes.
Abortive and prematurely still-born[1]	85	56	141
Still-born at the full time...	96	81	177
Totals	181	137	318
Born alive	2109	1951	4060
Deaths	2138	1837	3975

No attentive reader can fail to be struck with the difference (so ill understood) in the proportion of the sexes among the three kinds of births; those born alive, the still-born, and the abortions. This bill is but for a single year, but the same kind of difference prevails generally; and can hardly be contemplated by a philosophical mind without exciting curiosity and the desire of further information as to the difference between the sexes, first, in the difficulty of fully entering upon life, and afterwards in retaining it, more strongly marked, as we approach nearer to the period of conception.

In October 1836 appeared, in the 32d number of *Annales d'Hygiène* (tome xvi. part 2), *Considérations Statistiques sur le Royaume de Naples*, addressed to the Royal Institute of France by Dr. Salvatore de Renzi, in which he shews why the population of the kingdom, and consequently the rate of mortality among the people, could not be determined previous to the year 1818. He gives four tables. The first shews for each of the sixteen years 1818–1833, the number of the people, and the numbers of births and deaths which took place among them, in each of the fifteen provinces of the kingdom separately, without distinction of the sexes, and without including Sicily, being able, he states, to assure his readers of their exactness and precision during that period being incontestible.

The number of inhabitants in 1818 was 4,990,380, and at the end of 1833 it was 5,883,273. In his second table, he gives for each of the provinces, and for the whole of the kingdom, the proportions of the annual average numbers of births and of deaths to the number of the people. The following are a few of them:—

Province.	No. of inhabitants out of which one was born annually.	No. of inhabitants out of which one died annually.
Capitanata,	M. 21	26
Principato citra,	m. 29	m. 48
Abbruzzo ultra, 1°,	m. 29	45
—— ultra, 2°,	28	43
—— citra,	24	M. 21
The whole kingdom,	25	36

M. set against a number denotes that the mortality or fecundity is there a *maximum*, and m. that it is a *minimum*, not of those above mentioned only, but of all the provinces in the kingdom. The third table shews in what proportions 1000 inhabitants, and the fourth in what proportions 1000 deaths were, in each province separately, and in the whole kingdom taken together, distributed into the following intervals of age:—between birth and one year completed, between 1 and 8, 8 and 19, 19 and 26, 26 and 41, and those above 41 years of age.

A bill of mortality is published annually for the city of Naples, which contains most of the information contained in other bills of that kind; but is defective in one important point, the statement of the ages at which the deaths took place, those of the inhabitants are not even mentioned, which indeed is too common elsewhere. It states the number of the people at the end of the year it reports upon, and also at the end of the preceding year. The sexes are always distinguished in the enumerations of the people, as well as in the births and deaths; the legitimate are also distinguished from the illegitimate births; the number of twin births, with the sexes, are stated, and how many of them were pairs of boys, how many of girls, also how many of the pairs were children of different sexes; as was also done by M. Mallet and M. Hoffman, in their statements for Geneva and the Prussian states respectively.

The numbers of immigrants into and emigrants from the city, are stated, distinguishing native Neapolitan subjects from those of foreign states; the number of marriages contracted is given, but without any information as to the ages or previous conditions of the contracting parties. The number of deaths at home, and those in the hospitals and other public establishments are stated separately. The proportions also are always stated: as of the births, deaths, and marriages to the population, and of the annual births to the contemporaneous annual marriages, but not minutely; they are expressed in vulgar fractions, instead of decimals, having always the same denominator, as 100 or 1000, which is a great fault. No information is given as to the ages of the people, and the deaths are only stated in the following intervals of age:—between birth and 1 year completed, between 1 and 11, between 11 and 18, 18 and 26, 26 and 41, and those above 41. The only bill for the city of Naples in the author's possession is for the year 1822; it was inserted in the *Giornale del Regno delle due Sicilie*, of the 8th of February 1823. The population at the end of 1822 was 344,716, of whom 163,059 were males, and 181,657 females; at the end of 1821 the number of inhabitants was 341,143. The total number of births in 1822 was 14,233; of deaths, 12,195. The number of deaths in 1822 at ages above 100 years, was 17, and of the deceased 6 were males, and 11 females; the names, residences, and ages of them all are stated; they were all citizens of Naples but three, who came respectively from Procida, Salerno, and Venice, which last, Rosa Romanzo, was the oldest of all, having at-

[1] *Unzeitige und frühzeitige todtgeborne*, that is, untimely and early still-born, by which we presume are meant, the abortive which had never *quickened*, to use a more common than well defined term, and those which died between the time of quickening and the full period of gestation.

tained the age of 107; three other ladies attained each to the age of 104.

In the same Journal, for the 23d of April 1823, a bill of mortality for the city of Palermo during the year 1822, compiled by Dr. Francesco Calcagni, is given. The number of inhabitants at the end of 1821 is stated to have been 160,051, and at the end of 1822, 161,735; but this last was derived from the first number, only by adding to it the excess of the births above the deaths during the year 1822. No useful information is given as to the ages of the deceased, and this bill is in other respects inferior to that for Naples; it differs from that, and all others we have seen, in tracing persons born out of wedlock to their graves, whatever age they may attain, and distinguishing the legitimate from the illegitimate in the numbers of deaths as well as of births. In 1822 the number of deaths of the legitimate was 4476, of whom 2294 were males, and 2182 females; that of the bastards, as they are called, was 418, of whom 151 were males, and 267 females. Of the illegitimate children born in that particular year, 256 were boys, and 307 girls. Out of the 4894 deaths, 16 of the deceased are stated to have attained ages from 97 to 105 years; but no information is given as to the distribution of those 16 persons into or among those last nine years of age.

For these two Italian bills of mortality, the author is indebted to Mr. W. R. Hamilton, who was so good as to send them to him from Naples, when they were published; and he is happy to avail himself of this opportunity to acknowledge his obligations to that gentleman, for the facilities he has afforded him of procuring information from abroad on other occasions.

Of all the statements derived from bills of mortality and enumerations of the people, which we have mentioned, only those for Sweden and Finland, Dr. Heysham's for Carlisle, and Dr. Cleland's for Glasgow, have been given in the proper form, and with sufficient correctness to afford the information, which is the most important object of them all, viz., that which is necessary for determining the law of mortality.

To effect this, it is only necessary to know the mean number of the living and of the annual deaths, in sufficiently small intervals of age, throughout the extent of life, for a period of time sufficient to allow of the accidental fluctuations arising from more or less fruitful years, and other causes, compensating each other: such periods, probably, should not be less than eight or ten years; but the necessary length will depend upon the climate, the number of the people, their general modes of life, and their political circumstances.

These *data* being obtained, it is not difficult to determine the proportion of the annual deaths to the number of the living in each year of age. Then, assuming any number of births, as 1000 or 10,000, it is easy to show how many would die in each year of their age; and, consequently, how many would survive that year; which numbers of survivors and of annual deaths, when arranged in the order of the ages, constitute the desired table of mortality, by which all the most important questions respecting the duration of human life may be easily resolved.

For want of understanding the principles upon which the proper construction of such tables depends, most of the writers on this subject, many of them men of great merit and industry, have taken much pains to little purpose, and after excessive labour, have arrived at false conclusions. Hardly any of them appear to have been aware of the necessity of obtaining the number of the living, as well as of the annual deaths in each interval of age, or that that would greatly enhance the value of Bills of Mortality, by extending their useful applications.

Dr. Price's *Essays on the proper Method of constructing Tables of Mortality*, already mentioned in this article, was intended to show how such tables might be constructed from registers of the *deaths only* at all ages; but the hypotheses he proceeded upon can hardly obtain in any real case; and even if they did, his method would only determine the number of the living in the place, at every age; therefore, if it could be put in practice (which it never can), it would only supersede the necessity of actual enumerations; and, with the numbers so obtained, we should have to proceed as above.

That *Essay* of Dr. Price was an amplification of what Mr. Simpson had previously advanced on the subject, with his accustomed accuracy, and contains many just observations on the defects of the tables of mortality that had previously been published; but so far as it contributed to induce a belief that the determination of the number of the living in every interval of age, by actual enumeration, was not necessary to the construction of accurate tables, it must have done harm.

What is here stated will be found demonstrated in the third chapter of Mr. Milne's *Treatise on Annuities*.

It is desirable that a bill should be published for each year separately, to show how the rates both of mortality and fecundity, vary with the circumstances of the people in different years; and, from these yearly bills, nothing is more easy than to derive others for longer periods.

According to the form A, the births of both sexes in each year will be distinguished, and the born alive from the still-born; the number of marriages will also be given.

In this, and all other cases where those who undertake the formation of such bills are either unable or unwilling to distinguish all the particulars indicated, the reasons for the omissions should be inserted in the spaces set apart for the numbers omitted. The number of still-born children should always be stated separately, and should never be included in the number either of the births or deaths with those who had lived and breathed.

The numbers of deaths of the two sexes in each interval of age, during any year, may, as they are collected from the registers, be conveniently disposed according to the form B; the intervals between five years of age and an hundred, being each five years; and the number dying at each age above an hundred should be particularly specified.

But some persons, who would not take the trouble of forming bills of mortality in which the ages are to be so minutely distinguished, might yet be willing to furnish them with the requisite care, according to the form b, which might still be very useful; and, indeed, from twenty to sixty years of age, intervals of ten years each might do very well.

The value of Bills of Mortality would be greatly enhanced, by inserting in them the contemporaneous wages of labourers in agriculture, and of the workmen employed in the more common kinds of trade and manufacture carried on among the people they relate to; also the prices of the necessaries of life which persons of these descriptions consume the most of; together with any thing uncommon in the seasons or the crops, and every material change in the circumstances of the people.

Enumerations.

The number of the people in the several intervals of age, which we have stated above to be of so much importance, may be disposed in tables exactly similar to B or b, recommended for the deaths; but it is not necessary that the duration of life should be divided into the same intervals for the living as the dead. It is always desirable that the intervals should, in both cases, be small; but yet not so small, as, by the increase of labour, to occasion the numbers being determined with less exactness, or to deter many from engaging in the work. Such intervals should not, however, exceed ten years.

When the bills are given for a certain period, if there be

but one enumeration of the people, it should be made at the middle of the period; if two, at its extremities; and if more than two, it is desirable that they should be made at equal intervals of time throughout the period.

We give no forms here of Bills of Mortality and Fecundity, designed to distinguish legitimate from illegitimate children, or the mortality or fecundity of each month of the year, nor the number of women delivered annually at the different periods of life, nor the diseases the deaths were occasioned by. Neither are the forms here recommended for enumerations of the people, calculated to distinguish the numbers in the different states of childhood, celibacy, marriage, or widowhood; nor the ranks, or professions, or occupations of the people. All these things are curious, and of some use, although, if we except the diseases which the deaths of each sex at the different ages were occasioned by, they are of little value in comparison with the information the forms here given are calculated to convey. And it is of so much importance that that information should be given correctly, that we would willingly forego these minor objects, to avoid dividing and fatiguing the attention of those who undertake the more important part of the task, which is of itself sufficiently laborious.

And those who may be disposed to keep registers, and form bills and enumerations, on a scale so much extended as to include all these particulars, or most of them, and have also the requisite qualifications, will find no great difficulty in preparing the most convenient forms of tables for the purpose. Several forms of that description, with references to others, will be found in Mr. Milne's *Treatise on Annuities*, and in many other works referred to in this article.

A.

During the year 18 .	Males.	Females.	Both.
Born alive..............	449	431	880
Still-born................	13	9	22
Whole number born....	462	440	902
Number of Marriages, 261.			

B.

	Between the							Ages of			
	0 & 1	1 & 2	2 & 5	5 & 10	10 & 15	15 & 20	20 & 25	90 & 95	95 & 100	above 100	Totals.
Males..	210	152						7	4	0	881
Fem.....	180	149						18	10	2	959
Both....	390	301						25	14	2	1840

b.

	Between the Ages of													
	0 & 5	5 & 10	10 & 20	20 & 30	30 & 40	40 & 50	50 & 60	60 & 70	70 & 80	80 & 90	90 & 95	95 & 100	above 100	Totals.
Males..	417	42									7	4	0	881
Fem...	395	47									18	10	2	959
Both...	812	89									25	14	2	1840

The first, second, and fourth of the following tables are good examples of that kind; but for insertion of the deaths of children, we prefer the intervals of age between one and two, and between two and five, to those used in the Swedish tables, viz. between one and three, and between three and five; because the greatest mortality prevails at the earliest ages; and that from small-pox is greatest in the first year of age, while the mortality from measles is greatest in the second year. It is, therefore, desirable to have the means of comparing the rates of mortality in the first and second year of age in registers kept both before and after the prevalence of vaccination.

Information on the diseases and mortality of children is highly desirable; and as their ages at death can generally be stated correctly, if accurate registers were kept of the numbers born alive, and of the numbers of annual deaths at all ages, with the causes of them, the rate of mortality amongst children at every age might thence be determined, and even that produced by each of the principal diseases at each age. It will be seen by our account of the Parisian *Recherches Statistiques*, or by the *Annuaire du Bureau des Longitudes*, that the numbers of deaths of children are given for Paris in much more minute intervals of age than is usual in this country; and by the *Jaarboekje* of M. R. Lobatto, published at the Hague, that for Amsterdam, and also by the *Annuaire de l'Observatoire de Bruxelles*, by M. A. Quetelet, that for that city, they are given in intervals of age still more minute than for Paris. This indeed is the case for more advanced ages, but we consider it as being there of less importance.

The expression we have adopted of the interval of age in which any lives were prolonged, or in which any deaths took place, we consider as at once the most simple and free from ambiguity; yet it has been stated to be ambiguous, an opinion which we conceive can only be held by those who do not clearly comprehend the exact import of the expression. We therefore trust we shall be excused for giving an explanation here, of what we thought could have required none.

The age of every individual being the time that has elapsed since the moment of birth, is at that moment nothing; we therefore express it by 0; and whatever portion we assume for the unit of time, whether an hour, a day, week, month, or year, the age at the expiration of that time from birth will be exactly one such portion; and all individuals of a less age than that, may be properly stated to be between the ages of 0 and 1. Except in infancy, one year is generally taken for the unit of age; a man at the moment of the 25th anniversary of his birth, is precisely 25 years of age, and until the 26th anniversary, he is between the ages of 25 and 26, or, in other words, in his 26th year; although, it being sufficient for common purposes, he is usually stated to be 25 years of age till he attains 26. At the 30th anniversary of the moment of birth, he will be precisely 30 years of age, but cannot continue of that or any other age during any assignable portion of time, however small. So that at the moment a man is enumerated amongst the living, or dies, the probability of his being precisely of any one age that can be expressed by a whole number of years, is infinitely small; and he may always with the greatest strictness and propriety be stated to be between two such ages. Thus, in the case last mentioned, of a man who has attained the 25th anniversary of his birth but not the 30th, he may be properly stated to be between the ages of 25 and 30.

TABLE I.

Showing the number of the people in Sweden who were in each of the under mentioned intervals of age, at the end of each of the four years, 1805, 1810, 1820, *and* 1830.

1805.			Between the Ages of.	1810.		
Males.	Females.	Total.		Males.	Females.	Total.
32,591	32,505	65,096	0 and 1	33,821	33,342	67,163
60,435	60,945	121,380	1 — 3	52,006	52,650	104,656
57,100	57,436	114,536	3 — 5	53,741	54,439	108,180
123,547	122,850	246,397	5 — 10	120,157	120,295	240,452
121,946	120,767	242,713	10 — 15	118,711	117,954	236,665
105,016	107,896	212,912	15 — 20	112,241	114,644	226,885
96,072	104,481	200,553	20 — 25	92,534	106,073	198,607
91,427	98,236	189,663	25 — 30	85,065	97,104	182,169
76,675	85,189	161,864	30 — 35	82,641	91,589	174,230
72,516	81,966	154,482	35 — 40	68,454	76,515	144,969
70,116	78,810	148,926	40 — 45	65,434	75,753	141,187
61,845	69,239	131,084	45 — 50	61,056	69,913	130,969
57,012	64,790	121,802	50 — 55	54,173	63,155	117,328
43.692	51,551	95,243	55 — 60	47,040	55,700	102,740
34,077	41,149	75,226	60 — 65	35,227	44,184	79,411
23,394	31,679	55,073	65 — 70	23,671	30,390	54,061
16,606	23,647	40,253	70 — 75	15,014	20,382	35,396
9,000	13,076	22,076	75 — 80	8,480	12,311	20,791
3,903	6,087	9,990	80 — 85	3,399	5,371	8,770
1,053	1,746	2,799	85 — 90	937	1,711	2,648
235	371	606	90 — 95	184	310	494
38	49	87	95 - 100	18	51	69
4	7	11	above 100	4	7	11
1,158,300	1,254.472	2,412,772	Total.	1,134.008	1,243,843	2,377,851

1820.			Between the Ages of.	1830.		
Males.	Females.	Total.		Males.	Females.	Total.
37,079	36,052	73.131	0 and 1	40,983	40,132	81,115
67,287	67,287	134,574	1 — 3	79,054	79,407	158,461
64,873	64,974	129,847	3 — 5	72,528	72,812	145,340
130,351	131,518	261,869	5 — 10	170,878	169,870	340,748
115,187	115,626	230,813	10 — 15	145,150	145,247	290,397
115,465	116,868	232,333	15 — 20	130,368	132,925	263,293
110,730	114,758	225,488	20 — 25	107,122	110,585	217,707
105,308	111,270	216,578	25 — 30	106,353	110,261	216,614
88,115	97,691	185,806	30 — 35	102,105	106,088	208,193
77,979	87,492	165,471	35 — 40	93,658	100,661	194,319
73,443	83,021	156,464	40 — 45	76,441	87,263	163,704
57,873	66,806	124,679	45 — 50	64,762	76,528	141,290
53,463	63,969	117,432	50 — 55	58,901	70,808	129,709
46,413	57,715	104,128	55 — 60	43,507	54,435	97,942
37,409	48,001	85,410	60 — 65	36,505	48,958	85,463
28,438	38,206	66,644	65 — 70	28,246	39,092	67,338
17,469	24,436	41,905	70 — 75	18,765	27,008	45,773
8,334	12,251	20,585	75 — 80	10,459	16,028	26,487
3,157	5,151	8,308	80 — 85	3,934	6,794	10,728
911	1,699	2,610	85 — 90	1,009	,824	2,833
167	362	529	90 — 95	164	362	526
22	58	80	95 - 100	27	62	89
2	4	6	above 100	2	11	13
1,239,475	1,345,215	2,584,690	Total.	1,390,921	1,497,161	2,888,082

TABLE II.

Shewing the annual average number of deaths that took place in each of the undermentioned intervals of age in Sweden during each of the five quinquennial periods undermentioned.

Between the ages of	During the years 1806–1810.			During the years 1811–1815.			During the years 1816–1820.			During the years 1821–1825.			During the years 1826–1830.			Between the ages of
	Males.	Females	Total.	Males.	Females	Total.	Males.	Females	Total.	Males.	Females	Total.	Males.	Females	Total.	
0 and 1	8443	7104	15547	8345	6958	15303	8209	6754	14963	8316	6887	15203	9125	7563	16688	0 and 1
1 — 3	3514	3323	6837	3256	3078	6334	3048	2735	5783	2798	2550	5348	3164	2883	6047	1 — 3
3 — 5	1647	1564	3211	1164	1130	2294	1144	1096	2240	1001	975	1976	1279	1218	2497	3 — 5
5 — 10	1949	1774	3723	1213	1168	2381	1205	1099	2304	981	954	1935	1350	1222	2572	5 — 10
10 — 15	1179	1023	2202	740	687	1427	615	592	1207	548	549	1097	647	606	1253	10 — 15
15 — 20	1030	979	2009	741	753	1494	673	675	1348	567	578	1145	636	626	1262	15 — 20
20 — 25	1288	1014	2302	980	855	1835	905	851	1756	830	691	1521	940	760	1700	20 — 25
25 — 30	1228	1095	2323	949	859	1808	886	852	1738	909	779	1688	1142	881	2023	25 — 30
30 — 35	1213	1158	2371	1063	1012	2075	871	893	1764	953	831	1784	1355	1052	2407	30 — 35
35 — 40	1234	1213	2447	1084	1042	2126	1025	1057	2082	933	876	1809	1418	1143	2561	35 — 40
40 — 45	1386	1370	2756	1178	1085	2263	1134	1055	2189	1153	965	2118	1477	1176	2653	40 — 45
45 — 50	1567	1390	2957	1386	1142	2528	1139	989	2128	1180	896	2076	1609	1230	2839	45 — 50
50 — 55	1881	1736	3617	1597	1399	2996	1422	1294	2716	1253	1033	2286	1716	1411	3127	50 — 55
55 — 60	1951	1887	3838	1684	1629	3313	1565	1498	3063	1461	1314	2775	1645	1508	3153	55 — 60
60 — 65	2103	2276	4379	1931	2020	3951	1819	1920	3739	1668	1744	3412	1966	2060	4026	60 — 65
65 — 70	1857	2175	4032	1811	2090	3901	1827	2120	3947	1686	1885	3571	2045	2346	4391	65 — 70
70 — 75	1835	2322	4157	1604	2011	3615	1683	2087	3770	1692	2002	3694	2034	2527	4561	70 — 75
75 — 80	1506	2106	3612	1218	1645	2863	1177	1548	2725	1209	1573	2782	1640	2243	3883	75 — 80
80 — 85	924	1378	2302	775	1150	1925	713	1085	1998	707	1001	1708	957	1386	2343	80 — 85
85 — 90	378	619	997	303	511	814	310	510	820	269	443	712	322	561	883	85 — 90
90 — 95		...	...	75	156	231	66	136	202	76	152	228	72	156	228	90 — 95
95 – 100	93	187	280	...	1	1	15	30	45	11	31	42	15	37	52	95 – 100
above 100		...	...	...	...	...	1	3	4	2	3	5	1	5	6	above 100
Total...	38,206	37,693	75,899	33,097	32,381	65,478	31,452	30,879	62,331	30,203	28,712	58,915	36,555	34,600	71,155	...Total.

M. Leyonmarck observes that "the mortality during the five years, 1806—1810, was greater than it is stated in this table, owing to the lists of those who died in the service during the war, not having been so accurately made out as they ought to have been."

In the table sent to the author, from which the above has been copied, the average number of each sex in each interval of age was given in years and tenth parts of a year; and that given here in each case is the nearest whole number, whether greater or less: the difference is obviously of no importance.

TABLE III.

Shewing the number of Deaths that took place in Sweden from each of the causes, and in each of the years under mentioned.

Year.	Child-birth and mis-carriage.	Small Pox.		Measles.		Scarlet Fever.		Hooping Cough.		Putrid Fever.	
		Males.	Females	Males.	Females	Males.	Females	Males.	Females	Males.	Females.
1806	646	745	717	219	227	18	18	2274	2772	1369	1328
1807	657	1013	1116	251	249	35	30	1194	1435	860	898
1808	643	920	894	1275	1211	102	84	276	287	6088	5371
1809	648	1219	1185	825	749	201	191	313	315	5792	5711
1810	700	425	399	163	157	48	42	435	523	4535	4473
Total,...	3294	4322	4311	2733	2593	404	365	4492	5332	18644	17781
Average,...	658·8	864·4	862·2	546.6	518·6	80·8	73	898·4	1066·4	3728·8	3556·2
1811	761	337	361	140	161	During these ten years Scarlet Fever was not separated from other fevers.		987	1155	3578	3626
1812	672	215	189	136	113			1630	1828	1050	1051
1813	532	265	282	344	289			953	1174	3418	3195
1814	580	161	147	2096	2107			461	551	619	595
1815	636	250	222	885	883			532	642	636	575
Total,...	3181	1228	1201	3601	3553			4563	5350	9301	9042
Average,...	636·2	245·6	240·2	720·2	710·6			912·6	1070	1860·2	1808·4
1816	606	343	347	240	186			792	839	473	458
1817	644	125	117	243	234			947	1123	863	867
1818	649	138	167	229	241			598	747	1564	1509
1819	624	80	81	772	784			810	991	2536	2356
1820	647	71	72	1614	1515			709	823	469	468
Total,...	3170	757	784	3098	2960			3856	4523	5905	5658
Average,...	634	151·4	156·8	619·6	592			771·2	904·6	1181	1131·6
1821	695	22	15	3426	3498	88	88	1363	1627	499	531
1822	736	3	8	318	332	118	125	1149	1301	467	447
1823	694	21	18	169	140	100	91	681	673	89	85
1824	534	348	270	190	175	178	172	723	790	324	312
1825	567	685	558	162	161	125	103	1043	1228	128	117
Total,...	3225	1079	869	4265	4306	609	579	4959	5619	1507	1492
Average,...	645·2	215·8	173·8	853	861.2	121·8	115·8	991·8	1123·8	301·4	298·4
1826	601	357	268	209	187	191	165	1477	1584	195	200
1827	669	294	306	245	201	187	202	1244	1477	80	67
1828	673	133	124	2061	1874	369	370	979	1138	108	79
1829	718	34	19	3062	2933	110	111	1031	1053	68	60
1830	623	58	46	285	239	70	59	1015	1130	86	82
Total,...	3184	876	763	5862	5434	927	907	5746	6382	537	488
Average,...	636·8	175·2	152·6	1172·4	1086·2	185·4	181·4	1149·2	1276·4	107·4	97·6

Mortality, Bills of.

TABLE III. (CONTINUED).

Year.	Infants stifled in Bed.		Murdered.				Executed according to law.		Suicide.				Drowned.		By various other casualties.	
			Children.		Adults.				By ardent spirits.		In other ways.					
	Males.	Females	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.	M.	F.
1806	209	237	1	4	18	1	0	1	13	1	57	26	659	95	431	150
1807	173	182	1	3	15	2	4	1	18	1	69	21	691	128	479	145
1808	196	218	19	7	19	11	3	2	10	2	54	34	541	136	510	165
1809	169	172	4	3	18	8	3	2	6	1	48	16	495	102	515	162
1810	190	157	5	4	23	2	3	3	20	0	62	12	615	113	451	145
Total,...	937	966	30	21	93	24	13	9	67	5	290	109	3001	574	2386	767
Average,	187·4	193·2	6	4·2	18·6	4·8	2·6	1·8	13·4	1	58	21·8	600·2	114·8	477·2	153·4
1811	192	189	4	3	26	4	10	4	19	0	70	29	756	153	444	116
1812	232	229	13	5	12	3	6	0	10	1	53	23	568	119	389	146
1813	186	158	5	3	11	4	8	2	3	0	58	21	631	146	441	140
1814	185	183	3	4	12	3	4	3	15	1	74	34	618	137	438	118
1815	166	188	5	4	20	3	6	3	13	4	60	15	636	124	406	113
Total,...	961	947	30	19	81	17	34	12	60	6	315	122	3209	679	2118	633
Average,	192·2	189·4	6	3·8	16·2	3·4	6·8	2·4	12	1·2	63	24·4	641·8	135·8	423·6	126·6
1816	199	221	4	3	23	3	8	1	20	1	87	22	643	156	449	127
1817	203	167	7	5	17	4	3	1	13	0	96	27	670	167	421	129
1818	178	136	4	3	20	8	12	3	18	1	102	27	652	147	422	120
1819	152	143	8	2	25	16	5	0	8	0	95	16	819	144	402	149
1820	170	151	8	3	22	4	14	3	16	0	117	21	714	136	450	127
Total,...	902	818	31	16	107	35	42	8	75	2	497	113	3498	750	2144	652
Average,	180·4	163·6	6·2	3·2	21·4	7	8·4	1·6	15	0·4	99·4	22·6	699·6	150	428·8	130·4
1821	203	178	8	9	29	8	4	1	42	3	114	35	802	144	609	226
1822	175	177	5	5	30	13	7	1	25	2	113	40	1059	174	500	176
1823	224	204	7	9	23	9	8	3	38	5	119	32	876	184	499	157
1824	174	191	3	4	30	2	5	1	28	5	122	30	1000	205	514	205
1825	218	197	7	3	32	2	6	3	33	9	115	35	1006	179	574	134
Total,...	994	947	30	30	144	34	30	9	166	24	583	172	4743	886	2696	898
Average,	198·8	189·4	6	6	28·8	6·8	6	1·8	33·2	4·8	116·6	34·4	968·6	177·2	539·2	179·6
1826	181	181	4	6	25	4	10	1	31	2	138	33	1039	177	568	158
1827	162	168	10	3	23	3	12	4	21	2	115	29	741	151	506	160
1828	197	187	6	3	19	9	14	0	47	3	158	34	980	169	617	167
1829	250	251	10	6	29	5	11	2	50	12	154	27	797	136	635	154
1830	212	197	13	4	30	4	14	5	39	7	153	42	836	151	546	150
Total,...	1002	984	43	22	126	25	61	12	188	26	718	165	4393	784	2872	789
Average,	200·4	196·8	8·6	4·4	25·2	5	12·2	2·4	37·6	5·2	143·6	33	878·6	156·8	574·4	157·8

In the copy received by the writer of this article, the deaths from ardent spirits were put between the drowned and the other casualties; and the diseases were not arranged in the order in which they stand here.

TABLE IV.

Shewing the number of Persons who died in the Kingdom of Norway in each of the undermentioned intervals of age during the term of Nine years which commenced with 1824, and ended with 1833.

Between the ages of	Males.	Females.	Both sexes.
0 and 5	38,362	32,500	70,862
5 — 10	3,753	3,349	7,102
10 — 20	4,377	3,964	8,341
20 — 30	6,589	5,694	12,283
30 — 40	6,645	6,602	13,247
40 — 50	6,725	6,431	13,156
50 — 60	8,378	7,569	15,947
60 — 70	11,023	11,753	22,776
70 — 80	11,744	14,501	26,245
80 — 90	6,396	9,134	15,530
90 — 100	1,024	1,761	2,785
above 100	52	102	154
at all ages,...	105,068	103,360	208,428
The numbers, in the same time and place, of children born alive, were..........	181,712	172,784	354,496
Stillborn,............	...	...	11,438
Thus it appears that the excess of the number born alive above the number of deaths, was.......	76,644	69,424	146,068

II.—MORTALITY, LAW OF.

The Law of Human Mortality is that which determines the proportion of the number of persons who die in any assigned period of life, or interval of age, out of a given number of persons who enter upon the same interval; and, consequently, the proportion of them who survive that interval.

Tables showing how many out of a great number of children, as 10,000, or 100,000, born alive, die in each year of their age; and, consequently, how many complete each year; exhibit this law through the whole extent of life, and are called *Tables of Mortality*.

This section is divided into three parts. In the *first*, we deliver the history of this branch of knowledge, with as much brevity as appears to be consistent with the chief object, which is that of conveying correct and useful information.

In the *second part*, we demonstrate the whole theory by common arithmetic.

In the *third part*, a new table of mortality is given, constructed on the principles previously explained; some observations are made on the comparative merits of the different tables that have been published; which were purposely omitted in the historical part, when the tables they relate to were mentioned, to avoid discouraging such readers as might not be previously acquainted with the theory; and the faults are explained, which render most of those tables really of no use, since others, more correct, have been constructed.

Part I.—*History.*

The first table of mortality was constructed by Dr. Halley, from the Mortuary Registers of Breslau, for five years ending with 1691; and was inserted in his paper on the subject in the *Philosophical Transactions* for the year 1693, with many judicious observations on the useful purposes to which such tables may be applied.

No further information of this kind was communicated to the public, until William Kersseboom of the Hague published there three tracts on the subject (in 4to.) The first, dated March 1, 1738, was entitled, *Eerste Verhandeling tot een Proeve om te weeten de probable menigte des volks in de provintie van Hollandt en Westvrieslandt.* The second, dated May 15, 1742, *Tweede Verhandeling bevestigende de Proeve om te weeten de probable menigte des volks in de provintie van Hollandt en Westerieslandt;* and the third, dated August 31, 1742, *Derde Verhandeling over de probable meenigte des volks in de provintie van Hollandt en Westvrieslandt.*

A good account of the first of these tracts has been given by Mr. Eames, in the *Philosophical Transactions* for 1738; and rather a meagre one of the other two, by Mr. Van Rixtel, in the same *Transactions* for 1743. It is therefore unnecessary to repeat here, any thing contained in those accounts; but as they give no satisfactory information concerning the construction of Mr. Kersseboom's table of mortality (which he called a *Table of Vitality*), it will be proper to supply so material a defect in this place.

In his first tract, the author informs us that he constructed his table from registers of many thousand life-annuitants, in Holland and West Friesland, which had been kept there from 125 to 130 years previous to the date of his publication; and showed how many of the nominees, or lives the annuities depended upon, were, at the time of their nomination, under one year old, between one and two, between two and three, and so on for all ages.

An exact account was also kept of the age at which each life of every class failed; whence it clearly appeared, what degree of mortality prevailed at every age above one year. But because very few children were nominated at or near their birth, he could not, from these registers, determine the mortality under one year of age. He therefore had recourse to mortuary registers and other observations; from exact accounts of which he found, with sufficient certainty, as he says, that out of 28,000 born alive, 5500 died under one year. He also informs us, that, for this purpose, he made use of the observations of divers learned men in England and elsewhere, especially Major John Graunt's, upon the number of the people and the rate of mortality; and upon taking an average of the whole, he found it to differ but little from that just stated.

And this appears to be the only ground for the assertion made by most writers on this subject (probably copying from each other without having seen the original work), that Kersseboom's Table of Mortality was constructed from observations made upon annuitants in England as well as in Holland; also, that it was formed partly from observations made upon the inhabitants of some Dutch villages.

He first published his Table of Mortality in his second Tract, and in his third, he gave abstracts of the registers from which it was constructed. These were contained in twenty-nine tables, twenty-two of which were for the two sexes separately; in the rest the sexes were not distinguished; and the ages at which the lives failed were generally given to the exactness of half a year.

The numbers of lives, whose current year of age at the time of their nomination was given precisely in these tables, were,

Males separately	1843
Females separately	1769
Males and Females, without distinction of sex	1536
Total	5148

And none of these nominees were above twelve years of age at the time of their nomination.

These, however, are only specimens of M. Kersseboom's labours. He says there were so many lives in the registers, that he had not the courage to undertake extracting the necessary particulars for more than 50,000 of them; and in that, he was greatly assisted by his friend Thomas von Schaak. Of all the lives, not more than 1 of 120 was past 55 years of age at the time of nomination.

Nicholas Struyck, in his *Aanhangsel op de Gissengen over den staat van het Menschelyk Geslagt, en de Uitreekening der Lyfrenten*, published at Amsterdam in 1740, at the end of the quarto volume, commencing with his *Inleiding tot de Algemeene Geographie*, gave, from registers kept at Amsterdam for about thirty-five years, two tables of observations made upon the duration of the lives of 794 males, and 876 female annuitants separately; and two tables of mortality he had constructed from them for the two sexes; both beginning with five years of age. These two, taken together, differ but little from that of Dr. Halley; they represent the mortality to be considerably greater than Kersseboom's: having been constructed from so few observations, they are not entitled to much confidence, and appear to have been very little known or attended to.

This work of Struyck gave occasion to the publication, in the same year, of a small tract in quarto, by Kersseboom, entitled, *Eenige Anmerkingen op de Gissengen over den staat van het Menschelyk Geslagt*, &c. wherein he accused Struyck of plagiarism, with but too much appearance of justice.

Neither Kersseboom nor Struyck gave any information as to the manner in which they formed their tables of mortality from the observations on which they were grounded. M. Kersseboom informs us, that he submitted his table to Professor S'Gravesande, some years previous to its publication, and obtained his approbation of it for calculating the values of annuities on lives.

In the year 1742, Mr. Thomas Simpson, in his *Doctrine of Annuities*, (see the article ANNUITIES) gave a table of mortality for London, being the same that had previously been constructed by Mr. Smart, at twenty-five and all the greater ages, but corrected at all ages under twenty-five years, on account of the greater number of strangers who settle in London under that age, which occasioned, till the commencement of the present century, a constant excess of the burials above the births. This correction Mr. Simpson made by comparing together the numbers of christenings and burials; and observing, by means of Dr. Halley's table, the porportion between the mortality in London and Breslaw above twenty-five years of age.

In 1746, M. Deparcieux published (at Paris in 4to,) his *Essai sur les Probabilités de la durée de la Vie Humaine*, in which he gave six new and valuable tables of mortality; one of them constructed from the lists of the nominees in the French Tontines, principally those of the years 1689 and 1696, and the rest from the mortuary registers of different religious houses; four of these showing the mortality that prevailed amongst the monks of different orders, and the fifth, that which obtained amongst the nuns in different convents of Paris. Those for the monks and nuns, with the exception of the tables of Struyck, mentioned above, were the first ever constructed for the two sexes separately.

The *Essay* of M. Deparcieux is written popularly, and with great perspicuity; he has given the most satisfactory accounts both of the *data* his tables were constructed from, and the manner of their construction.

In his thirteenth table, he included with the five tables of mortality of his own construction; that of Mr. Smart for London, as corrected by Mr. Simpson, Dr. Halley's, and M. Kersseboom's, together with the expectation of life *at*, or its average duration *after* each age, both according to his own and M. Kersseboom's table for annuitants, and for every fifth year of age according to each of the other tables; the fractional parts of a year being always expressed in months, and not in decimals.

Dr. Halley first, and Struyck after him, had given the *probable duration of life* after several ages, according to their respective tables, that is, the term at the expiration of which, the persons now living at any proposed age, will be reduced by death to one-half their present number.

But Deparcieux appears to have first given the *average duration of life* after any age, and showed how to calculate it correctly from tables of mortality. On account of the scarcity and value of M. Deparcieux's *Tables of Mortality*, Mr. Milne has reprinted them, with the expectations of life just mentioned, in his *Treatise on Annuities*, with a short account of their construction; it is therefore unnecessary to pursue the subject further here.

In 1760 M. Deparcieux published (at Paris in 4to) his *Addition à l'Essai sur les Probabilités de la durée de la Vie Humaine*, with five tables; three of them relating to life annuities deferred on a peculiar plan, we consider to be of no interest or value at this time: the two others are tables of mortality constructed from statements of the numbers of deaths that took place at different ages, without knowing the numbers of the living at the same periods of life. He obtained the data for the first of them from a clergyman on the frontiers of Normandy and Perche, whose accuracy in all he undertook, he could rely upon; and who gave him the names of the parishes from the registers of which he had extracted the information; but strictly enjoined him not to disclose his name in the event of his making use of

the documents. In these the sexes were not distinguished.

The other table of mortality M. Deparcieux constructed from statements sent to him by M. Wargentin of the numbers of deaths of males and females separately, which took place in the different intervals of age in Sweden and Finland, during the three years 1754, 1755 and 1756. Those two tables have the same faults as others constructed from similarly defective data; and we consider them to be of no value.

M. Deparcieux states, (p. 28) that in 1744, he suggested to M. Aubert, the commissary who at that time prepared the Bills of Mortality for Paris, the expediency of distinguishing the sexes in the columns of births and deaths, which had not been done previously, but was in consequence of this commenced with the year 1745, and has been continued ever since, as we have already observed in our account of the Parisian *Recherches Statistiques*.

M. de Buffon, at the end of the second volume of his *Histoire Naturelle*, published in 1749, inserted a table of mortality that had been constructed by M. Dupré de Saint Maur, from the registers of twelve country parishes in France, and three parishes of Paris; which M. de Buffon informs his readers that he inserted in his work the more willingly, since these were the only kind of documents, or combinations of them, from which the probabilities of life among mankind in general, could be determined with any certainty. Yet this was a very faulty table, and the numbers of annual deaths were so injudiciously distributed, according to the ages, that it often represented the mortality in one year of age to be three or four times as great, and in some cases, six times as great, as in the next year. Some remarks of M. Kersseboom on this table may be seen in the *Philosophical Transactions* for 1753. M. de Saint Cyran corrected some of its most obvious errors, and inserted both the original and his corrected copy in his *Calcul des Rentes Viagères*. (Paris, 1779, in 4to.)

Mr. Simpson, in the *Supplement* to his *Doctrine of Annuities*, published in 1752, gave some further explanations of the corrections he had made in Mr. Smart's table of mortality for London; and made some very judicious observations on the difficulties that attend the construction of tables of mortality from the mortuary registers only, of large towns.

In the *Nouveaux Mém. de l'Acad. Roy. de Berlin* for the year 1760, there is a paper by the celebrated Euler, entitled *Recherches générales sur la Mortalité, et la Multiplication du Genre Humain*, wherein the subject is treated algebraically. He assumes that the population is not affected by migration, and that the annual births and deaths are always as the contemporaneous population; consequently, that the number of the people increases or decreases in geometrical progression. Then he gives several theorems exhibiting the relations that would obtain between the annual births and deaths and the population, and determines the law of mortality upon these hypotheses, but does not shew how it may be deduced from actual observations independent of hypotheses; neither does he undertake the construction of any table of mortality, but, by way of example, gives that of M. Kersseboom, with the changes of the numbers which become necessary, in consequence of his altering the radix from 1400 annual births to 1000.

Süssmilch took great pains in collecting the numbers of annual deaths in the different intervals of age, which he published in his *Göttliche Ordnung;* and four tables of mortality formed from these *data* are to be found in the same work; that in the second volume (§ 461), which has many imperfections, was formed by himself; the three others, being the 21st, 22d, and 23d, at the end of the third volume, were constructed by his commentator Baumann, according to the more correct method of Lambert.

The first edition of Dr. Price's *Observations on Reversionary Payments*, appeared in 1771, containing his observations on the proper method of constructing tables of mortality from bills which shew the numbers dying annually at all ages, and three new tables of mortality constructed from the London, Norwich, and Northampton bills.

The second edition of the same work was published in 1772, and contained, in the *Supplement*, much interesting and valuable information which did not appear in the first, together with five new tables, intended to exhibit the law of mortality that obtained, 1st, in the district of Vaud, in Switzerland; 2d, in a country parish in Brandenburg; 3d, in the parish of Holy Cross, near Shrewsbury; 4th, at Vienna; 5th, at Berlin. The first formed from bills of mortality given in the *Mémoire* of M. Muret; and the 2d, 4th, and 5th, from those given by Süssmilch in his *Göttliche Ordnung;* the 3d was from the parish register only of Holy Cross. But we consider none of those tables as now of any value, on account of the defects in the *data* from which they were constructed.

At the end of the first volume of the work of J. H. Lambert, entitled, *Beiträge zum Gebrauche der Mathematik und deren Anwendung*, published at Berlin in 1765, 8vo, he gave a chapter on the certainty of inferences deduced from observations and experiments; and the example with which he concluded the illustration of his theory, was the deduction of the law of mortality in London from the bills of mortality there; by means of a curve, of which the absciss being proportional to the age, the corresponding ordinate was proportional to the number of survivors of the same age.

In the third volume of the same work, published in 1772, the ingenious author treated the subject at much greater length: x being the age, and y the corresponding ordinate to the curve of mortality for London, proportional to the number of survivors of that age out of a given number (10,000) born alive, he gave this equation to the curve,

$$y=10{,}000\left(\frac{96-x}{96}\right)^2-6176\left(e^{-\frac{x}{13\cdot682}}-e^{-\frac{x}{2\cdot43114}}\right),$$

(e being the number of which unit is the hyperbolic logarithm), which determined the numbers in the table of mortality very near the truth, until 96 years of age, beyond which it was not intended to be used.

M. Lambert also constructed a table by which he intended to exhibit the law of mortality that prevails among mankind in general, from the 23d and 24th tables in the second volume of Süssmilch's *Göttliche Ordnung*, which gave the numbers of deaths, in the different intervals of age, in seventeen country parishes in the mark of Brandenburgh, and from the London bills for thirty years; supposing, with Süssmilch, (*Gött. Ord.* t. i. § 34), that the country people are double the number of those residing in towns.

By an extract of a letter from M. Lambert to Gaeta and Fontana, given in their Italian translation of Demoivre's *Treatise on Life Annuities, (Discorso Preliminare*, part iii.), it appears, that all his attempts to find *à posteriori* an equation which should determine the relation between the age and the number of survivors in this last table, proved fruitless; the formulæ he arrived at having been either too long and intricate, or too incorrect. This is the less to be regretted, since there is no doubt that M. Lambert's table did not represent the true law of mortality, as he made no allowance for the effect of the increase of the people by procreation; and it is singular he did not see that that law might be correctly determined from the numbers of the living, and the annual deaths at all ages in Sweden and Finland, given in M. Wargentin's paper in the *Stockholm Transactions* for 1766, which paper he himself quotes.

Lambert appears to have first demonstrated clearly the principal properties of tables of mortality, in doing which he made use of the differential and integral calculus; but

as he could not determine the equation to the curve of mortality, that resource did not avail him much.

Flourencourt treated this subject algebraically in the third chapter of his *Political Arithmetic*,[1] where he gave a perspicuous view of it, as it had been previously treated by Euler and Lambert; but added nothing himself that was original, except three new tables of mortality; one for males, another for females, and a third for both sexes without distinction; deriving his data in each case from the *Göttliche Ordnung* of Süssmilch. He also gave a new copy of the table of mortality M. Deparcieux had constructed from the registers of the nominees in the French tontines; assuming 10,000 for the radix, and inserting the numbers under three years of age, nearly according to M. Kersseboom's table; this, however, does not differ materially from the original table of Deparcieux.

The fourth edition of Dr. Price's *Observations on Reversionary Payments* was published in the year 1783, and contained new tables of mortality for Warrington and Chester, also for all Sweden and Finland, and for Stockholm separately, in which the sexes were distinguished. Those for the whole kingdom were constructed from enumerations of the living, and registers of the annual deaths, in each interval of age, during twenty-one years; those for Stockholm during nine years. The tables for Sweden and Stockholm were the first ever constructed from the data that are requisite to determine the law of mortality among the bulk of the people, and were sufficiently accurate representations of that law, for the times and places in which the observations were made.

In a paper of M. Henrich Nicander, inserted in the *Transactions of the Royal Academy of Sciences* at Stockholm, for the first quarter of the year 1801, he gave two tables of mortality for all Sweden and Finland, in which the sexes were distinguished, but they were not properly constructed; and the mean duration of life which he gave in them at each age, was very erroneous, especially in early life. In that paper he asserted, without offering any demonstration or proof, that, in what we have called the curve of mortality above, if an ordinate be drawn through the centre of gravity of the portion of the area cut off by the ordinate at any assigned age, on the side of the more advanced ages, the part of the base, or of the axe of the abscisses, intercepted between these two ordinates, will measure the mean duration of life after such assigned age. And the mean duration of life after each age, which he has given, was determined in this manner.

Mr. Milne's *Treatise on Annuities and Assurances* was published in the year 1815; and, in the third chapter of that work, the construction and properties of tables of mortality are fully treated of.

In the second volume of the same work, three new tables of mortality are given; one constructed from very accurate observations made at Carlisle, by Dr. Heysham, who preserved the bills of mortality of the two parishes, which include that city and its environs, and supplied their deficiences with great care, together with correct accounts of two enumerations of the inhabitants, in which their ages were taken; and a table showing the diseases by which the deaths at all ages were occasioned, is also given.

The fourth and fifth tables in Mr. Milne's work, exhibit the law of mortality which prevailed in all Sweden and Finland, both with and without distinction of the sexes, deduced from the registers kept and the enumerations made there, during the twenty years ended with 1795; which term was subsequent to that wherein the observations were made, from which Dr. Price's tables were constructed.

The seventh table in the same work exhibits the law of mortality at Montpellier for males and females separately, and was constructed from the bills of mortality of that place for twenty-one years, ending with 1792.

The second table at the end of this article, was published in the first edition of it in 1822; the tables of mortality for the lives insured in the Equitable Office, which were constructed by Mr. Babbage and Mr. Davies, were published in 1826; and we have given some account of them as well as of those formed by Mr Finlaison, from observations on Government Annuities in this country, and published in 1829, in the article *Annuities* in this work.

MM. Quetelet and Edouard Smits, in their *Recherches sur la Reproduction et la Mortalité de l'Homme*, in 1832, gave a table of mortality for the towns and the rural districts in Belgium separately, distinguishing males from females, and also for the whole population, without distinguishing the sexes, or the inhabitants of towns from those of the country.

Mr. Morgan, in the above mentioned publication of the Equitable Assurance Society, in 1834, gave a table of mortality for the lives insured in it, (marked C, p. 28), derived from table A of that work; another (D) derived from table B, is not worth a place there.

The second of the tables at the end of Dr. Casper's work on the *Probabilities of Human Life*, published in 1835, was intended to exhibit the law of mortality in Berlin, with distinction of the sexes; it was constructed from 69,362 deaths at different ages; 36,895 of males, and 32,467 of females, which took place there during the twelve years 1818–1829. And M. Mallet at the end of his valuable *Mémoire*, published in 1836, has given one for Geneva, in which the sexes are distinguished: it contains both the mean and the probable duration of life after every age, and was formed from the bills of mortality there for the eighteen years 1814–1833. For males, females, and the two sexes without distinction, M. Mallet took so high a radix as 100,000 births; the number of deaths were, of males 5219, females 5688, of both sexes 10,907; and in the column of deaths, on the same line for any age, as the survivors of that age, the author has put the number of deaths in the registers in the next following year, instead of the decrement of life, or excess of the number attaining that above the number attaining the next greater age, which will probably puzzle many readers.

Part II.—*On the Construction and Properties of Tables of Mortality.*

1. Suppose 10,000 children to have been all born alive at the same instant of time, more than 100 years since; and that the numbers of them who completed and who died in each year of age, were correctly entered in the following table:

Age.	Number who completed that year.	Number who died in their next year.
0	10,000	1,888
1	8,112	453
2	7,659	256
3	7,403	177
4	7,226	130
5	7,096	112
⋮	⋮	⋮
90	49	15
91	34	11
92	23	9
93	14	5
94	9	4
95	5	2
96	3	1
97	2	1
98	1	1

[1] *Abhandlungen aus der Juristischen und Politischen Rechenkunst*, von Carl Chassot de Florencourt. Altenburg, 1781, 4to.

which, then, would evidently be a table of mortality; and this mode of constructing one, were it practicable, would be the simplest possible.

2. But of 10,000 children taken indiscriminately at birth, it is manifest that the number who complete or survive any year of age, will be just the same, whether they be all born at the same time or not; and, therefore, this table might as well have been constructed by noting the times of the births of 10,000 children taken indiscriminately, and registering the time or the age at which each died; for then, after the whole were extinct, it would only be necessary to collect the sum of those who died in each year of their age, and insert it in the third column of the above table (1) against the proper age. The numbers in the second column would then be obtained by beginning with the 10,000 births, and merely subtracting the number in the third from the number in the second column, and placing the remainder in the next line below, in that second column, throughout the table.

3. It is evident that the number against any age in the second column of such a table, is equal to the sum of those in the third column against that, and all the greater ages; that is to say, that *the number who complete any year of age is equal to the sum of those who die at all the greater ages.*

4. Now let us suppose the population of a place to have remained invariable for one or two hundred years past, during which period 10,000 children have been born alive, at 10,000 equal intervals of time in each year. Also that, there having been no migration, and the law of mortality having been always the same, both the number of the living and that of the annual deaths in each year of age, have remained constant, the whole amount of the annual deaths at all ages, as well as the number of annual births, having been 10,000.

5. Then, if the law of mortality exhibited in the above table (1) be that which obtains in the place just mentioned, that table will represent the stream of life which flows through it, and fills the vacancies left by those who advance in age, or are carried off by death, their successors incessantly following and being followed in the same course.

6. Thus: 10,000 children being born annually at so many equal intervals of time, 7096 will annually complete their fifth year, also at equal intervals; and of these, 112 will die annually in the sixth year of their age.

7. And it is manifest that *the number who annually complete any year of their age in such a place, is equal to the sum of the annual deaths at all the greater ages.*

8. Let us next suppose, that the constant number of deaths which happen annually in any one year of age, take place at equal intervals of age in that year. For instance, that the four deaths which happen annually, in the ninety-fifth year of age, always takes place at the ages of

Years.		Months.
94	.	3
94	.	6
94	.	9

and 95 years; or rather, that the last individual dies at the moment before completing the 95th year.

9. Then the number constantly living in any year of age may be determined as follows:

Let us take, for example, the ninety-fourth year, which 14 persons annually enter upon, and 5 die in. Now, if no deaths happened in that year, it is obvious that the 14 persons who annually enter upon it at so many equal intervals (4 and 6), would be all constantly living at 14 equal intervals of age in that year; and if that year of age were divided into five equal intervals, there would be constantly living in each interval $\frac{14}{5}$ persons; or, in a place similarly circumstanced, but five times more populous, 14 persons.

But when five deaths take place at so many equal intervals in the ninety-fourth year of age, (the fifth part of a year being 73 days,) the case is altered. Thus,

Lives.	Complete the age of — Years.	Complete the age of — Days.	Number of the living during these last 73 days.
14	93	73	$\frac{14}{5}$
13	93	146	$\frac{13}{5}$
12	93	219	$\frac{12}{5}$
11	93	292	$\frac{11}{5}$
10	94	...	$\frac{10}{5}$

Or rather, the oldest life that fails in the 94th year, must be considered to expire the moment before completing that year, as only 9 *survive* 94.

But the numerators of these fractions being in arithmetical progression, their sum is equal to half the sum of the first and last terms multiplied by the number of terms; or $\frac{14+10}{2}\times 5$; which sum being divided by the common denominator, 5, we have the number of the living in the 94th year of age$=\frac{14+10}{2}$; an arithmetical mean proportional between the numbers who enter upon the first and last of the intervals which that year of age was divided into.

10. Now, the number, 9, who survive their 94th year, is less only by unit than the number 10, who enter upon the last of the intervals that year was divided into; so that if, instead of $\frac{14+10}{2}$, we take $\frac{14+9}{2}$, or an arithmetical mean proportional between the numbers who annually enter upon, and annually survive their 94th year, for the number constantly living in that year, it will only be less by half a life than what has just been demonstrated to be the true number, according to the hypotheses; and the difference would still have been but half a life, although the radix of the table had been 10,000,000 instead of 10,000; the number of the living would, in that case, according to these two methods, have been 1200 and 1199½. And the number of the living in any one year of age, even according to the above table, is generally several thousands, so that this difference, which remains always the same, is quite immaterial.

Besides, it is obvious that the above hypotheses can never coincide exactly with the facts. And the above reasoning is evidently applicable to any other year of age.

11. We are therefore authorised to conclude, that in a place, circumstanced as above stated, *the number of the living in any year of their age is an arithmetical mean proportional between the numbers who annually enter upon, and who annually complete that year.*

12. Thus it appears that

The number of the living in their	Is half the sum of
94th year,	14 and 9,
95th —	9 — 5,
96th —	5 — 3,
97th —	3 — 2,
98th —	2 — 1,
99th —	1 — 0.

But it is to be observed, that the same numbers occur in

the first of these two series as in the second, except the first term of the first, and the last of the second, which are 14 and 0 respectively. Therefore the sum of the second of these two series falls short of the sum of the first by 14, the number who annually complete their 93d year; so that the series of half sums falls short of the sum of the first series by 7, the half of 14. And this reasoning will apply equally to any other age than that of 93 years.

13. Whence it follows, that in a place circumstanced as we have supposed, *the number of persons constantly living at any assigned age and upwards, is less than the sum of those who annually complete that and all the greater ages, by half the number who annually complete that year of their age.*

14. From the supposition that the number of persons who die annually in any one and the same year of age, expire at so many equal intervals of age in that year (8), it follows, that for each of these lives which fails before the middle of that year of age, there will be another which will fail just so much after it, and, consequently, that the average quantity of existence during any year of age, for the lives that fail in it, is just half a year.

15. But in taking, for any one year of age, the sum of the numbers in the second column of the table (1) at all the greater ages, each life is counted once for every complete year it survives, after the age first mentioned; and if, to the sum of these, we add half the number in the same second column against that first mentioned age, this half number being the sum of the fractional parts of a year, by which the whole of these lives survive the last year of age they complete (14); the sum total thus obtained will evidently be the whole duration of life after the age first mentioned, enjoyed by all the lives that survive that age in any one year.

16. Therefore, if this last sum total be divided by the number who annually survive that first mentioned age, the quotient will be *the mean duration of life after that age* which is also called *the expectation of life at the same age*, being the portion of future existence which an individual at that age may reasonably expect to enjoy.

17. But, by No. 13, it appears, that the last mentioned sum total is also the number constantly living in the place, at and above the age first mentioned (15).

18. Whence, and from No. 16, it follows, that if the number of the living in the place at any age and upwards, be divided by the number who annually complete that age, the quotient will be the mean duration of life after the same age.

19. And, consequently, if the number constantly living at all ages, be divided by the number of annual births, the quotient will be the mean duration of life from birth, or the expectation of life of a child just born.

20. Hence also it appears, that the number of years in the expectation of life at any age, is the same as the number of living persons at that age and upwards, out of which one dies annually.

21. Thus, for example, the expectation of life at 40 years of age being 25·495 years, the proportion of the living in the place aged 40 years and upwards who die annually, is one of 25·495, or, which is the same, 1000 out of 25,495.

22. The numbers represented by a table of mortality to die in any intervals of age, are called *the decrements of life* in those intervals.

23. And the interval between any age and the utmost extent of life, according to any table of mortality, is called *the complement of life* at that age, according to the same table.

24. If the decrements of life be supposed to be equal and uniform through its whole extent, and the interval between birth and the utmost extremity of life be divided into as many equal parts as there are annual births, then, one of the individuals born will die at the expiration of each of these equal intervals of age; and the numbers who survive the several intervals, from birth to the extremity of life, will form an arithmetical progression.

25. Whence it will be found (11), that the number of the living at any assigned age and upwards, will be equal to the number who annually complete that age, multiplied by half the number of years in the complement of life at the same age.

26. And if this last product be divided by the number who annually complete that age, the quotient, that is, half *the complement of life, will be the expectation of life at that age* (18).

27. The mean numbers of annual deaths at all ages, or, which in this case is the same, the number of deaths in each year of age, that take place during any one year, in a place circumstanced as we have supposed, being given, a table may be constructed as follows, which will answer all the most interesting questions that can be put respecting the population and mortality of the place.

28. Let there be five columns, in the first of which insert the ages 0, 1, 2, 3, 4......96, 97, 98, 99, and against every age, insert in the fifth column, the given number that died in the year between that and the next greater age; then begin at the greatest age, and proceed towards the least, as follows:—

1*st*, To the number against any age in the fourth column, add that against the next less age in the fifth, and insert the sum against that next less age in the fourth (7).

2*d*, To the sum of the numbers in the third and fourth columns against any age, add half the number in the fifth column against the next less age, and insert this last sum against that next less age in the third column (11).

3*d*, Divide the number against any age in the third column, by the number against the same age in the fourth, the quotient will be the expectation of life at that age, to be inserted in the second column (16).

1	2	3	4	5
Age.	Expectation of life at that age.	Number of the living at that age, and upwards.	Number who annually complete that year of their age.	Number who die annually in their next year.
0	39·385	393,848	10,000	1888
1	...	...	...	...
2	...	...	...	...
3	...	...	...	...
:	:	:	:	:
90	2·357	115·5	49	15
91	2·176	74·0	34	11
92	1·978	45·5	23	9
93	1·928	27·0	14	5
94	1·722	15·5	9	4
95	1·700	8·5	5	2
96	1·500	4·5	3	1
97	1·000	2·0	2	1
98	0·500	0·5	1	1
99	0	0	0	0

A complete table of this kind for the two sexes separately, formed from observations made in all Sweden and Finland, during twenty years ending with 1795, will be found in Mr. Milne's *Treatise on Annuities and Assurances*, being the fourth in that work.

29. Hitherto we have supposed the state of the population to continue invariable for 100 years at the least, on account of the facility with which tables of mortality might be

formed from accurate mortuary registers in such circumstances.

But whether the population be stationary, or increasing, or decreasing, and from whatever causes these changes proceed, provided that they be produced gradually, and not by sudden starts during the time of the observations, the law of mortality may be determined from actual enumerations of the people, and the bills of mortality. Thus,

30. Let the number of persons in each year of their age, that are resident in a place at any one time, be taken, and let an accurate register be kept of the number that die annually in each year of their age, during a term of eight or ten years at the least, whereof the first half may precede, and the second follow the time of the enumeration.

Then, if the number of the inhabitants of every age either increase or decrease uniformly during that term, the mean number of annual deaths in each year of age thus registered, will be the same as if the population of the place had continued throughout that term what it was when the enumeration was made.

31. But if, to the number of the living in any year of age, we add half the number who annually die in the same year, the sum will be the number who annually enter upon that year of their age (11.)

And thus, from the enumerations and registers above mentioned, may be derived the ratio of the number who annually enter upon any year of their age, to the number who annually die in it.

32. But all the observations which have been made with sufficient minuteness, on the mortality during the first year from birth, concur in showing, that many more deaths take place in the first few weeks from birth, than in equal periods of time during the remainder of the first year; and that the nearer to birth, the greater is the mortality among infants. So that the number of the living in successive equal intervals in the first year of age, cannot be correctly assumed to be in arithmetical progression.

33. On this account it is desirable that the annual numbers, both of the children born alive, and the deaths under one year of age, should be correctly registered, as in Sweden.

34. Then, as the number annually born alive, is to the number of annual deaths under one year of age, according to the registers, so is the radix of the table of mortality, to the number dying under one year of age according to that table, which, being subtracted from the radix, the remainder is the number who complete their first and enter on their second year. Whence the numbers, both of survivors and annual deaths, at all the greater ages, may be determined in the order of their succession by No. 31.

35. If, instead of the number of the living in each year of age being taken only once, according to No. 30, that operation be performed several times during the term for which the mean number of annual deaths in each year of age is given;—then, the mean number of the living in each year of age throughout that term, must be deduced from the given numbers; and, being substituted for the number at the middle of the term according to No. 30, the law of mortality may be determined with more certainty, than when the people are only numbered once.

36. Both in enumerations of the people, and in bills of mortality, the numbers are, however, almost always given only for intervals of age of several years each. For the manner of interpolating the numbers in each particular year of age, the reader is referred to Mr. Milne's *Treatise on Annuities and Assurances*, arts. 180 and 181.

37. Hitherto we have only considered the determination of the law of mortality amongst the whole of the inhabitants of a place, of all ages, ranks, and conditions; and until within the last eight years, no statements of facts relating to particular classes of the people had been published, except those of M. Deparcieux, in his valuable *Essai*, sufficiently numerous and correct to be available for the purpose. But the inquiries made by order, and with the aid of government in this country, into the mortality amongst various classes of nominees, on whose lives annuities depended, published in Mr. Finlaison's report to the Lords of the treasury in 1829, and already noticed in the article ANNUITIES in this work; with the publication in 1834, of the still more interesting, important, and distinctly detailed observations on the mortality that has taken place among the lives insured in the Equitable Assurance Society, form most valuable accessions to our knowledge of the subject; we therefore proceed to show how the law of mortality among those classes of persons may be deduced from these documents. We shall have compassed that object, when we have determined out of a considerable number of persons who entered upon each year of age, how many died in that year, and, consequently, how many survived it; and the Equitable Assurance documents are so disposed, as to afford great facility in effecting this. The following table is extracted from them, with the addition of the column marked B.

			Age 30.+			
A	B		C	D	E	F
Age at admission.	Number admitted of that age.		Attained that age during the observations.	Of that age when they terminated.	Went out of the Society alive of that age.	Died of that age during the observations.
+						
7	40	... ...	5	...	...	...
8	53	... ...	8	...	...	...
9	26	... ...	1	...	...	...
10	31	... ...	6	...	2	...
11	40	... ...	11	1	...	...
12	35	... ...	14	...	...	...
13	53	... ...	13	1	...	...
14	48	... ...	14	2	...	...
15	50	... ...	6	1	1	...
16	66	... ...	20	...	3	...
17	71	... ...	11	...	1	...
18	149	... ...	18	...	...	...
19	250	... ...	26	...	6	...
20	263	... ...	45	2	2	1
21	373	... ...	124	...	5	...
22	438	... ...	177	3	13	1
23	499	... ...	232	4	11	2
24	521	... ...	314	6	19	3
25	643	... ...	421	10	29	2
26	615	... ...	451	7	26	7
27	683	... ...	557	6	31	5
28	732	... ...	676	7	70	4
29	783	... ...	780	1	45	5
30	762	... ...	762	...	1	2
			4692	51	265	32
					51	
			539		762	
			4153		1078	

38. According to the common mode of expressing the ages, which is adopted both in the government documents

Mortality, Law of.

and in those of the Assurance Society, the year of age stated is always that which was last completed; but wherever that is the case, it should be distinctly stated, and kept steadily in view. We confine ourselves in this table to the 31st year of age, and mark it 30+ to avoid ambiguity; for the same reason (+) is put over the ages in column A, to show that each number in it denotes the age last completed.

39. Column B has been added for the sake of illustration; it shows at what earlier ages the different lives entered the society, which afterwards completed the 30th year of their age in it, and entered their 31st: thus, out of 40 insured in the 8th year of age during the period of the observations, only 5 entered their 31st while insured in the society, the rest having passed out of it either by death or otherwise, at earlier ages, as the preceding columns of the original table fully show; and of the 373 persons who were insured in their 22d year, 124 remained insured till they entered their 31.

40. This table shows that of 4692 persons who entered on their 31st year of age in the society, 265 went out of it alive in the same year of their age during the observations, 51 were still living and insured at the termination of the observations, and 762 came into the society in that year of their age; the individuals of those three classes amount together to 1078 persons. But of the 265 who went out of the society alive during that year of age, it may reasonably be assumed, that whatever number of them at the time of their exit exceeded 30½ years of age by any interval of time, as many would fall short of that middle age by the same interval, when they went out; and, therefore, that the whole of them on an average may properly be considered to have been exposed to the action of the Law of Mortality during one half of that year of age; so that the mortality among them must have been the same as it would have been among half the number of exactly similar lives, in passing through the whole of that year.

In the same manner it appears, that of the 762 persons who were insured at various periods of the 31st year of age, and of the 51 persons who remained alive and insured in the society at various periods of that year of age when the observations terminated; may, each of them on an average, be properly assumed to have been exposed to the action of the law of mortality in the society during one half of the 31st year of age; and we are therefore entitled to conclude that the mortality among them was the same as it would have been among half the number of exactly similar lives in passing through the whole of the 31st year of age.

But 4692, the total of the numbers in column C includes all those 1078 lives, the same as if they had all entered upon their 31st year of age in the society, and had all passed through it except those which were carried off by death. It is, therefore, manifest, that 539, the half of their number, must be substracted from 4692, and the remainder, 4153 must be taken as the number of persons entering on the 31st year of their age, and continuing exposed to the law of mortality in the society during the whole of that year, among whom thirty-two deaths take place in the same year of age.

This, when the principle is clearly understood, is certainly a very simple operation and easily performed; and its application to every other age in the original table of data is exactly the same as to the 31st year.

41. In constructing the table of mortality, supposing that in proceeding from the earliest age we have arrived at the completion of the 30th year, or the entrance on the 31st, and have determined the number of survivors at that limit to be 4305; since

$$4153 : 32 :: 4305 : 33{\cdot}1712,$$

we find 33 to be the number of deaths which will take place in the 31st year of age out of 4305 persons who enter on it; and, consequently, that 4272 enter on their 32d year. according to the table we are constructing; the method of completing it is obviously the same throughout, and can be attended with no difficulty after the valuable documents requisite for the purpose have been obtained.

Mortality, Law of.

42. What has been shown here respecting the determination of the law of mortality amongst insured lives, applies also, and with rather more facility to the nominees on whose lives annuities depend. The life annuities sold by government in this country not being redeemable, are always continued during the whole of the lives they depend upon; therefore, with regard to them, column E in the above table is left blank; and in the case of the old English Tontine, which commenced in 1693 and ended in 1783 with the life of the last survivor, column D will also be quite blank.

PART III.—*On the Law of Mortality as deduced by the preceding methods from actual observations; and on the comparative merits of the different Tables of Mortality that have been published.*

43. When the uniformity of anatomical structure in different individuals of the human species is considered, and the great power possessed by the human body, of so adapting itself to the circumstances it is placed in, as to avoid injury from changes in those circumstances, it appears natural to expect *a priori*, that, where the circumstances of the people are not greatly different, the law of mortality will be nearly the same. And, from a comparison of the best tables of mortality yet constructed, we are induced to believe that this expectation will be realized, whenever a sufficient number of good observations shall have been made, under circumstances sufficiently varied.

44. We know of no observations that have hitherto been made and published, from which the law of mortality may be correctly determined, except the following:

1. Those of M. Deparcieux in France.
2. The Swedish.
3. Dr. Heysham's at Carlisle.
4. Dr. Cleland's at Glasgow.
5. Mr. Finlaison's on the nominees of life annuities granted by government in this country.
6. Mr. Morgan's on the lives insured in the Equitable Assurance Society.

Those of Deparcieux, Finlaison and Morgan, were made only on select classes of the people; the Swedish are incomparably the most numerous and extensive; and whilst Dr. Cleland's exhibit the mortality in a large manufacturing town, Dr. Heysham's will, we believe, be found to be best authenticated, and most correct.

45. The climate of Sweden is so unfavourable to the products of agriculture, and the number of the people is so great in proportion to the quantity of food produced, that unfavourable seasons there, are generally followed by distressing dearths, and the destructive epidemical diseases constantly attendant upon famine, which raise the mortality, when they occur, much above what it would otherwise be; and both in that way, and by weakening the constitutions of those who survive them, they materially increase the average mortality deduced from observations made during any considerable number of years. Of this the reader will find ample proofs drawn from authentic sources, in the 10th, 12th, and 13th chapters of Mr. Milne's *Treatise on Annuities.*

46. For these reasons, the mortality in Sweden deduced from many years' observations, will be found to be higher than in the more temperate and fruitful parts of Europe. And we shall probably make the nearest approach to the general law of human mortality in the temperate climates, that can be made from the Swedish observations, by selecting a period in which no remarkable epidemics prevailed. Such a period was that of five years, 1801–1805; during

which, according to a statement of M. Nicander, in the *Transactions of the Royal Academy of Sciences at Stockholm* for the year 1809, the population and mortality were as stated in Table I. at the end of this article.

47. From these *data*, the second table at the end of this article has been formed. The numbers in the columns for males and females separately, having been determined according to Nos. 36 and 31–35; assuming that, of 20,000 children born alive, 10,219 are males, and 9,781 females, in the ratio of 275,599 to 263,812.

The numbers against each age in the columns for the whole population without distinction of sex, are arithmetical mean proportionals between the corresponding numbers in the columns for males and females separately, against the same age.

48. From the table last mentioned, Table III. has been deduced by No. 16, exhibiting the expectation of life *at* every fifth year of age; or its mean duration *after* that age.

49. Vaccination commenced throughout Sweden and Finland in 1804, during which year, the number vaccinated was 38,255; and, in the year following, 42,839.

The number of deaths by small-pox there, during the year

1801, was	6,458
1802, —	2,679
1803, —	8,610
1804, —	3,764
1805, —	1,887
Sum,	23,398

Annual average number, 4,680

Whilst the annual average of the ten years ending with 1803, was 6962. *(Vet. Ac. Handl.* 1809, and Mr. Milne's *Treatise on Annuities*, art. 698.)

50. Therefore if we assume that, had vaccination not been practised in the years 1804 and 1805, the annual average number of deaths during the five years ending with that last mentioned, would have been greater by 2,282 than it actually was, and that these 2,282 additional deaths would have all taken place under five years of age, both assumptions will be near the truth; and it will follow that the annual mortality under five years of age, which actually was but one of 13·534, would have been one of 12·629, had vaccination not been introduced. Its introduction cannot have affected the first three tables above five years of age; and under that age, not quite so much as has just been stated.

51. Of all ages, and both sexes, there actually died annually, during these five years, one of 40·901; had vaccination not been practised at all, the annual average mortality would not have been so great as one of 39·759.

52. Table IV. exhibits the mean duration of life after every fifth year of age, according to twelve different tables of mortality; the first six, A, B, C, D, E, F, having been constructed from the requisite *data* (30 and 38,) the last six, M, N, O, P, Q, R, from mortuary registers only.

53. The numbers in the first column A have been taken from table III. in Mr. Milne's *Treatise on Annuities*, and those in B from table E (p. 28) in the Equitable Assurance Society's publication.[1]

54. Deparcieux's table C constructed from great numbers of accurate observations on the nominees in the French Tontines, resident principally in Paris and its environs, represents the duration of life too small after 60 or 65 years of age. (See Mr. Milne's *Treatise on Annuities*, articles 867 and 868.)

55. Column D has been taken from the 45th table in Dr. Price's *Observations*, E from the 5th in Mr. Milne's *Annuities*, and F from the 3d table in this article. All these tables represent the duration of life in Sweden and Finland, after 45 or 50 years of age, to be less than according to the others; and it might reasonably be expected, *a priori*, that the excessive cold in Sweden would be unfavourable to the prolongation of life in old age.

56. Of the less correct columns, M has been deduced from the 7th table in Mr. Milne's *Annuities*, and N from the 42d in Dr. Price's *Observations;* but, as the Montpellier and Chester tables, just referred to, give the expectations of life only for males and females separately, the numbers in columns M and N against each age, are arithmetical mean proportionals between the expectations for males and females against the same ages in those tables; which, though not quite correct, is fully sufficient for our present purpose.

57. The number in column O against each age has been derived from that given by M. Mallet in his table of mortality as the mean duration of life in Geneva from and after that age, by subtracting one half (0·5) from each of them; which will be found to be a necessary correction.

58. Column P has been derived from Lambert's table for mankind in general, already mentioned in the historical part of this article, in which he gives a column headed *mean age*. Thus, against the age of 20 in that column, stands 54·3, by which he means that persons who survive 20 years of age, do, on an average, attain the age of 54·3 years; so that their expectation of life at 20, will be 34·3. But his numbers in that column are all too great by $\frac{1}{2}$, or 0·5, as he has himself demonstrated; the last, therefore, should be 33·8; and

Against the age of	For his number.	We insert in column P.
0	29·5	29·00
5	47·7	42·20
10	51·4	40·90
15	53·1	37·60
	and so on.	

[1] The author of this article in reading the note on the 4th and 5th pages of Mr. Arthur Morgan's introduction to the valuable work above mentioned, when that gentleman was so good as to send it to him on its first publication, had noted with a pencil in the margin, that the practice there stated was not quite correct; but the circumstance had long passed from his recollection, when he showed in No. 40 of the present article, how the law of Mortality in the Society might be determined from the large and valuable table marked A; therefore, by the words "age on admission," at the head of the extreme left hand column over the age in the same horizontal line with the number of lives admitted in the first division of the large column with that age at its head, he was naturally led to conclude that that was, as it ought to be, the number of lives which really were insured during the observations, when that was the age they had last completed. But by the note referred to, it appears not to be so; on the contrary, none of the lives insured during any year commencing with the first of January, are entered in these statements as having come into the Society until the first day of January next following the day of their actual admission, and then each is stated to be one year older than it was when insured; although whatever deaths may happen amongst them before the first of January next following the commencement of the insurances, are entered in the statements as having taken place amongst the lives previously insured. The manuscript being wanted immediately, was in the hands of the printer, 400 miles from the author, before these circumstances were called to his recollection, by his accidently seeing his original note on the subject; he is therefore anxious to give this explanation. The principle of the method of determining the law of mortality in such cases, remains just the same. But it now appears that the number stated in Table A to have been admitted at any age, should have been stated to be so at the next younger age, and any calculator who may choose to employ himself on the subject, had better make that correction before proceeding farther. The probable error arising from the fault will not be great; but it is incumbent upon us to state the right method of proceeding.

59. The reason assigned by Lambert for voluntarily admitting this error at each age, as well as the corresponding one in the number of the living at and above the same age, into his table, was, that he did not consider the data in his possession enabled him to determine the duration of life within half a year of the truth.

60. In both these errors M. Lambert has been followed by J. C. Baumann, in constructing the 21st, 22d, and 23d tables inserted at the end of the third volume of Süssmilch's *Göttliche Ordnung* which were intended to represent respectively, the law of mortality among the country people in the churmark of Brandenburg, amongst the whole population of the churmark, and amongst the inhabitants of London.

61. The numbers in column Q were calculated by Deparcieux from Dr. Halley's table; and those in column R have been extracted from the 18th table in Dr. Price's *Observations*.

62. Upon comparing the numbers in the first six of these columns, which are more correct, with those in the last six, which are less so; it will be found, that at the early periods of life, its future mean duration according to the tables formed from mortuary registers alone, is less than according to those formed from the requisite data; also that the difference is greater the younger the lives are, and diminishes while the age increases, so as at 60 or 65 years of age to be little or nothing, and to continue small, and variable both in kind and magnitude, through the rest of life.

63. This appears to have arisen from the number of the people having varied but little during the first 35 or 40 years of the century that ended at or about the middle of the term in which the observations were made; and having increased considerably by procreation, during the remainder of that century; such increase having been slow at first, but gradually accelerated afterwards.

64. Table V. is calculated to illustrate this part of the subject. The columns A and B represent the law of mortality among the whole population of Sweden and Finland without distinction of sex, having been merely copied from Table II.

Column C shews the proportion of 10,000 annual deaths in Sweden and Finland that took place in each year of age, on an average of five years ending with 1805. And the number in column D against any age, being the sum of of those in column C against that and all the greater ages, would be the number who annually attain to that age, if the number of the people of every age had remained stationary from the year 1700 till 1806 (7).

65. The table of mortality formed by the columns C and D therefore, is that which Dupré de Saint Maur, Süssmilch, Lambert, Baumann, Florencourt, Muret and others, for want of the mortuary registers of a whole country, endeavoured to form by combining the registers of different town and country parishes.

Those tables also have the same faults, which have been formed in a similar way for particular towns or other comparatively small districts, from the bills of mortality alone, where the population had been increasing during the century preceding the commencement of the observations or statements in the bills of mortality which each table was formed from, and also during the period of the observations.

66. But it has been ascertained by repeated enumerations of the people in Sweden and Finland, that the hypothesis of their number having remained stationary for the last 100 years or more, is far from the truth. And by comparing columns A and B with C and D, it will be seen in what manner, and to what degree, the falsity of the hypothesis in this case, has vitiated the table derived from it.

67. To facilitate this comparison, columns E and F have been added. Taking the age of five years for an example; the numbers against that age in columns C and D show, that, according to the hypothesis, out of 5988 children who annually enter upon their 6th year, 144 die in it; while it appears by columns A and B, that out of 7096 children who enter upon that year of their age, only 112 die in it: and 112 : 7096 :: 144 : 9123, so that 9123, inserted against the age of five years in column E, is the number of children annually entering upon their 6th year, out of whom 144 *really* die in the same year of their age; and the mortality as represented by the hypothetical table in this case, is to the true mortality, as 9123 to 5988, or as 3 to 2 nearly.

Then the number in column F against any age, is always the excess of that in E above that in column D against the same age.

68. Columns B and C both containing 10,000 deaths, it will be seen that in column C, they are greatly accumulated at the early ages, in comparison with those in column B; and that in old age, the deaths in column C are much less numerous than in B; which are necessary consequences of the people increasing by procreation; the numbers of the people in a progressive population, in comparison with a stationary one, being greater in early life, and less in old age. And, while the law of mortality remains the same, the numbers of deaths at the different ages, must necessarily be distributed in a similar manner.

69. This enables us to see clearly how the principal differences have arisen between the correct and incorrect tables of mortality AB and CD; whilst the number of annual deaths at all ages (10,000) is the same in both, the proportions of that number are necessarily in column C of the increasing population greater, and the deaths are more densely distributed at the early ages, and less so at the advanced ones than in column B of the population which has consisted of the same number of persons of every age, and has produced the same number of annual births and of annual deaths at every age for 100 years past. The increasing population is necessarily attended with a corresponding increase of the annual births and of young persons; while the elderly persons are only those left by the law of mortality out of the corresponding small numbers that were born annually, 50, 60, 70, or 100 years back. And as columns A and B represent the true law of mortality that prevails among the people, columns C and D cannot do so, although constructed from observations on the same people; for in an increasing population it is not true that the sum of the deaths happening annually above a given age will be the same as the number of persons annually arriving at or completing that age; it always falls short of it, and the more so as the given age is younger, there being deficiencies at all ages above that.

Columns E and F show what the errors of the hypothetical table are at the different ages, and they are of a similar kind in all tables similarly constructed from records of the number of deaths at the different periods of life in an increasing population; and such are probably 99 out of 100 of those hitherto published; many of them for people increasing their numbers much faster than the Swedes have done, and the errors of such tables must be greater than those of the table CD.

70. Table VI., which needs no further explanation than is placed at the head of it, will also illustrate the difference between tables of mortality formed from the requisite data, and those constructed from mortuary registers only.

It is better fitted for this purpose than Table IV., with which, however, it will be found to correspond very well. But the 4th table has other uses which this has not.

71. From what has already been advanced, it would appear probable, that the number of annual births in Sweden and Finland had been nearly stationary, and rather decreasing than increasing, upon an average, from about 1700 till 1735.

The numbers both of the annual births and deaths, from the year 1749 till 1803, will be found in Milne's *Treatise*

Mortality, Law of.

on Annuities, art. 698: these kind of returns to government were not made before 1749, neither have we any satisfactory account of the population before that period.

72. But the statements in our 7th table corroborate the inferences just drawn from the 5th and 6th, as they shew that during the 43 years ended with 1800, the total population increased, while the proportion above 90 years of age diminished through the whole term, and increased very little during the next 10 years.

The numbers in that table include both sexes, and the long continued diminution of them past 90, cannot be explained by supposing the males to have fallen in battle; for the females were reduced in the same proportion, their number throughout, having been to that of the males above 90 years of age, as nine to five nearly.

From the 7th table, therefore, it appears probable, that the annual births in the years 1698, 1705, 1710, and 1715, were respectively proportional to the numbers.................. 907, 637, 837, and 786.

The last number, 786, has been calculated upon the supposition that the proportion of the population in Sweden and Finland to those in Sweden alone, was the same in 1810 as in 1805.

73. It should also be observed here, that the disastrous career of Charles the Twelfth commenced with the eighteenth century, and terminated in 1718, when the country was in such a state of exhaustion as it could not have recovered from for many years; whence there appears reason to believe, that the annual births during the succeeding fifteen or twenty years, did not increase fast.

Cantzlaer informs us, that between the 10th of August 1710, and the month of February 1711, near 30,000 persons were carried off by the plague in Stockholm alone. *(Mém. du Royaume de Suède*, t. i. p. 29.)

74. It will be seen that the numbers in col. F of Table V., in proceeding back from four years of age to birth, continually decrease, contrary to what generally obtains; and as we ascribe the general increase of these numbers, when taken in the retrograde order of the ages, to the annually increasing number of births, so will this anomalous appearance be found to arise partly from the average number of annual births having actually *decreased* for a few years; for

During the five years ending with	The annual average number of births was
1800	107,690
1801	106,392
1802	105,504
1803	104,644
1804	105,430
1805	107,882

But it appears to have arisen principally from the practice of vaccination during the years 1804 and 1805, by which the mortality among children, or the numbers in col. C, in a few of the first years from birth, were reduced below what they otherwise would have been (50) while those in col. D remained nearly the same (64); consequently, the numbers in col. E were reduced in nearly the same ratio as those in C (67), and the reduction in col. F. was in each case nearly the same as in E (61).

75. The numbers relating to Sweden and Finland in the 7th table, have been derived from the Stockholm *Transactions* for the years 1766, 1801, 1809, and 1813.

Those relating to Spain and the Spanish possessions in Europe and Africa, including the Canary Islands, from the *Censo de la Poblacion de Espana en el ano de* 1797, mentioned in the first section of this article. These last have been included in this Table, to show the difference in the proportion of aged persons between Spain and Sweden, and still more between the Canary Islands and both.

76. If the population of Spain had remained invariable from 1697 to 1797, the law of mortality there, might have been easily derived from the statements above mentioned of the enumeration in 1797; but in the actual state of things, that cannot be determined without comparing these with exact accounts of the numbers that died annually in each interval of age. And, as was observed in the first section of this article, the author has obtained satisfactory information that no such returns from the parish registers throughout Spain, as are there mentioned, ever were published, nor is it probable they were ever made.

77. When what we have advanced respecting the 5th and 6th tables is clearly understood, it will not be difficult to account for the greater part of the difference between the more and less correct columns in Table IV.

Most of the observations which the German tables were constructed from, were made between the years 1720 and 1750; and those who died then between 60 and 100 years of age, must have been born between 1620 and 1690; in which period nearly the whole of the thirty years' war, ended in 1648, was included, during which, and for several years after, it is probable that the annual births increased little or nothing, if they did not decrease.

78. Amongst the less correct columns of Table IV., those for Montpellier, Chester, and Geneva, agree much better than the rest with the more correct ones, which has probably arisen in each case, partly from the mortality in these three places having really been less throughout life than in most large towns; and partly from the annual births in them, having increased less than in the other places, during the fifty or sixty years preceding the period in which the observations the tables were constructed from were made.

79. The Northampton table was constructed by Dr. Price, from the bills of mortality (from the year 1735 to 1780) of the single parish of All Saints, containing a little more than half the inhabitants of the town; and as the deaths exceeded the births in number, the Doctor applied a correction to the table under twenty years of age, which, if it had answered the intended purpose under that age, as we are satisfied it did not, could have no effect on any of the numbers above the same age; and almost all of the useful applications of such tables, are to ages above twenty.

80. The table so formed could only be correct, provided that the numbers, both of the living and the annual deaths at every age above twenty years, had continued invariable during the 146 years that intervened between 1634 and 1780; provided also, that no migration from or to the town took place, except at twenty years of age, and that the annual increase the population received by migration at that age, was just equal to the excess of the annual deaths above the annual births.

81. But we consider it to be much more probable, that during these 146 years, Northampton partook of the prosperity and adversity that prevailed in the rest of the kingdom; and, consequently, that its population was generally progressive, though sometimes stationary, and sometimes retrograde.

82. We have not room here to support this opinion by numerical statements and calculations, but from the population abstracts, and an enumeration of the inhabitants of Northampton, given in Dr. Price's *Observations on Reversionary Payments*, (vol. ii. p. 94,) it will be found, that both the annual births, and annual settlers in that town, have been increasing ever since about the year 1715 or 1720; also, that although the burials exceeded the baptisms till the year 1802, the supply by migration was much greater than that excess; and, consequently, that the numbers of the living have been accumulated more at the early ages, and less at the advanced ones, than they would have been had the population remained stationary.

83. Thus it appears, that the faults in the Northampton table are of the same kind as those of the others constructed from mortuary registers only. And the civil war in the time of Charles the First, with the unsettled state of the kingdom for some years before and after it, would probably have prevented or greatly retarded, the increase of the annual births, during the time in which those persons were born, who died past sixty years of age between the years 1734 and 1781, and may account for the table after that age being near the truth; while the comparatively rapid increase of the people during the sixty years ending with 1780, appears to explain the great excess of mortality in that table at the early periods of life.

84. As it was only from the Carlisle and Northampton tables of mortality, that tables of the values of annuities on single and joint lives had been calculated, sufficiently copious to admit of the values of interests dependent upon the continuance or the failure of human life being accurately derived from them. When the first edition of this article was published in the year 1820, the author gave the following comparison between the mortality represented by each of these tables to take place at the different periods of life, with that which had been observed to obtain among the members of the Equitable Assurance Society.

85. From an address delivered at a general court of that Society, by Mr. Morgan the actuary, on the 24th of April 1800, it appears, that according to the result of an annual experience of thirty years, the decrements of life (22) among the members of the society, were to those in the Northampton table,

Between the ages of	10 and 20	as 1 to 2.
	20 — 30	— 1 — 2.
	30 — 40	— 3 — 5.
	40 — 50	— 3 — 5.
	50 — 60	— 5 — 7.
	60 — 80	— 4 — 5.

The same information may also be found in two notes in Dr. Price's *Observations on Reversionary Payments*, (vol. i. p. 183, and vol. ii. p. 443.)

86. From the preceding statement, the Carlisle table of mortality, (No. II. in Mr. Milne's *Annuities*, or No. V. at the end of the article ANNUITIES in this work, and the Northampton table, (No. XVII. in Dr. Price's *Observations*), we have derived the following:—

Out of	Who attain the age of	There die before the age of	According to the Carlisle Table.	Experience of the Equitable Society.	Northampton Table.
Persons.	Years.				
6460	10	20	370	309	618
6090	20	30	448	443	886
5642	30	40	567	579	965
5075	40	50	678	652	1086
4397	50	60	754	900	1260
3643	60	80	2690	2244	2805

87. This table shows that the law of mortality exhibited in the Carlisle table is almost exactly the same as that which has prevailed among the members of the Equitable Assurance Society. And although the members of such a society, when they first enter, are select lives, they are not, even then, so much better than the common average, as many persons suppose; for the more precarious a life is, the stronger is the inducement for parties interested in its continuance, to get it insured, so that bad risks are frequently offered to such companies. And many proposals for insurance are accepted by the directors, that are not thought very eligible at the time, in cases where they are not aware of any specific objection to the life proposed.

88. Besides, it is to be considered, that of the number in a society at any one time, but a small proportion can have been recently admitted, and in a few years from the time of admission, the members will generally have come down to the common average of persons of the same ages.

89. It ought also to be observed, that most of the tables of mortality that have been published, have been constructed from observations made upon the whole population of very large towns, such as London, Paris, Vienna, and Stockholm; in each of which there are particular quarters inhabited only by the very lowest of the people, who, unfortunately, are also very numerous, badly clothed and fed, therefore exposed to serious injury from the inclemencies of the weather; extremely ignorant and vicious, indulging in the abuse of spirituous liquors, and inattentive to cleanliness both in their persons and habitations, which last are crowded, badly ventilated, and surrounded with mud and the putrid remains of animals and vegetables. These are the nests of contagious diseases, in which they are generated and kept alive, where they at all times occasion great mortality, though not so much within the last forty-five or fifty-five years as previously, and from which, when circumstances favour them, they spread amongst the rest of the people.

90. It is, therefore, obvious, that in such places, the average mortality at every age, must be considerably greater than that which prevails only among the middling and higher classes of society, even in such towns.

91. But the lives upon which leases, annuities, reversions, and assurances depend, are very seldom exposed to the influence of the causes of mortality mentioned in number 89. Whence it follows, that a table of mortality on which those causes have had no great influence, is best adapted to the valuation of such interests.

And these kind of valuations are the most important purposes to which tables of mortality can be applied.

92. The number of years in *the mean duration of life from birth* according to a table of mortality properly constructed from the necessary data, will, when the population has remained stationary for a century or more, be the same as the number of persons in the whole population, out of which one dies annually (20). When the population has been increasing, the mean duration of life, according to the table, will be less than the number out of which one dies annually in that population; but the difference will be small, except under particular circumstances, as appears by the following statement.

	Place.	Years.	Term of the observations.	Died annually, one of	Mean life.	Difference.	Authorities.
1	Stockholm, males	9	1755–1763	16·86	14·25	2·61	Dr. Price's *Observations*, tab. 46.
2	Ditto, females	9	1755–1763	20·93	18·10	2·83	Ditto.
3	Ditto, both sexes	9	1755–1763	18·85	16·18	2·67	Ditto.
4	Sweden and Finland	21	1755–1776[1]	34·60	34·45	0·15	Ditto, tab. 44.
5	Ditto	20	1776–1795	37·33	36·12	1·21	Mr. Milne's *Annuities*, tab. 5.
6	Sweden alone	5	1801–1805	40·90	39·39	1·51	This article.
7	Carlisle	9	1779–1787	40·00	38·72	1·28	Mr. Milne's *Annuities*, tab. 2.
8	Glasgow, males	10	1821–1830	35·42	34·38	1·03	Dr. Cleland's *Observations*, and a table of mortality formed from them by the author of this article.
9	Ditto, females	10	1821–1830	42·32	37·24	5·08	
10	Ditto, both sexes	10	1821–1830	38·81	35·77	3·04	

93. The above mentioned table of mortality for Glasgow, which the author has had by him several years, he expects to publish soon.

The high number in the column of differences for females in that place, arises from the small mortality amongst them, which was occasioned principally by the great influx of healthy females between the ages of 15 and 30, at which period of life the rate of mortality amongst them was small; its *minimum* for them being in their 18th year.

Between the ages of 10 and 15 the numbers of the two sexes were just about equal, whilst between the ages of 15 and 30 the females were more numerous than the males in the ratio of 3 to 2; and this accounts for the great number of females (42·32), out of which one died annually there, which necessarily raises the number out of which one died annually in the whole population of both sexes, and therefore the number in the column of differences (in the line numbered 10) for the whole population of both sexes in Glasgow.

94. Similar causes probably produced similar effects, although in a much less degree in Stockholm.

95. When tables of mortality are constructed from the numbers of deaths only in the different intervals of age, without comparing them with the numbers of living persons in the same intervals; such as that formed by columns C and D of Table V. at the end of this article, and the population is increasing. The number of years in the mean duration of life from birth, according to that table, will fall short of the number of the people, out of which one dies annually, by a much greater number than in the case we have just been considering, of the table of mortality having been properly constructed from the necessary data: as the following statement will show.

	Place.	Years.	Term of the Observations.	Died annually, one of	Mean Life.	Difference.	Authorities.
1	Sweden and Finland	5	1801–1805	40·90	30·86	10·04	Table V. C. & D. and Tab. VI. D.
2	Belgium	3	1825–1827	43·00	32·15	10·85	MM. Quetelet and Smits, *Recherches*, &c., 8vo, 1832, pp. 29 and 36.
3	Berlin	12	1818–1829	36·91	27·39	9·52	Dr. Casper; *Lebensdauer der Menschen*, tab. 2 & § 14, s. 35; also *Staatskräfte der Preussischen Monarchie*, b. 1. ss. 303 & 304.
4	Geneva, males	20	1814–1833	45·00	37·97	7·03	M. Mallet, in the places referred to above.
5	Ditto, females	20	1814–1833	48·69	42·21	6·48	
6	Ditto, both sexes	20	1814–1833	46·92	40·18	6·74	
7	Chester, males	10	1772–1781	34·54	28·13	6·41	Dr. Price's *Observations on Rev. Payments*.
8	Ditto, females	10	1772–1781	37·27	33·27	4·00	
9	Ditto, both sexes	10	1772–1781	35·97	30·70	5·27	
10	Montpellier	21	1772–1792	29·56	25·36	4·20	Mr. Milne's *Annuities*.

96. In both of the above statements, where the sexes are not mentioned, the table is for both without distinction.

97. In places where the increase of the population was slow, the numbers set against them in the column of differences are smaller than where the population increased more rapidly.

98. In the tables of mortality for Belgium and Montpellier, the sexes were distinguished, but not in the given number of the whole population, as well as the whole number of deaths in each of those places, and for that reason the sexes could not be distinguished for those two places in this last table.

99. When what we have shewn here is clearly understood, and the proportion of the people dying annually is known, it will not be difficult to judge whether a table of mortality for that people has been constructed properly from the necessary data; or, what is much more common, and more easily effected, merely by summation of the deaths at all ages. For in the case of the correct table of mortality, the difference obtained in the manner stated above, will probably not exceed 2; nor in the case of the incorrect table, will it be likely to be less than 7, upon the supposition of the population having increased generally for a considerable number of years preceding the termination of the observations; if for a whole century, so much the better.

[1] But omitting the year 1764, in which no observations were made.

100. The probable life at birth, or the age to which half the number born attain, will also be a good criterion for enabling us to judge, by comparison, whether a table of mortality has been correctly constructed from the necessary data or not; provided that, in the places the compared tables have been constructed from, the children have been similarly circumstanced, or nearly so.

According to the	The probable duration of life from birth, is	The probable duration of life from 10 years of age, is
Correct table for Sweden, in this article,	45 years.	53 years.
Incorrect one,	22 —	48 —
Belgian table,	25 —	48 —

In Belgium vaccination was practised during the whole period of the observations, in Sweden only during about 1½ out of the 5 years' observations.

101. From all that has now been stated, we are entitled to conclude, that the Belgian table of mortality has been constructed either from the registers of burials alone, or only from the statements of the numbers living in the different intervals of age at the time of the enumeration; most probably from the burials alone. M. Quetelet appears now to be aware that such tables are very incorrect. In his late work *sur l'Homme et le Dévelopement de ses Facultés, ou Essai de Physique Sociale*, 2 tom. Paris 1835, in 8vo, after giving the above mentioned table of mortality for Belgium, in which only the numbers attaining the different ages are given, without the decrements of life, or its mean or probable duration at the different ages, he states the mean duration of life from birth according to that table, and then proceeds thus, (tome i. p. 166):—"D'après le dernier ouvrage de M. Rickman, la vie moyenne serait en Angleterre de 33 ans (32 pour les hommes, 34 pour les femmes).[1] On l'estime en France de 32·2 ans d'après le chiffre des naissances.[2] Du reste, ces calculs supposent une population stationnaire, et nous aurons occasion de voir qu'ils peuvent conduire à des erreurs assez graves."

102. Reasoning as in Nos. 68 and 69, it will be seen that when the number of the people has been decreasing for a series of years, the deaths will be more densely distributed among the advanced ages, and more rarely in the early periods of life, than if the number of the people at every age, and the law of mortality had remained always the same. Consequently, in the table of mortality constructed from such data, merely by taking the successive sums, in retrograde order, from extreme old age to birth; those successive sums, which are the numbers of the living at the different ages in the table so constructed, will be greater at advanced ages and less in early life than if the population had remained stationary, as stated above. So that the errors of the incorrect table would, in this case, be of the opposite kind to those of the common tables, constructed in a similar way from the deaths only, in an increasing population. From the general increase of arts, manufactures, commerce, and civilization, ever since tables of mortality were first formed, the population has been increasing more or less rapidly in almost every place, for which a table of mortality has been constructed. But in Amsterdam we have an instance of the population having continued to decrease for half a century or more. We here present a view of it since the year 1622.

Population of Amsterdam.

In the year	Number of persons.	Authorities.
1622	104,961	Struyck, *Nader Ontdekkingen*, p. 118.
1753	200,000	Ditto ditto, p. 146.
1777	241,353	Quetelet *sur l'Homme*, tom. i. p. 246.
1787	224,862	R. Lobatto *on Life Insurance*,[3] p. 20.
1826	200,784	Ditto, p. 21.
1830	202,175	Quetelet *sur l'Homme*, tom. i. p. 246.

103. The information on this subject is scanty and difficult to procure. Kersseboom took much pains in endeavouring to make just estimates of the population from the annual births and deaths; and taking it to be 35 times the number of annual births, he estimated the population of Amsterdam in 1742 at 241,000 persons.

Three only of the six numbers stated above, viz. those for the years 1622, 1826, and 1830, were determined by actual enumerations at the times stated. Although M. Smits, the secretary of the Statistical Commission, relative to the population of the Netherlands, is not mentioned in the above table, we are greatly indebted to him. In his *Statistique Nationale* he gave a table, (No. 10, p. 82), shewing the number of deaths that took place in Amsterdam in each year of the 18th century. M. Lobatto has given them in the place above referred to for each of the ten years 1816–1825; and M. Quetelet, in the part of his work referred to above, has given them for each of the 17 years, 1816–1832, and states that in the year 1777 the mortality was 1 in 27; the number of deaths in that year was 8939, whence the population inserted in the table is derived. M. Lobatto states, on the authority of Professor Van Swinden and of M. Nieuwenhuys, that from 1774 to 1813 there died annually 1 of 26; the deaths in 27 years, 1774–1800, were 233,510, the annual average number, therefore, was 8648·5, and multiplying this by 26, we obtain 224,862, the mean number of the people during these 27 years, which is stated in the above table to have been the population in 1787, the middle year of the 27.

104. The enumeration in 1622 was made in levying a capitation tax, which was exacted with great strictness, even in every receptacle for paupers, the master or owner of it was obliged to pay the tax for each inmate. This enumeration appears not to have been known of, either by Kersseboom or by Struyck at the time of his first publication on the subject; but an original paper, with many particulars which he gives, was afterwards communicated to him. Struyck, after taking great pains with the subject, stated his opinion, that in 1753, Amsterdam did not contain 200,000 inhabitants.

105. M. Lobatto, at the end of his *Beschouwing*, &c. gives two tables of mortality for Amsterdam, one for males, the other for females, constructed from the deaths that took place during the ten years 1816–1825, with the expectation of life at every age, and we here give the same particulars for it as are given for some others above, but marking the difference (—) as it is of the opposite kind to those which resulted from an increasing population.

Place.	Term of the observations.	Died annually, one of	Mean duration of life.	Difference.
Amsterdam.	10 yrs. 1816-1825	29·22	32·22	— 3·00

[1] Preface to the Population Abstract. 1831.

[2] *Annuaire du Bureau des Longitudes, pour l'année* 1834, p. 102.

[3] *Beschouwing van den aard, de voordelen, en de inrigting der Maatschappijen van Levensverzekering*, &c., door R. Lobatto; Amsterdam, in 8vo, 1830.

106. This low mortality of one in 29·22 was obtained by M. Lobatto stopping at the year 1825, which he himself states was on account of the mortality having been high in the two following years, 1826 and 1827. He obtained the annual mortality of 1 in 29, by dividing the number of the people in 1826, the year after the end of the term, by the annual average number of deaths during the term. During the 12 years 1821–32, of which 1826 was the middle one, the annual average number of deaths was 7,336·18, and there died annually, on an average, one of 27·369; the *difference* in the above statement should therefore be —4·85, or nearly 5; which is the true excess of the number of years in the mean duration of life, above the number of persons out of which one died annually.

107. For some of the most important applications of the facts and inferences stated in this article, the reader is referred to the article Annuities in this work, where he will find that the valuation of Assurances or Reversions dependent upon lives is also treated of.

Mortality, Law of.

TABLE I.

In all Sweden and Finland during the Five Years ending with 1805.

Between the ages of	Mean number of the living.		Annual average number of deaths.		That is, Males one of.	That is, Females one of.
	Males.	Females.	Males.	Females.		
0 and 1	44,536	43,847	11,132	9,238	4·00	4·74
1 — 3	85,548	86,533	4,113	3,752	20·79	23·06
3 — 5	84,854	85,909	1,857	1,771	45·69	48·57
5 — 10	170,878	171,343	1,919	1,743	89·04	98·30
10 — 15	161,613	160,777	872	797	185·33	201·72
15 — 20	140,467	144,782	799	795	175·80	182·11
20 — 25	132,414	143,012	1,018	927	130·07	154·27
25 — 30	120,349	130,183	977	978	123·18	133·11
30 — 35	108,804	118,978	982	1,056	110·79	112·67
35 — 40	100,293	111,158	1,078	1,150	93·03	96·06
40 — 45	94,497	103,711	1,293	1,324	73·08	78·33
45 — 50	82,258	91,932	1,442	1,255	57·04	73·25
50 — 55	71,899	81,265	1,811	1,582	39·70	51·36
55 — 60	54,543	64,127	1,768	1,666	30·85	38·49
60 — 65	42,847	51,938	1,931	2,015	22·19	25·77
65 — 70	30,923	40,414	1,942	2,242	15·92	18·02
70 — 75	20,945	28,615	2,138	2,620	9·79	10·92
75 — 80	11,009	15,660	1,627	2,135	6·76	7·33
80 — 85	4,452	6,817	994	1,452	4·47	4·69
85 — 90	1,214	1,988	352	561	3·45	3·54
above 90	268	468	102	207	2·62	2·26
Of all ages,	1,564,611	1,683,457	40,147	39,266	38·97	42·87

The Numbers of Births during the same Five Years were,

Males.	Females.	Both.
275,599	263,812	539,411

TABLE II.

Exhibiting the Law of Mortality which prevailed in all Sweden and Finland, during the Five Years ending with 1805.

Age.	Males.		Females.		Both.		Age.	Age.	Males.		Females.		Both.		Age.
	Number who annually complete that year.	Number who annually die in their next year.	Number who annually complete that year.	Number who annually die in their next year.	Number who annually complete that year.	Number who annually die in their next year.			Number who annually complete that year.	Number who annually die in their next year.	Number who annually complete that year.	Number who annually die in their next year.	Number who annually complete that year.	Number who annually die in their next year.	
0	10,219	2064	9,781	1712	10,000	1888	0	50	4,540	103	4,754	83	4,647	93	50
1	8,155	481	8,069	426	8,112	453	1	51	4,437	108	4,671	88	4,554	98	51
2	7,674	266	7,643	244	7,659	256	2	52	4,329	109	4,583	88	4,456	98	52
3	7,408	181	7,399	174	7,403	177	3	53	4,220	109	4,495	90	4,358	100	53
4	7,227	136	7,225	125	7,226	130	4	54	4,111	109	4,405	92	4,258	101	54
5	7,091	117	7,100	105	7,096	112	5	55	4,002	110	4,313	97	4,157	103	55
6	6,974	89	6,995	81	6,984	84	6	56	3,892	116	4,216	102	4,054	109	56
7	6,885	70	6,914	65	6,900	68	7	57	3,776	122	4,114	106	3,945	114	57
8	6,815	59	6,849	52	6,832	56	8	58	3,654	127	4,008	110	3,831	118	58
9	6,756	50	6,797	45	6,776	47	9	59	3,527	130	3,898	115	3,713	123	59
10	6,706	40	6,752	39	6,729	39	10	60	3,397	136	3,783	124	3,590	130	60
11	6,666	37	6,713	34	6,690	36	11	61	3,261	137	3,659	131	3,460	134	61
12	6,629	35	6,679	31	6,654	33	12	62	3,124	137	3,528	135	3,326	136	62
13	6,594	33	6,648	30	6,621	31	13	63	2,987	133	3,393	138	3,190	136	63
14	6,561	33	6,618	31	6,590	32	14	64	2,854	140	3,255	142	3,054	140	64
15	6,528	35	6,587	34	6,558	35	15	65	2,714	143	3,113	146	2,914	145	65
16	6,493	35	6,553	34	6,523	35	16	66	2,571	142	2,967	148	2,769	145	66
17	6,458	36	6,519	36	6,488	35	17	67	2,429	147	2,819	151	2,624	149	67
18	6,422	36	6,483	36	6,453	37	18	68	2,282	150	2,668	155	2,475	153	68
19	6,386	41	6,447	39	6,416	39	19	69	2,132	159	2,513	160	2,322	159	69
20	6,345	45	6,408	39	6,377	43	20	70	1,973	168	2,353	169	2,163	168	70
21	6,300	48	6,369	40	6,334	43	21	71	1,805	163	2,184	178	1,995	171	71
22	6,252	49	6,329	41	6,291	46	22	72	1,642	158	2,006	177	1,824	168	72
23	6,203	49	6,288	42	6,245	45	23	73	1,484	155	1,829	179	1,656	166	73
24	6,154	49	6,246	42	6,200	45	24	74	1,329	153	1,650	175	1,490	165	74
25	6,105	48	6,204	44	6,155	47	25	75	1,176	147	1,475	169	1,325	158	75
26	6,057	48	6,160	45	6,108	46	26	76	1,029	135	1,306	156	1,167	145	76
27	6,009	48	6,115	46	6,062	47	27	77	894	124	1,150	143	1,022	133	77
28	5,961	49	6,069	46	6,015	47	28	78	770	113	1,007	141	889	127	78
29	5,912	50	6,023	48	5,968	50	29	79	657	104	866	132	762	118	79
30	5,862	50	5,975	49	5,918	49	30	80	553	97	734	125	644	112	80
31	5,812	51	5,926	50	5,869	50	31	81	456	89	609	112	532	100	81
32	5,761	52	5,876	52	5,819	52	32	82	367	78	497	96	432	87	82
33	5,709	52	5,824	54	5,767	54	33	83	289	62	401	87	345	74	83
34	5,657	54	5,770	55	5,713	54	34	84	227	53	314	70	271	62	84
35	5,603	55	5,715	55	5,659	55	35	85	174	41	244	62	209	52	85
36	5,548	56	5,660	57	5,604	56	36	86	133	34	182	44	157	38	86
37	5,492	58	5,603	57	5,548	58	37	87	99	25	138	34	119	30	87
38	5,434	60	5,546	59	5,490	60	38	88	74	21	104	25	89	23	88
39	5,374	64	5,487	60	5,430	61	39	89	53	15	79	20	66	17	89
40	5,310	67	5,427	62	5,369	65	40	90	38	11	59	18	49	15	90
41	5,243	69	5,365	67	5,304	68	41	91	27	8	41	14	34	11	91
42	5,174	70	5,298	69	5,236	70	42	92	19	6	27	11	23	9	92
43	5,104	72	5 229	69	5,166	70	43	93	13	5	16	7	14	5	93
44	5,032	74	5,160	69	5,096	71	44	94	8	3	9	4	9	4	94
45	4,958	76	5,091	65	5,025	71	45	95	5	2	5	2	5	2	95
46	4,882	79	5,026	64	4,954	72	46	96	3	1	3	1	3	1	96
47	4,803	83	4,962	65	4,882	73	47	97	2	1	2	1	2	1	97
48	4,720	86	4,897	68	4,809	78	48	98	1	1	1	1	1	1	98
49	4,634	94	4,829	75	4,731	84	49								

TABLE III.

According to the Law of Mortality that prevailed in all Sweden and Finland during the Five Years ending with 1805.

Age.	Years in the average future Duration, or Expectation of Life. Males.	Females.	Both.	Age.
0	37·820	41·019	39·385	0
5	48·987	51·046	50·014	5
10	46·681	48·570	47·629	10
15	42·888	44·727	43·809	15
20	39·051	40·905	39·980	20
25	35·486	37·167	36·330	25
30	31·853	33·494	32·684	30
35	28·208	29·901	29·063	35
40	24·622	26·353	25·495	40
45	21·189	22·924	22·066	45
50	17·901	19·367	18·651	50
55	14·968	16·087	15·550	55
60	12·173	12·978	12·598	60
65	9·606	10·220	9·933	65
70	7·255	7·698	7·497	70
75	5·509	5·784	5·665	75
80	4·095	4·221	4·165	80
85	3·230	3·230	3·230	85
90	2·553	2·263	2·357	90
95	1·700	1·700	1·700	95

TABLE IV.

Showing the Number of Years in the Expectation of Life at every fifth year of age, from birth to 90 years, according to different Tables of Mortality.

Age.	MORE CORRECTLY. A Carlisle.	B Equitable Assurance Society.	C Deparcieux's Annuitants.	D Sweden and Finland. 1755–76	E 1775–95	F 1801–5	Age.	LESS CORRECTLY. M Montpellier.	N Chester.	O Geneva. M. Mallet.	P Mankind in general. Lambert.	Q Breslaw.	R Northampton.	Age.
0	38·72	...	...	34·42	36·12	39·39	0	25·36	36·70	40·18	29·00	...	25·18	0
5	51·25	...	48·25	46·79	47·92	50·01	5	45·40	45·32	46·56	42·20	41·25	40·84	5
10	48·82	48·32	46·83	45·07	46·16	47·63	10	45·45	43·55	43·67	40·90	40·42	39·78	10
15	45·00	45·03	43·50	41·64	42·63	43·81	15	41·54	39·70	40·14	37·60	37·50	36·51	15
20	41·46	41·67	40·25	38·02	38·96	39·98	20	37·99	36·48	37·07	33·80	34·17	33·43	20
25	37·86	38·12	37·17	34·58	35·47	36·33	25	34·90	33·39	34·24	30·50	30·93	30·85	25
30	34·34	34·53	34·08	31·21	32·12	32·68	30	31·89	30·76	31·21	27·60	27·93	28·27	30
35	31·00	30·93	30·92	28·03	28·82	29·06	35	28·85	27·62	27·75	24·90	25·00	25·68	35
40	27·61	27·40	27·50	24·66	25·45	25·50	40	25·75	24·65	24·33	22·30	22·33	23·08	40
45	24·46	23·87	23·92	21·61	22·26	22·07	45	22 72	21·85	20·96	19·60	19·67	20·52	45
50	21·11	20·36	20·42	18·46	19·03	18·65	50	19·79	19·13	17·80	16·80	17·25	17·99	50
55	17·58	16·99	17·25	15·53	15·90	15·55	55	16·98	16·33	14·86	14·20	14·83	15·58	55
60	14·34	13·91	14·25	12·63	12·85	12·60	60	14·44	13·28	12·11	11·80	12·42	13·21	60
65	11·79	11·13	11·25	10·10	10·19	9·93	65	12·12	11·37	9·76	9·90	9·93	10·88	65
70	9·18	8·70	8·67	7·72	8·01	7·50	70	9·90	8·43	7·81	8·20	7·58	8·60	70
75	7·01	6·61	6·50	5·91	6·27	5·67	75	7·88	7·70	5·96	6·50	5·58	6·54	75
80	5·51	4·75	4·67	4·28	4·85	4·17	80	5·86	5·32	4·72	5·70	4·50	4·75	80
85	4·12	3·39	3·17	3·23	3·84	3·23	85	4·07	4·53	3·68	6·50	...	3·37	85
90	3·28	2·56	1·75	2·05	3·03	2·36	90	3·62	2·98	3·46	5·00	..	2·41	90

Mortality, Law of.

TABLE V.

Exhibiting the Law of Mortality that prevailed among the whole Population of Sweden and Finland, during the five years ending with 1805, according to two different methods of constructing tables.

Age.	MORE CORRECTLY.		LESS CORRECTLY.				Age.	Age.	MORE CORRECTLY.		LESS CORRECTLY.				Age.
	A	B	C	D	E	F			A	B	C	D	E	F	
	Number who complete that year of age.	Number who die in their next year.	Number who die in their next year.	Out of the undermentioned number who complete that year by hypothesis.	Out of the undermentioned number who complete that year by observation.	Errors of the hypothesis.			Number who complete that year of their age.	Number who die in their next year.	Number who die in their next year.	Out of the undermentioned number who complete that year by hypothesis.	Out of the undermentioned number who complete that year by observation.	Errors of the hypothesis.	
0	10,000	1888	2565	10,000	13,586	3586	0	50	4,647	93	81	3,418	4,047	629	50
1	8,112	453	625	7,435	11,192	3757	1	51	4,554	98	[illegible]	3,337	3,950	613	51
2	7,659	256	365	6,810	10,920	4110	2	52	4,456	98	86	3,252	3,910	658	52
3	7,403	177	261	6,445	10,916	4471	3	53	4,358	100	87	3,166	3,792	626	53
4	7,226	130	196	6,184	10,895	4711	4	54	4,258	101	87	3,079	3,668	589	54
5	7,096	112	144	5,988	9,123	3155	5	55	4,157	103	86	2,992	3,471	479	55
6	6,984	84	106	5,844	8,813	2969	6	56	4,054	109	86	2,906	3,199	293	56
7	6,900	68	84	5,738	8,524	2786	7	57	3,945	114	86	2,820	2,976	156	57
8	6,832	56	68	5,654	8,296	2642	8	58	3,831	118	86	2,734	2,792	58	58
9	6,776	47	59	5,586	8,506	2920	9	59	3,713	123	89	2,648	2,687	39	59
10	6,729	39	49	5,527	8,454	2927	10	60	3,590	130	95	2,559	2,624	65	60
11	6,690	36	43	5,478	7,991	2513	11	61	3,460	134	98	2,464	2,530	66	61
12	6,654	33	40	5,435	8,065	2630	12	62	3,326	136	100	2,366	2,446	80	62
13	6,621	31	39	5,395	8,330	2935	13	63	3,190	136	101	2,266	2,369	103	63
14	6,590	32	39	5,356	8,032	2676	14	64	3,054	140	103	2,165	2,247	82	64
15	6,558	35	39	5,317	7,308	1991	15	65	2,914	145	103	2,062	2,070	8	65
16	6,523	35	39	5,278	7,269	1991	16	66	2,769	145	104	1,959	1,986	27	66
17	6,488	35	39	5,239	7,230	1991	17	67	2,624	149	105	1,855	1,849	— 6	67
18	6,453	37	40	[illegible]	6,976	1776	18	68	2,475	153	106	1,750	1,715	— 35	68
19	6,416	39	44	5,160	7,239	2079	19	69	2,322	159	109	1,644	1,592	— 52	69
20	6,377	43	47	5,116	6,970	1854	20	70	2,163	168	116	1,535	1,494	— 41	70
21	6,334	[illegible]	49	5,069	7,218	2149	21	71	1,995	171	121	1,419	1,412	— 7	71
22	6,291	46	50	5,020	6,838	1818	22	72	1,824	168	122	1,298	1,325	27	72
23	6,245	45	50	4,970	6,939	1969	23	73	1,656	166	121	1,176	1,207	31	73
24	6,200	45	50	4,920	6,889	1969	24	74	1,490	165	119	1,055	1,075	20	74
25	6,155	47	49	4,870	6,417	1547	25	75	1,325	158	111	936	931	— 5	75
26	6,108	46	49	4,821	6,506	1685	26	76	1,167	145	101	825	813	— 12	76
27	6,062	47	[illegible]	4,772	6,320	1548	27	77	1,022	133	94	724	722	— 2	77
28	6,015	47	49	4,723	6,271	1548	28	78	889	127	87	630	609	— 21	78
29	5,968	50	49	4,674	5,849	1175	29	79	762	118	82	543	530	— 13	79
30	5,918	49	50	4,625	6,039	1414	30	80	644	112	77	461	443	— 18	80
31	5,869	50	50	4,575	5,869	1294	31	81	532	100	69	384	367	— 17	81
32	5,819	52	51	4,525	5,707	1182	32	82	432	87	62	315	308	— 7	82
33	5,767	54	52	4,474	5,553	1079	33	83	345	74	55	253	256	3	83
34	5,713	54	53	4,422	5,607	1185	34	84	271	62	47	198	205	7	84
35	5,659	55	54	4,369	5,556	1187	35	85	209	52	38	151	153	2	85
36	5,604	56	55	4,315	5,504	1189	36	86	157	38	28	113	116	3	86
37	5,548	58	56	4,260	5,357	1097	37	87	119	30	21	85	83	— 2	87
38	5,490	60	57	4,204	5,216	1012	38	88	89	[illegible]	15	64	58	— 6	88
39	5,430	61	60	4,147	5,341	1194	39	89	66	17	12	49	47	— 2	89
40	5,369	65	62	4,087	5,121	1034	40	90	49	15	9	37	29	— 8	90
41	5,304	68	65	4,025	5,070	1045	41	91	34	11	7	28	22	— 6	91
42	5,236	70	67	3,960	5,011	1051	42	92	23	9	6	21	15	— 6	92
43	5,166	70	68	3,893	5,018	1125	43	93	14	5	5	15	14	— 1	93
44	5,096	71	67	3,825	4,809	984	44	94	9	4	4	10	9	— 1	94
45	5,025	71	66	3,758	4,671	913	45	95	6	[illegible]	3	6	8	2	95
46	4,954	72	66	3,692	4,541	849	46	96	3	1	2	3	6	3	96
47	4,882	73	67	3,626	4,481	855	47	97	2	1	1	1	2	1	97
48	4,809	78	68	3,559	4,193	634	48	98	1	1	0	0	0	0	98
49	4,731	84	73	3,491	4,111	620	49								

TABLE VI.—*Exhibiting the Expectation of Life in Sweden and Finland, both according to Columns A and D of the preceding Table.*

Age.	A. More Correct.	D. Less Correct.	Age.	A. More Correct.	D. Less Correct.
	Expectation of Life.			Expectation of Life.	
0	39·385	30·863	50	18·651	18·159
5	50·014	45·719	55	15·550	15·384
10	47·629	44·361	60	12·598	12·562
15	43·509	41·019	65	9·933	9·978
20	39·980	37·531	70	7·497	7·536
25	36·330	34·299	75	5·665	5·752
30	32·084	30·983	80	4·165	4·259
35	29·063	27·650	85	3·232	3·361
40	25·495	24·382	90	2·357	2·770
45	22·066	21·294	95	1·700	1·167

TABLE VII.—*Exhibiting the Increase of the Total Pop. of Sweden and Finland, and the Decrease of the Absolute Number above 90 Years of Age, throughout the latter half of the Eighteenth Century.*

In the Year	Total Pop. of Sweden and Finland.	Above 90 Years.	Who were born between the Years
1757	2,323,196	1609	1657 and 1667
1760	2,367,398	1574	1660 ... 1670
1763	2,446,394	1515	1663 ... 1673
Mean No. between 1776 and 1780	2,706,757	1082	1676 ... 1690
1781 ... 1785	2,823,826	1014	1681 ... 1695
1786 ... 1790	2,884,834	1072	1686 ... 1700
1791 ... 1795	2,974,447	907	1691 ... 1705
In 1800	3,182,132	637	1700 ... 1710
In 1805	3,320,647	837	1705 ... 1715

(J. M.)

APPENDIX.

The following Tables will be found to contain, in a condensed form, the most important vital statistics of England published on this subject since the above article was written:—

Annual Rate per Cent. of Marriages, Births, and Deaths in England, during the Years 1847–57.

	1847.	1848.	1849.	1850.	1851.	1852.	1853.	1854.	1855.	1856.	Mean. 1847–56.	1857.
Estim. Pop. of Eng. in *thousands* in middle of each year.	17,132	17,340	17,552	17,766	17,983	18,206	18,403	18,619	18,787	19,045	—	19,304
Marriages	·793	·797	·808	·860	·858	·872	·894	·858	·810	·836	·839	—
Births	3·152	3·247	3·294	3·340	3·425	3·428	3·328	3·407	3·380	3·454	3·346	—
Deaths	2·471	2·306	2·512	2·077	2·199	2·236	2·288	2·352	2·266	2·055	2·276	—

Annual Rate of Mortality per Cent. of Males and Females at different Ages in England.

Years—	1838.	1839.	1840.	1841.	1842.	1843.	1844.	1845.	1846.	1847.	1848.	1849.	1850.	Average 1838–50.
	Deaths to 100 Males living.													
All ages	2·343	2·281	2·377	2·242	2·244	2·206	2·245	2·173	2·398	2·549	2·394	2·584	2·147	2·322
0	7·041	7·167	7·542	6·843	7·048	6·898	6·984	6·665	7·760	7·588	7·401	7·513	6·695	7·165
5	·901	·904	1·083	·956	·901	·844	·897	·823	·826	·970	1·043	1·124	·814	·930
10	·519	·512	·542	·510	·501	·478	·473	·466	·507	·550	·530	·646	·467	·515
15	·851	·819	·832	·811	·783	·772	·763	·781	·859	·929	·858	·951	·717	·825
25	1·064	·986	·995	·978	·928	·924	·940	·926	1·025	1·100	1·026	1·243	·879	1·001
35	1·342	1·255	1·286	1·217	1·197	1·218	1·225	1·262	1·272	1·436	1·303	1·581	1·165	1·283
45	1·949	1·798	1·796	1·785	1·733	1·722	1·750	1·715	1·800	2·065	1·864	2·262	1·716	1·843
55	3·410	3·192	3·142	3·137	3·041	3·008	3·051	2·975	3·129	3·649	3·286	3·655	2·980	3·203
65	6·916	6·421	6·678	6·482	6·595	6·578	6·736	6·491	6·758	7·696	6·793	7·244	6·306	6·746
75	14·752	13·874	14·488	14·266	14·578	14·690	14·651	14·400	15·070	17·326	14·986	15·187	14·019	14·745
85	29·745	27·923	30·242	29·650	29·438	28·758	31·716	30·191	32·214	35·553	30·622	29·976	28·555	30·353
95 & up.	49·699	43·112	48·498	46·633	46·427	45·681	43·228	49·035	51·651	56·607	42·435	42·859	38·560	46·494
	Deaths to 100 Females living.													
All ages	2·136	2·094	2·205	2·085	2·100	2·048	2·085	2·013	2·222	2·381	2·225	2·447	2·014	2·158
0	6·047	6·138	6·432	5·861	6·023	5·897	5·885	5·657	6·675	6·553	6·396	6·488	5·738	6·138
5	·895	·935	1·113	·963	·925	·848	·902	·890	·813	·951	·997	1·102	·810	·927
10	·543	·535	·569	·520	·512	·485	·503	·476	·533	·577	·566	·653	·491	·536
15	·854	·848	·868	·842	·830	·784	·810	·815	·870	·919	·878	1·000	·777	·853
25	1·046	1·007	1·033	1·007	1·065	·976	1·066	·980	1·048	1·173	1·090	1·347	·988	1·054
35	1·313	1·248	1·269	1·227	1·220	1·227	1·200	1·188	1·242	1·422	1·301	1·617	1·169	1·260
45	1·660	1·549	1·567	1·542	1·526	1·484	1·525	1·467	1·559	1·789	1·589	1·998	1·473	1·594
55	2·977	2·730	2·829	2·740	2·744	2·692	2·773	2·668	2·783	3·226	2·860	3·355	2·625	2·846
65	5·919	5·554	5·899	5·841	6·013	5·877	6·052	5·856	6·156	6·964	6·072	6·596	5·717	6·040
75	13·281	12·519	13·541	13·375	13·084	13·037	13·494	13·036	13·794	15·945	13·604	14·028	12·684	13·494
85	26·463	25·242	28·394	28·255	28·438	27·655	28·434	27·569	35·350	32·104	27·623	28·028	25·922	28·037
95 & up.	41·099	39·915	46·199	45·907	42·832	46·679	44·616	42·036	52·200	58·230	46·816	43·323	42·927	45·214

The Table may be read thus:—Of 100 Males living of the age of 35 and under 45, 1·342 died in 1838, 1·255 in 1839, 1·217 in 1841, and so on for other years; a correction for increase of Pop. having been made for each Age at each Year. (The data upon which these Tables are constructed appeared in the Census Report for 1851; and in the Ann. Reps. of the Reg. Gen., particularly the 6th.)

Mortality, Law of.

Countries *arranged according to Mortality in Native Race, with Ratio of Deaths in every* 1000 *of Population per Annum.*

Mortality, Law of.

Montserrat	6·7
Tortola	9·6
New Zealand	11·4
South Australia	12·7
Western Australia	13·2
Newfoundland	13·2
Van Diemen's Land	13·3
Ceylon	13·6
Ithaca	13·6
Norfolk Island	14·5
Java	14·6
Ireland	14·8
New South Wales	15·2
Cerigo	15·5
Bahama Islands	15·9
Palma	17·3
Venezuela	18·3
Bermudas	18·5
Cape of Good Hope	18·7
New Granada	19·2
Cephalonia	19·3
Lanzarote	19·3
Norway	19·5
Portugal	20·0
Fuerteventura	20·1
Transylvania	20·5
Madeira	20·6
Denmark	21·1
Mechlenburg-Schwerin	21·1
Teneriffe	21·1
French Possess. in India	21·2
Canary Islands	21·4
England and Wales	21·4
St Helena	21·7
Scotland	22·2
Hanover	23·0
St Pierre and Miguelon	23·2
Dalmatia	23·2
Sweden	23·3
Ionian Islands	23·5
France	23·6
Hierro	23·6
Lower Canada	23·9
Isle of Bourbon	24·1
Barbadoes	24·2
Malacca	24·3
Santa Maura	24·4
U. Canada (Indians)	24·5
Switzerland	24·5
Lucca	24·6
St Christopher	24·6
Canary	25·1
Belgium	25·2
Hungary	25·5
Carinthia and Carniola	26·1
Pazo	26·2
Gozo	26·3
Sierra Leone	26·3
Gomera	26·4
Corfu	26·4
Nevis	26·9
Tyrol	27·1
Saxony	27·2
White Russia	27·2
Holland	27·6
Malta	28·1
Upper Austria	28·2
Styria	28·2
Prussia	28·3
N. Russian Provinces	28·9
Bohemia	29·1
Sardinia	29·1
Moravia and Silesia	29·2
Naples	29·2
Bavaria	29·2
Baltic Provinces	29·3
Tuscany	29·5
Martinique	29·6
Siberia	30·0
Illyrian Coast	30·1
Nova Scotia	30·3
Guadaloupe	30·5
Demerara	30·8
Lithuania	31·3
Venice, Province	32·2
Galicia	32·7
Lombardy	32·8
Franconia	33·0
Zante	33·1
Algiers	33·3
Moldavia	34·0
Wurtemberg	34·6
New Russia	35·4
Grenada	35·5
Lower Austria	36·5
Trinidad	37·1
Great Russia	38·1
Iceland	39·1
Military Frontier	40·0
Ural Provinces	40·1
Sicily	40·3
Little Russia	41·3
Volta and Caspian Prov.	41·8
Tobago	42·3
Mauritius	45·3
Dominica	46·2
Senegal	47·2
[redacted]	57·6
Gambia	68·2
Azores, Oriental	25·9
Central	29·5
Occidental	102·8

Cities *arranged according to Mortality in Native Race, with Ratio of Deaths in every* 1000 *of Population per Annum.*

St John's, Newfoundland	13·7
Lowell, United States	14·4
Hobart Town, Van D. Ld.	15·2
Berbice, Demerara	19·5
Cork	19·7
Boston	20·3
Frankfort	20·4
Geneva	22·2
Gibraltar	22·3
London	[redacted]
St Petersburg	24·7
Hanover	24·5
Cologne	25·0
Belfast	25·4
Birmingham	26·0
New York	26·3
Baltimore	26·6
Scottish Towns	26·6
Glasgow	28·7
Edinburgh	24·0
Dundee	25·5
Aberdeen	21·3
Philadelphia	26·8
Copenhagen	26·9
Leipsic	26·9
Turin	27·2
Havannah	27·5
Archangel	28·4
Leghorn	28·6
Berlin	29·4
Stettin	29·4
Paris	29·6
Dublin	30·5
Dresden	30·7
Gratz	30·8
Dantzic	31·3
Cape Town	31·3
Innsbruck	31·7
Odessa and Russ. townsh.	31·7
Manchester	32·1
Hamburg	32·3
Liverpool	33·6
Konigsberg	34·2
Laibach	34·4
Brussels	36·3
Brunn	36·5
Milan	36·7
Genoa	36·9
Cadiz	37·0
Queretaro, New Spain	37·9
Guanaxuato, do.	38·8
Linz	38·1
Naples	38·8
Breslau	39·8
Amsterdam	39·0
Barcelona	39·7
Stuttgart	40·0
Prague	40·0
Stockholm	42·2
Trieste	45·3
Vienna	46·1
Rennes	46·8
Rome	47·4
Venice	47·9
Vicenza	51·3
Calcutta	51·1
Zara	52·0
Valparaiso	53·1
New Orleans	60·6
Limburg	65·8
Alexandria	73·0
Groningen	94·0

Mortality of White Races of Mankind in Foreign Countries.

TROOPS, &c.

New Zealand	11·4
Cape of Good Hope	13·7
New South Wales	14·0
Van Diemen's Land	14·0
Norfolk Island	14·5
Nova Scotia, New Brunswick	14·7
United States (North)	15·6
Canada	16·1
Malta	16·3
Bengal Civil Servants	21·1
Gibraltar	21·4
Newfoundland	22·0
Ionian Islands	25·0
Bourbon, Isle of	25·6
Mauritius	27·4
French Guiana	28·1
Bermudas	28·8
St Helena	33·0
Norfolk Island (new convicts)	33·0
Tenasserim	34·6
China (Chusan)	37·0
Madras (E. I. Co's. troops)	38·4
Antigua and Montserrat	40·6
Newfoundland	41·0
United States (Middle)	44·6
Madras (Queen's troops)	48·0
United States (South)	48·5
Bombay (E. I. Co's. troops)	50·7
St Vincent's	54·9
West Indies	55·1
Grenada	61·8
East Indies	68·9
Ceylon	69·8
St Kitts, Nevis, Tortola	71·0
Bengal (E. I. Co's. troops)	73·8
British Guiana	84·0
Morea, Greece	84·6
Algiers	87·8
Bengal (Queen's troops)	90·2
Guadaloupe	96·3
China (Hong Kong)	97·5
Martinique	100·4
Zealand	103·0
Bombay (Queen's troops)	105·2
Honduras	103·0
Trinidad	106·3
Senegal	121·0
Jamaica	121·3
Spain (British troops)	118·6
St Lucia	122·8
Dominica	137·4
Tobago	152·8
Bahamas	200·0
China	285·0
Burmah	426·0
Sierra Leone	483·0
Cape Coast	668·0
St Domingo	943·1

RESIDENTS.

Tobago	10·5
Cape of Good Hope	13·8
Van Diemen's Land (excluding convicts)	20·1
St Helena	21·7
Malta (British only)	22·5
Cumberland District, Australia (Rom. Catholics)	22·5
New South Wales (with convicts)	23·2
Do. (excluding convicts)	33·0
Cumberland District, Australia (Protestants)	26·1
Adelaide alone	27·9
Antigua and Montserrat	29·0
Malacca (Europeans)	30·0
Cape Town	31·3
Calcutta	35·1
Malacca (Portuguese descendants)	38·4
Barbadoes	38·5
Algiers	40·5
Mauritius (white and coloured pop.)	45·3
Honduras	57·8
New Orleans	73·7
St Lucia	82·1
Calcutta (Portuguese and French descendants)	124·4

MORTAR, a chemical utensil, used for the division of bodies, partly by percussion and partly by grinding. Mortars have usually the form of an inverted bell, and are made either of iron, stone, stoneware, or glass, &c., according to the use to which they are applied. For the finer chemical processes they are often composed of agate, flint, or porphyry. The matter intended to be pounded is put into them, and then struck and bruised by an instrument denominated a *pestle*.

MORTAR, in the military art, is a short cannon of a large bore, with chambers. It is made of brass or iron, and is used to project hollow shells, filled with powder, called bombs, and sometimes also carcasses. (See ARTILLERY.) The mortars used at sea are fixed in bomb-vessels, which are constructed for their reception; they are made somewhat longer and much heavier than those employed on land. The mortar is the most ancient kind of cannon, and was first made in England in 1543. (See GUNNERY.)

MORTARA, a walled town of the kingdom of Sardinia, in Italy, the capital of the province of Lomellina, is situated on an eminence on the right bank of the Arbogna, which is here crossed by a bridge, 14 miles S.S.E. of Novara. The principal buildings are,—three churches, a court-house, a theatre, several schools, and an hospital. There is some trade in rice, grain, and silk. The situation of the town is unhealthy; and from this circumstance it is said to derive its name, being a corruption of *mortis ara*. Another account, however, derives this name from the battle fought here in 774 A.D., when the Lombards were defeated by Charlemagne with great slaughter. Pop. 5316.

MORTIER, EDOUARD-ADOLPHE-CASIMIR-JOSEPH, Duke of Treviso and Marshal of France, was born at Chateau-Cambresis in 1768. At the age of twenty-three he entered the army of the Revolution as captain in a battalion of volunteers. He fought with distinction at the battles of Jemeppes and Neerwinden, and was gradually promoted. In 1799 the rank of general of brigade had been conferred upon him. Serving soon afterwards as a general of division in the army of Switzerland, he led the right wing of Massena's forces in the battle of Zurich. His next important service was the occupation of the electorate of Hanover in 1803. On his return in the following year, his valour was publicly acknowledged by Bonaparte; and a marshal's baton and the rank of general of the consular guard were conferred upon him. He supported his reputation at the battle of Friedland in 1807. The title of Duke of Treviso was bestowed upon him in 1808. At the head of the 5th corps in the army of Spain he defeated the Spaniards at Ocana in 1809, and at Jebora in 1811. He served under Napoleon in the Russian expedition, and at all the important battles of 1813 and 1814. In this latter year the defence of Paris against the victorious allies was entrusted to him and Marshal Marmont. He was one of those who sent in their allegiance to Louis XVIII. at the commencement of the Hundred Days, recalled it when Napoleon landed from Elba, and renewed it after the battle of Waterloo. Yet his attachment to the Bourbons did not prevent him, after the Revolution of 1830, from rising into favour with Louis Philippe. He was riding by the side of that monarch at a review of the National Guard of Paris, on the 28th July 1835, when the infernal machine of Fieschi, intended for the destruction of royalty, exploded. Marshal Mortier was among the number of those who were struck dead on the spot.

MORTIMER, JOHN HAMILTON, a noted artist, was the son of a collector of customs, and was born at Eastbourne in Sussex in 1741. His early-developed talent for painting found congenial subjects among the rocks and woods of his native shore. He repaired to London about his eighteenth year, and studied his art first under Hudson, and afterwards under Pine. At the same time he executed several imitations of the antique figures in the gallery of the Duke of Richmond. Some of these secured for him premiums from the Society for the Encouragement of Art, and facilitated his admission into the private academy in St Martin's Lane. But his first introduction to general notice was his representation of "Edward the Confessor seizing the Treasures of his Mother," a painting which, by the judgment of Sir Joshua Reynolds, received the prize of fifty guineas, in preference to a rival picture by Romney. His great work, "St Paul preaching to the Britons," was executed soon afterwards, and raised him to the height of popularity. Yet owing to his rapidity of execution, and his tameness in colouring, Mortimer did not reach a high excellence in historical painting. He excelled far more in the designs which he threw off for the booksellers. In these his facile hand sketched with unerring skill the forms that his happy fancy conceived or his well-stored memory suggested. He was also unrivalled in his feats of rapid and dexterous drawing; and in his creation of fantastic and striking images. This eccentricity and fondness for display was not confined merely to his art,—it extended also to his ordinary life. Gaudy dress, convivial pleasures, athletic contests, and grotesque buffoonery, occupied a great part of his time and attention. At length he married and settled down into sobriety of life, but not before his constitution had become prematurely weak. In 1775 his health began to decline, and rendered it necessary that he should retire into the pure air of the country. His rapid power of painting, however, remained unimpaired; and in his rural retreat at Aylesbury in Berks he produced in one year a number of pictures of the united value of L.900. He returned to London in 1778, and died of a fever in February of the following year. The best known historical paintings of Mortimer, in addition to the two already mentioned, are "King John signing the Magna Charta," "The Battle of Agincourt," "The Origin of Health," "The Tragic and Comic Muses," "Sextus consulting Erietho from Lucan," "The Incantation," and "Vortigern and Rowena." (See Cunningham's *Lives of British Painters*, &c.)

MORTMAIN, or ALIENATION IN MORTMAIN (*in mortua manu*), is an alienation of lands or tenements to any corporation, sole or aggregate, ecclesiastical or temporal. But these purchases having been chiefly made by religious houses, in consequence of which the lands became perpetually inherent in one dead hand, this occasioned the general appellation of *mortmain* to be applied to such alienations, and the religious houses themselves were principally considered in framing the statutes of mortmain. In deducing the history of these statutes, it will be matter of curiosity to observe the great address and subtle contrivance of the ecclesiastics, in eluding from time to time the laws in being, and the zeal with which successive Parliaments pursued them through all their finesses; how new remedies were still the parents of fresh evasions, until the legislature at last, though with difficulty, obtained a decisive victory.

By the common law, any man might dispose of his lands to any other private man at his own discretion, especially when the feudal restraints of alienation were worn away. Yet in consequence of these it was always, and still is, necessary for corporations to have a license of mortmain from the crown, to enable them to purchase lands; for as the sovereign is the ultimate lord of every fee, he ought not, unless by his own consent, to lose his privilege of escheats and other feudal profits, by the vesting of lands in tenants who can never be attainted or die. Such licenses of mortmain appear to have been necessary amongst the Saxons above sixty years before the Norman conquest. But, besides this general license from the King as lord paramount of the kingdom, it was also requisite, whenever there was a mesne or intermediate lord between the King and the alienator, to obtain his license also for the alienation of the

specific land; and if no such license was obtained, the King or other lord might respectively enter on the land so alienated in mortmain, as a forfeiture. The necessity of this license from the crown was acknowledged by the Constitutions of Clarendon, in respect of advowsons, which the monks always greatly coveted, as forming the groundwork of subsequent appropriations. Yet such were the influence and ingenuity of the clergy, that notwithstanding this fundamental principle, we find that the largest and most considerable donations of religious houses happened within less than two centuries after the Conquest. When a license could not be obtained, they contrived that, as the forfeiture for such alienations accrued in the first place to the immediate lord of the fee, the tenant who meant to alienate should first convey his lands to the religious house, and instantly take them back again to hold as tenant to the monastery, which kind of instantaneous seisin was probably given not to occasion any forfeiture; and then, by pretext of some other forfeiture, surrender, or escheat, the society entered into those lands in right of such their newly-acquired signiory, as immediate lords of the fee. But when these donations began to grow numerous, it was observed that the feudal services ordained for the defence of the kingdom were every day visibly withdrawn; that the circulation of landed property from man to man began to stagnate; and that the lords were curtailed of the fruits of their signiories, their escheats, wardships, reliefs, and the like. To prevent this, therefore, it was ordained by the second of King Henry III.'s great charters, and afterwards by that printed in the common statute-books, that all such attempts should be void, and the land forfeited to the lord of the fee.

But as this prohibition extended only to religious houses, bishops and other sole corporations were not included therein; and the aggregate ecclesiastical bodies, who had among their counsel the most learned men that they could get, found many means to creep out of this statute; by buying in lands which were *bonâ fide* holden of themselves as lords of the fee, and thereby evading the forfeiture; or by taking long leases for years, which first introduced those extensive terms, for a thousand or more years, which are now so frequent in conveyances. This produced the statute *De Religiosis*, 7 Edward I., which provided, that no person, religious or other whatsoever, should buy or sell, or receive under pretence of a gift, or term of years, or any other title whatsoever, nor should by any art or ingenuity appropriate to himself any lands or tenements in mortmain, upon pain of the immediate lord of the fee, or in default of him for one year the lords paramount, and in default of all of them the King, entering thereon as a forfeiture.

This seemed to be a sufficient security against all alienations in mortmain. But as these statutes extended only to gifts and conveyances between the parties, the religious houses now began to set up a fictitious title to the land which it was intended they should have, and to bring an action to recover it against the tenant, who, by arrangement and collusion, made no defence; and thereby judgment was given for the religious house, which then recovered the land by a sentence of law upon a supposed prior title. And thus they had the honour of inventing those fictitious adjudications of right which afterwards became the great assurance of the kingdom, under the name of *common recoveries*. But upon this it was enacted by the second statute of Westminster, 13 Edward I., c. 32, that in such cases a jury shall try the true right of the demandants or plaintiffs to the land; and if the religious house or corporation be found to have it, they shall still recover seisin; otherwise it shall be forfeited to the immediate lord of the fee, or else to the next lord, and finally to the King, upon default of the immediate or other lord. A similar provision was made by the succeeding chapter, in case the tenants should set up crosses upon their lands, the badges of knights templars and hospitallers, in order to protect them from the feudal demands of their lords, by virtue of the privileges of those religious and military orders. And so careful was this prince to prevent any future evasions, that when the statute of *Quia emptores*, 18 Edward I., abolished sub-infeudations, and gave liberty to all men to alienate their lands to be holden of their next immediate lord, a proviso was inserted that this should not extend to authorize any kind of alienation in mortmain. When, afterwards, the method of obtaining the King's license by writ of *ad quod damnum* was marked out by the statute 27 Edward I., st. 2, it was further provided, by statute 34 Edward I., st. 3, that no such license should be effectual without the consent of the mesne or intermediate lords.

Yet still it was found difficult to set bounds to ecclesiastical ingenuity; for when the clergy were driven out of all their former holds, they devised a new method of conveyance, by which the lands were granted, not to themselves directly, but only to nominal feoffees for the use of the religious houses, thus distinguishing between the possession and the use, and receiving the actual profits, whilst the seisin of the land remained in the nominal feoffee, who was held by the courts of equity, then under the direction of the clergy, to be bound in conscience to account to his *cestuy que use* for the rents and emoluments of the estate. And it is to these inventions that our practitioners are indebted for the introduction of uses and trusts, the foundation of modern conveyancing. But unfortunately for the inventors themselves, they did not long enjoy the advantage of their new device; for the statute 15 Richard II., c. 5, enacts, that the lands which had been so purchased to uses should be admortised by license from the crown, or else be sold to private persons; and that for the future, uses should be subject to the statutes of mortmain, and forfeitable like the lands themselves. And as the statutes had been notoriously eluded by purchasing large tracts of land adjoining to churches, and consecrating them by the name of "churchyards," such subtle imagination was also declared to be within the compass of the statutes of mortmain. Civil or lay corporations, as well as ecclesiastical, were also declared to be within the mischief, and of course within the remedy provided by those salutary laws. Lastly, as during the times of Popery lands were frequently given for superstitious uses, though not to any corporate bodies, or were rendered liable in the hands of heirs and devisees to the charge of obits, chantries, and the like, which were equally pernicious with actual alienations in mortmain; therefore, at the dawn of the Reformation the statute 23 Henry VIII., c. 10, declared that all future grants of lands for any of the purposes aforesaid, if granted for any longer term than twenty years, should be void.

But during the whole of this time it was in the power of the crown, by granting a license of mortmain, to remit the forfeiture, as far as related to its own rights, and to enable any spiritual or other corporation to purchase and hold any lands or tenements in perpetuity—a prerogative which is declared and confirmed by the statute 18 Edward III., st. 3, c. 3. But as doubts were entertained at the time of the revolution how far such license was valid, since the King had no power to dispense with the statutes of mortmain by a clause of *non obstante*, which was the usual course, though it seems to have been unnecessary; and as by the gradual declension of mesne signiories through the long operation of the statute of *Quia emptores*, the rights of intermediate lords were reduced to a very small compass; it was therefore provided by the statute 7 and 8 William III., c. 37, that the crown for the future, at its own discretion, might grant licenses to alienate or take in mortmain, of whomsoever the tenements might be holden.

After the dissolution of monasteries under Henry VIII., though the policy of the next successor affected to grant

a security to the possessors of abbey lands, yet, in order to regain as much of them as either the zeal or timidity of their owners might induce them to part with, the statutes of mortmain were suspended for twenty years; and during that time any lands or tenements were allowed to be granted to any spiritual corporation without any license whatsoever. And long afterwards it was enacted by the statute 17 Car. II., c. 3, that appropriators might annex the great tithes to the vicarages, and that all benefices under L.100 per annum might be augmented by the purchase of lands without license of mortmain in either case; and the like provision has been since made in favour of the governors of Queen Anne's Bounty. It has also been held, that the statute 13 Henry VIII. before mentioned did not extend to anything but superstitious uses, and that therefore a man may give lands for the maintenance of a school, an hospital, or any other charitable uses. But as it was apprehended from recent experience that persons on their deathbeds might make large and improvident dispositions even for these good purposes, and defeat the political ends of the statutes of mortmain, it was therefore enacted by the statute 9 Geo. II., c. 36, that no lands or tenements, or money to be laid out thereon, should be given for or charged with any charitable uses whatsoever, unless by deed indented, executed in the presence of two witnesses twelve calendar months before the death of the donor, and enrolled in the Court of Chancery within six months after its execution (except stocks in the public funds, which may be transferred within six months previous to the donor's death), and unless such gift were made to take effect immediately, and were without power of revocation; and that all other gifts should be void. The two universities, their colleges, and scholars upon the foundation of the colleges of Eton, Winchester, and Westminster, were excepted from the operation of this act; but such exemption was granted with this proviso, that no college should be at liberty to purchase more advowsons than were equal in number to one moiety of the fellows or students upon the respective foundations.

Such is the history and condition of the law of mortmain, as stated by Blackstone (*Com.*, b. ii., c. 20). It has been to a certain extent modified by recent statutes. The Church-Buildings Acts, consolidated in 1840 (3 and 4 Vict., c. 60), exempted from the license in mortmain endowments for the sites of churches, parsonages, or glebes, "or for the use or benefit of any church or chapel, or of the incumbent or minister thereof, or for repairs thereof." There have been further partial changes in the Church-Buildings Acts, the latest in 1851 (14 and 15 Vict., c. 97), and property dedicated to purposes of education. A reference will be found to several of the statutes containing these modifications in the act 15 and 16 Vict., c. 49.

MORTON, Cardinal John, was born at Bere in Dorsetshire in 1410. He was educated at Baliol College, Oxford, and became principal of Peckwater Inn, now merged in Christ Church. His learning and talents introduced him to Cardinal Bourchier, and thus set him on the path to preferment. He was recommended to the notice of Henry VI., and was appointed a member of the Privy Council. Not less successful in the reign of Edward IV., he was nominated Bishop of Ely and Lord Chancellor of England in 1478, and was finally appointed one of the King's executors. His tried probity, however, did not fit him for the lawless service of the next King, Richard III., and he was imprisoned in the Castle of Brecknock. But contriving to escape, he fled to the Earl of Richmond on the Continent, and is said to have been the first who proposed a marriage between that prince and Elizabeth, the eldest daughter of Edward IV. At the death of Richard III., and the accession of Henry VII., a succession of preferments awaited Morton. He was appointed a privy-councillor; he was raised to the see of Canterbury in 1486; the chancellorship was again conferred upon him in 1487; and Pope Alexander VI. created him a cardinal in 1493. His death took place in September 1500.

Morton, *Thomas*, a successful writer of comedy, was born at Durham in 1764. After attending school at London, he enrolled as a student of Lincoln's Inn; but his love for dramatic amusements led him to spend his evenings in the theatres, and to study the drama more than the law. The knowledge of stage effect which he thus acquired was employed in the production of numerous plays. By their skilfully-arranged scenes, their strongly-contrasted characters, and their sudden transitions of feeling, these dramas secured the attention of mixed audiences. The acting of Lewis, Munden, and Emery greatly increased their effect. Accordingly, several of them, such as *The Way to get Married*, *A Cure for the Heart-Ache*, *Speed the Plough*, *The School of Reform*, and *The Invincibles*, secured a footing on the stage, which they still retain. Morton died in 1838.

MOSAIC, or Mosaic Work, an assemblage of little pieces of glass, marble, precious stones, and other substances, of various colours, cut in prisms, and fixed in a ground of cement, in such a manner as to imitate the colours and gradations of painting. This sort of work was used both for pavements and for ornamenting walls until a comparatively late period in the middle ages. It was much practised by the Byzantine artists, who re-introduced it into Italy. The most famous kinds of mosaic of recent times are the Roman and the Florentine. Pictures in mosaic were wrought at Rome in the eleventh and twelfth centuries. Some of the finest specimens of mosaics in existence are to be found in St Peter's at Rome. The origin of the name *mosaic* has not been accurately determined. The most probable derivation, however, is from the Greek *μυσειον*, Lat. *opus musivum*. (See the *Glossarium* of Ducange.)

MOSCHUS, a Greek bucolic poet, flourished at Syracuse about the close of the third century B.C. His genius was fostered by a study of the works, and probably by the friendship, of the pastoral poet Bion. He was also, according to Suidas, acquainted with the grammarian Aristarchus. Theocritus was his great model; but instead of the exquisite simplicity of that celebrated poet, he often displayed an excess of ornament and an over-refinement of style. His four extant idyls are *Fugitive Love*, *Europa*, *An Elegy on Bion*, and *Megara*. They have been usually edited with the works of Bion. (See Bion.) Many modern writers of different nations have imitated and translated them.

MOSCOW, the ancient capital of Russia, is situated in the government of the same name, in 55. 45. 13. N. Lat., and 55. 17. 11. E. Long., 698 versts, or 466 English miles, from St Petersburg, and 1349 versts, or 902 English miles, from the frontiers of Poland. The soil in its immediate neighbourhood is sandy and argillaceous. A great part of it is under cultivation, and is highly productive. The situation of Moscow is most happily chosen.

The town is divided into two unequal parts by the River Moskva. On the left bank, on which the larger part of the city stands, the surface is broken and hilly. On the right, at the distance of about a mile, rises an amphitheatre of low hills, covered with wood, called the Sparrow Hills, from the summit of which you obtain a fine view of the city. At your feet the river winds through beautiful meadows; rising beyond, you see a mingled mass of towers, gilded and painted domes, churches, monasteries, and palaces. The whole, when seen on a sunny day and under a clear sky, possesses an almost unearthly splendour, from the dazzling whiteness of the buildings, and the glancing brilliance of the gilded domes of the churches.

The River Moskva rises in the S.E. of the government of Moscow, towards the district of Mojaisk. Its course is very winding, and hence its name, which signifies "the winding" or "serpentine." In spring it becomes navigable

Moscow. by the melting of the snow and ice, and then by means of the River Oka, its junction with which falls into the Volga, affords a communication between Moscow and that great river.

The length of Moscow from the Sparrow Hills on the S.W. to the Preobrajensky Barrier on the N.E., is about 14 versts, or 10 English miles. Its width from E. to W. is about 10 versts, or 7 English miles; its circumference is about 20 English miles. It covers a larger extent of ground than any other European capital, excepting London and Constantinople.

Moscow is divided into three distinct circles within the rampart or earthen walls thrown round the whole city. The first or most remote from the centre is called the *Zemlianoi Gorod*, or Earth City. It lies between a line of streets called the *Sadova*, or Garden Street, because most of the houses have a garden or inclosure in front, and the Boulevards. The second division, the *Beloi Gorod*, or White City, is that part of the town which lies between the Boulevards and the Kitai Gorod. The general form of the Boulevards is that of an avenue of lime-trees for foot-passengers, on either side of which runs a carriage-road or street, the intervening space being filled up with clumps of small trees, shrubs, and flowers. The Beloi Gorod is the most aristocratic division of the town. The last circle is inclosed by an embattled wall, and covers a very extensive space of ground. It is almost entirely occupied by what is termed the Gosteeny-dvore, an immense mass of buildings divided into rows of shops, warehouses, and storehouses, each row being devoted to the sale of a particular kind of goods, and having the name of the article sold,—as, *e.g.*, Knife Row, Linen Row, Silk Row, Plate Row, &c. This division is called the *Kitai Gorod*, or Chinese Town. The origin of the name is not exactly known. One hypothesis is, that it was called after a small town of Lithuania of the same name, which was the birthplace of Helen, mother of Ivan IV., who built this division of the town. The most probable account of the name is, that it was at one time the great mart for Chinese goods. When, however, it is spoken of separately from the other divisions, it is simply called "Gorod," just as in London we speak of the "City." It may be added, that in other respects it bears a striking analogy to the "City" of London, being the centre of trade and business, and having within its limits the great commercial and civic buildings.

On the S.W. of the Kitai Gorod, and separated from it by a large square called the *Crasnaia*, or Red Square, stands the Kremlin, the ancient fortress of the city. It is built on the brow of a hill, at the foot of which flows the Moskva River. Its form is irregular, but almost approaching a triangle. A high crenellated wall surrounds it, broken at intervals by towers of various heights, and of pyramidal or spiral form. On three sides runs a sort of boulevard; and on the fourth side, over the bed of a small stream called the Neglinna, which is now conveyed by an underground canal into the Moskva, is a large public walk called the Alexander Gardens, from having been laid out by order of the Emperor Alexander I. These gardens are the work of a Scotchman. Taken as a whole, the Kremlin is one of the most original, beautiful, and striking objects that can well be conceived. Its commanding situation on the banks of the Moskva River; its high and venerable white walls, with its variously-coloured towers and steeples; the number and size of some of its fine buildings, with their painted roofs; the cathedrals, churches, monasteries, and belfries, their domes gilt, tin-plated, or green;—the whole presents a grandeur and beauty indescribable and altogether unique.

The interior of the Kremlin contains the imperial palace, a modern erection, replacing the older one, which in former days had been occupied by the Tsars, and in which Napoleon had spent a part of his disastrous sojourn in Moscow. Though a fine and spacious building, it strikes the eye as out of character with the general style of the Kremlin. Behind the new palace is a small one of great antiquity. The rooms have vaulted ceilings, completely covered with arabesque paintings, exceedingly rich and curious. Moscow.

The cathedrals are three in number,—the Church of the Assumption, built in 1472 A.D., where the Emperors of Russia are always crowned; the Church of the Archangel Michael, where, until St Petersburg was built, the Tzars were buried; and the Church of the Annunciation. Near these churches stands the Ivan Veliki tower, or Tower of John the Great. It was built by Boris Goudanoff about the year 1600. The best view of Moscow is to be obtained from it, as it commands more objects than that from any other place.

At the foot of the Kremlin stands the great bell of Moscow, said to be the largest in the world. Its circumference at the bottom is nearly 68 feet, and its height more than 21 feet. In the stoutest part it is 23 inches thick, and its weight has been computed to be 443,772 lb. It has never been hung, and was probably cast on the spot in which it now stands. When Dr Clarke visited Moscow in the year 1800 it was in a pit, the mouth of which was covered, and the entrance was by a trap-door, beneath which were ladders. Since then it has been raised, and now stands on a stone pedestal. A piece of the bell has been broken off. The fracture was occasioned, according to Dr Clarke, by water having been thrown upon it when heated by the building erected over it being on fire.

The other buildings of importance in the Kremlin are,—the Granite Palace or treasury, where the crowns, sceptres, coronation robes, &c. &c., are kept; the Senate-House; the Tchoudoff monastery; the Arsenal, along the outside of which lie a great number of cannon, most of them foreign, and taken in the campaign of 1812-14. Amongst them are two Russian cannon of immense size; the mouth of the largest is about 2 feet 6 inches in diameter; the weight of the metal is 2200 poods; the ball weighs 80 poods, or about 1 ton.

The Kremlin is approached by five gateways. One facing N.W., and opening into the Great Square, which divides the Kremlin from the Kitai Gorod, is called the *Spaskoi Varott*, or Gate of the Saviour, and sometimes the Holy Gate. Through this gate no male person is allowed to go without taking off his hat. Outside this gate stands one of the most remarkable buildings in Moscow,—the church of Vassili Blashenny, or Basilius the Blissful, erected by Ivan the Terrible after the conquest of Kasan—the work of an Italian architect. It is a strange blending of every imaginable style of architecture, thrown together in the most capricious and fanciful manner. In its principal feature, however, it is Tartar, and bears a strong resemblance to the oriental mosque. Its numerous and heavy cupolas, surmounted by gilded crosses, exhibit a striking contrast of colour and ornament.

Another gate of the Kremlin, also facing the N.W., and opening into the Great Square, is called the *Nicholskoi Varott*, or Gate of St Nicholas, and was the one blown up by the French. It has been restored with considerable taste and elegance.

About the middle of the Great Square is a monument consisting of the statues of Minim, citizen of Novogorod, and Prince Pojarsky, who together delivered Moscow from the Poles; an event which was followed by the election of Michael Feodorovitch, the first of the Romanoff dynasty, to the throne.

Among the remarkable buildings of Moscow should be mentioned the Church of our Saviour, not yet quite finished, erected in commemoration of the retreat of the French after the burning of Moscow in 1812. It was begun on the edge of the Sparrow Hills, and near the

Moscow.

spot where Napoleon took his first view of Moscow; but the ground giving way, the site was changed to the spot on which it now stands, on the opposite side of the river. The building is in the Byzantine style of architecture, and with its gilded domes is a conspicuous object, seen from every side of the city.

Another remarkable building, standing on high ground, in the Zemlianoi Gorod is the *Sukareva Bashnoi*, or Tower of Sukareff. It is now used as a reservoir to receive the water with which Moscow is supplied. The water, which is of excellent quality, is brought from the far-famed springs of Metischa, forty-two in number. From the Sukareva Bashnoi it is conveyed by underground pipes to fountains in various quarters of the town. The whole was done by order of Katherine II.

The Foundling Hospital, a magnificent pile of building on the banks of the Moskva, was founded by Katherine II. in 1763. Any person may bring an infant, and without giving any further information than whether it has been baptized, may leave it there. If at any future time the parents wish to have the child again, a card is given them with the number in which it is entered in the register of the establishment, the same number being hung round the child's neck. Connected with this hospital is a school for the education of orphan young ladies of noble birth; also a Lombard or loan bank, and a widow alms-house for the widows of civil officers.

Of the educational establishments of Moscow, the university is divided into 4 faculties, and had, in 1857, 40 professors and lecturers, and 1473 students. Of these last 63 belonged to the historico-philological faculty, 296 to the law, 950 to the medical, and 160 to the mathematical. The cadet corps, or military schools, are 3 in number, containing altogether 1285 cadets. The gymnasia, or public schools, are 4 in number. There is 1 commercial academy and 1 commercial school, 1 seminary for the education of the clergy, 1 academy for divinity students who desire a superior education to that given in the seminary. The Katherine Institution, founded by Katherine II., is devoted to the education of young ladies, and contains 290 pupils. The Elizabethan Institution, founded by the Empress Elizabeth, contains 173 pupils. The house of education in connection with the Foundling Hospital, already referred to, contains 700 pupils.

The number of churches is 375; of chapels, *i.e.*, places of worship connected with public institutions, 26; of monasteries, 21.

Moscow is a great centre of internal commerce, its position being peculiarly favourable for this. Its principal foreign trade is with China, with which for the teas of that country it used to exchange manufactured goods. Owing, however, to the frauds practised by the Moscow merchants, the Chinese will now only take gold and silver. Moscow is now the seat of the principal manufactures of Russia. There are, according to the latest statistics, in the government of Moscow 484 manufactories. Of these there are 135 of cotton, 117 silk, 30 cloth, 10 of chemical drugs and instruments, 7 of hats, 29 of leather, 1 sugar refinery, 6 distilleries of brandy, 8 of vinegar, 10 tallow foundries, 14 manufactories of tobacco, and some iron foundries, &c., &c.

The climate of Moscow is more healthy than that of most of the capitals of Europe. Its elevated position, the width of its streets, and the low elevation of its houses, allow a free circulation of air; but being unprotected by mountains, the winds are often very violent, and in the early summer vegetation frequently suffers severely from them. The summer is short, and would be very fine but for the sudden changes of weather to which it is subject, so that the winter is generally preferred; the sky is then of wonderful purity, and the respiration easier. The winter generally sets in about the middle of November, and lasts, with occasional thaws of short duration, till the beginning of April; the change from winter to summer is very rapid. The mean temperature in winter is 4° below zero, Fahr. Vegetation is vigorous. The ordinary grain crops raised in the neighbourhood of Moscow are rye and wheat. The common vegetables of England thrive well in the gardens in its environs. The silver birch and pine attain the same height as in Great Britain. The commonest trees, in addition to those just mentioned, are the pine, the lilac, and a kind of acacia. The ivy cannot stand the severity of the climate, but is cultivated indoors as an exotic.

History.

The origin of Moscow is wrapt in obscurity. The ordinary tradition is that it was founded by Youri Vladimorivitch Dolgorouki, in the middle of the twelfth century; the year given is 1147. The 700th anniversary of its foundation was kept in Moscow in the year 1847. The name of Moscow is supposed to have been taken from the River Moskva, on the banks of which it is built. The history for many centuries is little else than a record of fires, pestilences, sieges, and wars. Probably there is no other city in Europe which has suffered so frequently and so terribly from these calamities as the ancient capital of Russia. Its earliest traditions, alike with that last terrible event with which its name will be for ever associated in the mind of Europe, are of fire and sword. Moskva was for some time only an appendage of the principality of Vladimir, and shared the fate of other towns of that principality, being often sacked and burned by the Tartars. But it gradually grew into notice and importance; and about the middle of the thirteenth century history mentions a prince of Moscow, Michael, surnamed the Brave. The first prince of Moscow who obtained the title of Grand Prince was George Danilovitch, A.D. 1319. From this time the history of Moscow becomes the history of Russia. George was succeeded by his brother Ivan, surnamed Kalita, A.D. 1328. The Tartar khans were then the suzerains of Russia, and the Grand Princes received at their hands their investment to the princedom. Ivan was distinguished for the craft and ability of his dealings with his Tartar masters. He persuaded the primate to remove his residence from Vladimir to Moscow, and thus make the latter city the capital of Russia. The primate's name was Peter; he built the cathedral of the Assumption, and was the first patron saint of Moscow.

The geographical position of Moscow was peculiarly favourable to the grand design entertained by Ivan of consolidation. It formed the central point of those districts which, lying in the neighbourhood of Vladimir, might be expected to form a union of interest with the grand principality; and that union being accomplished by the appointment of a Muscovite prince to the sovereignty, the long-desired concentration of means to free the country from its oppressors was at length obtained. Ivan surrounded Moscow with wooden walls, and rebuilt the Kremlin. He was succeeded by his son Simeon Ivanovitch, surnamed the Proud, A.D. 1339. He carried on his father's policy, but with less success, owing to the dissensions among the Russian princes which disturbed his reign. His grandson Demetrius (A.D. 1359) was a man of great courage and energy, and did much to strengthen and consolidate the Russian power. He surrounded Moscow with stone walls. The most memorable event in the reign of his son and successor Vassili (A.D. 1389), was the retreat of Tamerlane from the walls of Moscow. Russian chroniclers relate that it was owing to the intervention of the Virgin of Vladimir, and that it took place at the moment when the people of Moscow met her image, which at Vassili's order had been sent for from Vladimir. The Grand Prince built a monastery on the spot where the meeting took place, and gave it the name of *Stretenka*, or Place of Meeting. In the course, however, of the same reign Moscow was besieged by another army of Moguls, and Vassili was com-

pelled to purchase peace by the sacrifice of his independence. The earlier part of his son Vassili's reign was full of disasters (A.D. 1425), but its termination was happier. He succeeded in freeing Moscow from the Tartar yoke, and consolidated his authority by decisive victories over the Novogorodians. His son Ivan, surnamed the Great (A.D. 1462), extended by conquest the Russian frontier to the Ural Mountains, made himself master of Novogorod, Tver, and Viatka, and formed an alliance with Maximilian, Prince of Austria, against Cassimir, King of Poland, and the Grand Duke of Lithuania. He was the first Grand Prince who took the title of Prince of all the Russias, and the name of Tzar, which is either a corruption of *Cæsar*, or more probably is of eastern origin, and signifies "king." He rebuilt the walls of the Kremlin, and in other respects greatly improved and added to the town. He was succeeded by his son Vassili (1505), who was equally great and prosperous with his father, and by the conquest of Pskoff, Seversky, and Smolensk, he made himself master of the whole of Russia. He was also successful in repelling an attack of the Crimean Tartars. Vassili received the ambassadors of Charles V. and Pope Clement who came to negotiate a treaty between Russia and Lithuania. They were accompanied by Herberstein, who has left an account of his visit to Moscow, written in Latin. The only part of Moscow at this period called the town was the Kremlin. The suburbs were occupied by mechanics. The houses were built at a distance from one another, and surrounded by gardens and corn-fields. The air was remarkably pure and healthy, and there were no endemic diseases. The number of houses was 4500, and the inhabitants 100,000; the shops were filled with the rich merchandise of Europe and Asia. Vassili died suddenly, after a short reign, leaving a son only three years old, A.D. 1543. This was Ivan the Terrible. The name was given him from the horrible crimes and deeds of blood which marked and disgraced the conduct of the latter part of his reign. In the beginning of his reign a terrible fire destroyed almost the whole of Moscow. The most memorable events of his reign were the conquest of Kasan, the taking of Astrachan, and the final destruction of the Tartar power in Russia.

His son and successor Fedor (A.D. 1581) reigned thirty years. The feebleness of his rule gave ample room for the exercise of faction and ambition; and his prime minister, Boris Goudanoff, having caused the death of the young Demetrius, the only direct heir to the throne, was, on the demise of Fedor, elected Tzar A.D. 1598. His son Fedor was dethroned by a monk who pretended to be the Demetrius whom Boris had caused to be put to death, and who obtained the aid of the Poles in support of his pretensions, A.D. 1605. The false Demetrius was driven from the throne and assassinated by Chouisk, who in his turn became Tzar. During his reign there were several pretenders to the throne, one of whom was supported by Sigismund, King of Poland, who took possession of Moscow and held it for two years. It was saved (A.D. 1610) by two Russians—Minim, a simple citizen merchant of Nishni Novogorod, and Prince Pojarsky, a nobleman who had been dangerously wounded by the Poles in a massacre of the Muscovites. They raised an army, and approaching Moscow, the town capitulated, thus relieving the inhabitants at the same time from the horrors of war and famine. Michael Fedorovitch, of the family of Romanoff, and by the female line descended from Ruric, the son of the patriarch of Russia, was then elected Tzar. His son and successor Alexis (A.D. 1645) was distinguished for his wise laws. Feodor, the son of Alexis, was succeeded by Peter the Great A.D. 1681.

The change of residence made by Peter from Moscow to St Petersburg did the former less injury than might have been expected. At first Peter made a law prohibiting, under severe penalties, the building of houses in Moscow; but after twenty years the prohibition was withdrawn, and the sovereigns themselves vied with the great families of the empire in embellishing their ancient capital with new monuments of their munificence and power. Peter himself built a large military hospital; and other important buildings have since been erected—among others, a printing-press, a university with two colleges, a foundling hospital, and an arsenal. Katherine II., in particular, magnificently restored the principal cathedrals, and added new buildings; she also prohibited the erection of wooden houses in the Beloi Gorod. At the beginning of this century travellers described Moscow as immense, triangular, half wooden half stone, interspersed with gardens, dirty and badly paved, and in many points more resembling an overgrown village than the second capital of a great empire. The terrible catastrophe of 1812 has, however, made a vast difference in the external appearance of Moscow. On Wednesday, September 15, Napoleon took up his head-quarters in the Kremlin, and on the same day the fire broke out in the shops of the Kitai Gorod. The night of the 16th was illuminated by the fire of a general conflagration. The explosions, the balloons of flame which were seen falling from the tops of towers, showed the means which were being taken to spread the fire. A vast sea of flame illuminated the horizon for miles, and announced to the unhappy Muscovites who still lingered near the town that their homes no longer existed. The different quarters of the town took fire, burned, and disappeared all at once. Heaps of calcined and blackened stones indicated the spots where houses had stood. The silence of terror was only interrupted by a roaring like that of the waves of a stormy sea; this was produced by the wind, which, driving with violence the torrent of flame, hurried on far and wide the destroying element. From time to time whole buildings fell with a crash. Wherever the eye turned nothing could be seen but smoking ruins or devouring flames. Ever and anon was heard the mournful toll of a bell, which sounded like the signal passed between one and another agent in this work of destruction. In spite of the vigilance of the sentinels posted at the houses, the fire spread as if it had been driven by an invisible power. Although a great part of the town was built of wood, it took many days of general conflagration to consume it. At last, in most quarters of the town there were left so few traces of habitations that the streets could hardly be recognised. Human bodies half-burned, and the dead carcases of horses, cows, and dogs, lay in the midst of the ruins. 30,800 houses, besides a great number of palaces, were reduced to ashes; scarcely 6000 buildings were left standing. Among these, however, was the Kremlin, which the fire did not touch. The private loss by the destruction of houses and their contents was calculated at not less than L.30,000,000 sterling, and this was probably under the mark. The question has been often asked, What hand set the torch to this great conflagration? Count Rostopchine, the then governor, to whom fame has commonly attributed it, repudiates the honour in a work entitled *La Verité sur l'Incendie de Moscou*, published in Paris, 1828. The hypothesis that it was the act of the French is most unlikely. Napoleon could never have designed or permitted a calamity of which himself and his army were the first victims. The more probable theory is, that it was the act of the inhabitants themselves, and that Rostopchine set the example of patriotic devotedness. The desolation did not last long; Russian patriotism soon raised from its ashes their holy city, whose destruction had saved their country from foreign oppression. Subscriptions were opened in every part of the empire, and the liberality of the sovereign seconded the enthusiasm of his subjects. Moscow rose like a Phœnix from her ashes, but in greater beauty, and under a newer form. Her original character is not,

Moscow.

however, entirely lost. The injuries which Napoleon wantonly inflicted on the Kremlin were restored in keeping with its peculiar style of architecture. It is to be regretted that the same taste has not been shown in other erections, both within that ancient fortress and in the rest of the city. The Kitai Gorod, however, is still in its principal features the Moscow of the seventeenth and eighteenth centuries; and the churches and monasteries, many of which escaped the ravages of the fire, preserve their distinctive character. Indeed, the whole city, though modernized, still preserves to a great degree its oriental appearance. The whitewashed houses with their painted roofs, the frequent gardens, the quaint-looking churches, in their general appearance,—save the Christian emblem which invariably surmounts their domes and cupolas, more like the Hindu pagoda or Mussulman mosque than a Christian place of worship,—strike the eye of the English traveller as rather Eastern than European. Those who have seen Moscow and Benares have been struck with the resemblance of the former to the holy city of North India. Moscow will always retain its place as the second capital of Russia. Its old associations, the sanctity which is attached to its name, the law according to which no emperor is invested with full imperial authority until he has received his crown within the ancient cathedral of the Assumption, will always secure for it the high rank it holds in this great empire. It may be added, that its importance in a commercial point of view is on the increase. The wealthier portion of the aristocracy are leaving it for the more courtly city of St Petersburg, but merchant princes are purchasing and inhabiting their palaces. It is the centre of the inland traffic of the country. Its wholesale houses supply the neighbouring governments with goods of foreign produce and manufacture; and in its own manufactories are made many of those articles for which there is the largest home demand and consumption.

The population of Moscow in 1855 was 380,000. The births were 9889; the deaths, 13,643; the marriages, 1725. (G. T. C.)

MOSCOW, a government of European Russia, lying between 54. 40. and 56. 30. N. Lat., and between 34. 45. and 38. 11. E. Long., is bounded on the N. by the government of Tver, E. by Vladimir and Riazan, S. by Kaluga and Toola, and W. by Smolensk. Length, 140 miles; greatest breadth, 110; area, 12,683 square miles. The surface is low and undulating, broken by very few eminences, and these principally on the banks of the streams. The rivers and lakes are numerous, but are mostly of small size. The Volga traverses for a short distance the northern part of the government, and receives the Oka, with its affluents the Kliasma and the Moskva, all of which are navigable. The other streams, which are of smaller size, discharge their waters into one or other of these. The climate, like that of the other parts of Russia in the same latitude, is temperate, but more subject to extremes of heat and cold than in the west of Europe. The mean annual temperature is 40°, and the difference between summer and winter 47°·7. Though agriculture is the principal occupation of the people, and this government is one of the best cultivated in Russia, the fertility of the soil is not great; so that the produce of grain is not sufficient to supply the wants of the inhabitants. The quantity of cultivated land in the government of Moscow is about 3,089,600 acres; of meadow land, 1,307,000 acres; of wood, 3,592,000 acres; and of waste land, 384,151 acres. The amount of corn produced in 1849 was 22,306,729 bushels; and of potatoes, 3,475,264 bushels. Flax, hemp, and hops are also raised for home supply; and a large portion of the ground in the neighbourhood of Moscow is laid out in gardens and orchards, which supply that city with vegetables and fruits. The inhabitants are also employed to a large extent in the rearing of cattle. In 1849 the government contained 294,267 horses, 279,742 horned cattle, 353,715 sheep, 41,023 swine, and 1128 goats. No metals are worked in Moscow; but granite in the form of boulders, freestone, limestone, potter's clay, &c., are found and made use of. Manufactures of cloth, silk, hats, leather, copper, glass, earthenware, &c., are carried on here; and the population is more actively employed, as well as more dense here than in any of the other governments of the empire. The value of the woollen goods manufactured in the government of Moscow is estimated at more than L.2,000,000, which is about one-half of the whole amount produced in the empire. The manufacture of silk in Russia has its chief seat in this government, and 1,260,000 lb. of raw material are consumed annually. Moscow is also one of the principal seats of the cotton manufacture. From the position of the country, its commerce is entirely internal, and is facilitated by excellent roads, and by the railway from St Petersburg to Moscow, which was completed in 1851, as well as by rivers and canals. The prevalent religion is that of the Greek Church; and the government forms the see of an archbishop. Pop. (1851) 1,348,041; estimated in 1857 at 1,526,000.

Moseirah || Moselle.

MOSEIRAH, an island in the Indian Ocean, off the S.E. coast of Arabia, between 20. 8. and 20. 44. N. Lat., and between 58. 37. and 58. 58. E. Long. It is about 38½ miles in length, and nowhere rises more than 600 feet above the sea. Parts of the surface are cultivated; and there are some copper mines, which were formerly worked by the Persians. The population is numerous, and the island is governed by two sheikhs, who seem to be mutually independent, but subject, at least nominally, to the Imam of Muscat.

MOSELLE, a department of France, lying between 48. 54. and 49. 34. N. Lat., and 5. 25. and 7. 40. E. Long. It is bounded on the N. by Belgium, Dutch Luxembourg, and Rhenish Prussia, E. by the palatinate and the department of Lower Rhine, S. by that of Meurthe, and W. by that of Meuse. Its length is 102 miles; its breadth, which varies very much, is on an average about 25 miles; and its area is 2350 square miles. The surface of the department is in general undulating, with a gradual slope towards the N.; while the eastern part is occupied by branches of the Vosges Mountains, and the western part by those of the Ardennes. None of the hills, however, rise above 650 feet in height; and they are well wooded on the top with timber, which is used for ship-building, and on the sides with fruit trees. The country is watered by the Moselle, from which it derives its name, and by its affluents, flowing generally towards the north. The Moselle is navigable in this department for 49 miles, and the Sarre for 23. The Chiers, a tributary of the Meuse, also traverses the N.W. corner of Moselle. The climate is for the most part mild, but colder and more severe in the hilly regions. The mineral resources of the department are considerable, consisting of iron, which is found in great abundance, building stone, sandstone, potter's clay, marl, and plaster of Paris. The soil of the valleys and slopes of the hills is very rich, and well cultivated; and improvements are being gradually introduced in the implements and methods of agriculture used in the department. Of its whole extent it has been calculated that there are 741,343 acres of arable land, 111,200 of meadows, 222,402 of wood, and 14,826 of waste land. Corn is raised in sufficient quantities to leave a considerable amount for exportation; and the principal kinds are oats, rye, and wheat; the two former of which are more suitable to the soil than the last. Besides these, peas, beans, millet, vetches, lentils, potatoes, beet-root, rape, turnips, hemp, flax, &c., are grown; but although the vine is cultivated in the department, the wines of Moselle are of inferior quality, and are chiefly

used for the manufacture of what is called champagne, for sale in Germany and Russia. Gardens are extensively and well cultivated, and many kinds of fruit are raised of an excellent quality. The horses of the department, amounting in number to 65,000, are of small size; the horned cattle, about 110,000, of an inferior breed; the sheep, about 180,000, yield bad wool; and the only animals of good breed are the pigs, amounting to 108,000, to the rearing of which considerable attention is paid. There are also many bees, which produce a large supply of honey. Game of various kinds is plentiful in the forests, and fish in the rivers. The manufactures of Moselle are numerous, consisting principally of iron-works, in which sheet iron, nails, cutlery, &c., are fabricated. Next in extent and importance to these are the glass-works and potteries. There are also manufactures of linen, paper, beer, tobacco, beetroot sugar, leather, hosiery, &c. A considerable trade is carried on in the exportation of the produce of the manufacturing and agricultural industry of the department. The capital is Metz, where there is a court of appeal for the department. Moselle also contains 4 civil tribunals, an academy, 2 grammar schools, a normal school for the department, and 900 elementary schools; besides other educational institutions. It is divided into 4 arrondissements, as follows:—

	Cantons.	Communes.	Pop. (1851).
Metz	9	223	169,472
Thionville	5	118	91,708
Briey	5	132	67,481
Sarreguemines	8	155	131,023
Total	27	628	459,684

The population of the department in 1856, however, was only 451,152.

Moselle (Germ. *Mosel*, Dutch *Moezel*, anc. *Mosella*), a river of Europe, rises in France, in the Vosges Mountains, at the S.E. corner of the department of Vosges, and flows in an irregular course for some distance N.W., and then nearly N., through the departments of Vosges, Meurthe, and Moselle. It then separates Dutch Luxembourg from Rhenish Prussia for a short distance; and finally, after crossing the latter country in a very winding course, generally N.E., it falls into the Rhine at Coblentz. For the greater part of its course this river flows in a narrow valley, bounded in some places by rocky mountains; but in the department of Moselle, from Metz as far as Sierck, the hills recede to some distance from the river, and inclose a wider plain. The largest of the tributaries of the Moselle enter it from the right,—namely, the Mosellette, the Vologne, the Meurthe, the Seille, and the Sarre. Its tributaries from the left are the Madon, the Math, the Orne, the Sure, the Kyll, and the Elz; the first three being in France, and the others in Prussia. The Moselle occasionally overflows its banks, and causes great injury to the surrounding country. Its whole length is 320 miles, of which 182 are in France; and it is navigable as far as its confluence with the Meurthe, 210 miles from Coblentz. Above this point, however, it may be traversed by small boats for some distance; and timber is floated down the stream from very near its source. The soil through which it flows is very fertile, and the scenery on its banks is in many places of great beauty.

MOSER, Johann Jacob, a German writer on public law, and one of the most voluminous of modern authors, was born at Stuttgart in 1701. At the age of nineteen his acquirements raised him from the rank of a student to the dignity of professor extraordinary at the university of Tübingen. He was appointed a councillor at Stuttgart in 1726; and on the removal of the public administration from that city to Louisburg in the following year, the chair of law at Tübingen was conferred upon him. But the impatient temper of Moser was ever apt to involve him in broils with his acquaintances. In course of time a misunderstanding with his colleagues induced him to resign his professorship. He was prevented by a similar cause from remaining longer than 1739 in the situation of director of the university of Frankfort-on-the-Oder. Then retiring to the small town of Ebersdorf, he devoted his time to the composition of numerous works, and especially of his chief treatise, on the *Public Law of Germany*. His fastidious disposition, however, had not yet found its proper sphere. He left his retirement in 1747, and after remaining in the service of Hesse-Homburg for two years, he repaired to Hanau, and founded an academy for the instruction of the young nobility in public affairs. In 1751 the office of *landschaftsconsulent* in Stuttgart was conferred upon him. He was apprehended in 1759 on the suspicion of having written a memorial to the Duke; and he lay for five years in the fortress of Hohentwiel. On his release he abandoned public life, and spent the rest of his days in illustrating and explaining, by means of his writings and compilations, the laws and privileges of Germany. Moser died at Stuttgart in 1785. A list of his works, which amount to about 484, has been published by Meusel.

MOSES, the son of Amram and Jochebed, was born in the year 1571 before Christ. Pharaoh, King of Egypt, perceiving that the Hebrews had become a formidable nation, issued an edict commanding all the male children to be put to death. To avoid this cruel decree, Jochebed, the mother of Moses, having concealed her son for three months, at length made an ark or basket of bulrushes, daubed it with pitch, laid the child in it, and exposed him on the banks of the Nile. Thermuthis, the King's daughter, who happened to be walking by the river's side, perceived the floating cradle, commanded it to be brought to her, and being struck with the beauty of the child, determined to preserve his life. In three years afterwards the princess adopted him as her own son, called his name Moses, and caused him to be diligently instructed in all the learning of the Egyptians. But his father and mother, to whom he was restored by a fortunate accident, were at still greater pains to teach him the history and religion of his fathers. When in his fortieth year, Moses left the court of Pharaoh, and went to visit his countrymen the Hebrews, who groaned under the tyranny and oppression of their unfeeling masters. Having perceived an Egyptian smiting a Hebrew, he killed the Egyptian, and buried him in the sand. But he was obliged, in consequence of this murder, to fly into the land of Midian, where he married Zipporah, daughter of the priest Jethro, by whom he had two sons, Gershom and Eliezar. Here he lived forty years, during which time he employed himself in tending the flocks of his father-in-law. Having one day led his flock towards Mount Horeb, God appeared to him in the midst of a bush, which burned with fire, but was not consumed, and commanded him to go and deliver his brethren from their bondage. Moses at first refused to go, but was at length prevailed on by two miracles, which the Almighty wrought for his conviction. Upon his return to Egypt, he, together with his brother Aaron, went to the court of Pharaoh, and told him that God commanded him to let the Hebrews go to offer sacrifices in the deserts of Arabia. But the impious monarch disregarded this command, and caused the labour of the Israelites to be doubled. The messengers of the Almighty again returned to the King, and wrought a miracle in his sight, that they might move his heart, and induce him to let the people depart. Aaron having cast down his miraculous rod, it was immediately converted into a serpent; but the same thing being performed by the magicians, the King's heart was more and more hardened; and his obstinacy at last drew down the judgments of the Almighty upon his kingdom, which was

afflicted with ten dreadful plagues. (See Bryant's *Observations on the Plagues inflicted on the Egyptians.*) These dreadful calamities at length moved the heart of the hardened Pharaoh, and he consented to allow the people of Israel to depart from his kingdom.

Profane authors who have spoken of Moses appear to have been in part acquainted with these mighty wonders. That he performed miracles has been allowed by many, by whom he was considered as a famous magician; and he could scarcely appear in any other light to men who did not acknowledge him as the messenger of the Almighty. Both Diodorus and Herodotus mention the distressed state to which Egypt was reduced by these terrible calamities. The Hebrews, amounting to the number of 600,000 men, without reckoning women and children, left Egypt on the 15th day of the month Nisan, which, in memory of this deliverance, was thenceforth reckoned the first month of their year. Scarcely had they reached the shore of the Red Sea, when Pharaoh with a powerful army set out in pursuit of them. On this occasion Moses stretched forth his rod upon the sea, and the waters thereof being divided, remained suspended on both sides till the Hebrews passed through dry-footed. The Egyptians determined to follow the same course; but God caused a violent wind to blow, which brought back the waters to their bed, and the whole army of Pharaoh perished. (See Wilkinson's *Manners and Customs of the Ancient Egyptians*, vol. i., c. 2.)

After the miraculous passage of the Red Sea, the army proceeded towards Sinai; and after suffering considerable privation, arrived at the foot of that mountain on the 3d day of the ninth month after their departure from Egypt. Moses having ascended several times into the mount, received the law from God in the midst of thunders and lightnings, and concluded the famous covenant between the Lord and the children of Israel. When he descended from Sinai, he found that the people had fallen into the idolatrous worship of the golden calf. The messenger of God, shocked at such ingratitude, broke in pieces the tables of the law which he carried in his hands, and put 23,000 of the transgressors to the sword. He afterwards re-ascended the mountain, and there obtained new tables of stone, upon which the law was inscribed.

Moses having dedicated the tabernacle, consecrated Aaron and his sons to be its ministers, and appointed the Levites to its service. He likewise gave various commandments concerning the worship of God and the political government of the Jews. This was a theocracy in the fullest extent of the word. God himself governed them immediately by means of his servant Moses, whom he had chosen to be the interpreter of his will to the people; and he required all the honours belonging to their king to be paid to himself. He dwelt in his tabernacle, which was situated in the middle of the camp, like a monarch in his palace; he gave answers to those who consulted him, and himself denounced punishment against the transgressors of his laws. This was properly the time of the theocracy, taken in its full extent; for God was not only considered as the divinity who formed the object of their religious worship, but as the sovereign to whom the honours of supreme majesty were paid. The case was nearly the same under Joshua, who, being filled with the spirit of Moses, undertook nothing without consulting God. Every measure, both of the leader and of the people, was regulated by the direction of the Almighty, who rewarded their fidelity and obedience by a series of miracles, victories, and successes. After Moses had regulated everything regarding the civil administration and the marching of the troops, he led the Israelites to the confines of Canaan, to the foot of Mount Nebo; and here the Lord commanded him to ascend into the mountain, whence he showed him the promised land, into which he was not permitted to enter. He immediately afterwards yielded up the ghost, in the hundred and twentieth year of his age, and 1451 years before Christ.

Moses is believed to be the author of the first five books of the Old Testament, which go by the name of the *Pentateuch*, and which both Jews and Christians acknowledge to be inspired. The ninetieth Psalm is also ascribed to him; and some allege that he was the author of the book of Job, but the arguments on this point are not very conclusive. Numerous traditions respecting this celebrated personage are to be met with among the ancient Jews and the later rabbinical writers. (See Philo, *Vita Mosis*, c. iii.; Josephus, *Antiq.* ii. 9; Bartolocci, *Bibliotheca Rabbinica*, iv. 115; also Milman's *History of the Jews*, vol. i., p. 61.) Among the Arabs also legends abound regarding him. (Hottinger, *Historia Orientalis*, p. 80.) Repeated mention is made of Moses in the Greek and Roman classics, but their accounts of him are generally distorted and fictitious. (See Meier, *Judaica, seu veterum Scriptorum profanorum de Rebus Judaicis Fragmenta*, Jena, 1832. Concerning the life of Moses, see Warburton's *Divine Legation of Moses;* Hess, *Geschichte Mosis*, 2 vols., Zurich, 1778; Niemeyer, *Charakteristik der Bibel*, vol. iii.)

MOSHEIM, JOHANN LORENZ VON, a celebrated ecclesiastical historian, was descended from a noble family, and was born at Lübeck in October 1694. He was educated in the Protestant religion; and from the gymnasium of his native place he was sent to study divinity at the university of Kiel. There, when he had scarcely attained the age of manhood, he was appointed to succeed Albert zum Felde as professor and first pastor. In this double office his talents found full scope. His lectures were pervaded by great erudition, controlled by delicate ingenuity and penetrating sagacity. He appeared to especial advantage in the pulpit. The style of his sermons, formed on the models of the great English and French preachers, was chaste, lucid, and graceful, and burned with a fervid and eloquent piety. Ere four years had passed, Mosheim had become famous in other countries, and was besieged with offers of preferment from several governments. Accepting the invitation of the Duke of Brunswick, he removed to the chair of theology at Helmstädt in 1723. Here, during the next four-and-twenty years, his fame continued steadily to increase. His eloquence, the moral graces of his character, and his skill in tuition, rendered him the favourite professor of the university. The publication of his *Institutionum Historiæ Ecclesiasticæ libri iv.*, in 2 vols. 12mo, 1726, and of numerous other works, extended his celebrity. The Duke of Brunswick appointed him Abbot of Marienthal and Michaelstein, and inspector-general of the schools in the duchy of Wolfenbüttel, and in the principality of Blankenburg. From foreign princes, and from several learned societies, he also received marks of distinction. All this eminence only served to bring into greater prominence his affable bearing, the gentle amiability of his disposition, and his consistent Christian practice. In 1747 Mosheim was promoted by George II. of Great Britain to the theological chair and the chancellorship of the university of Göttingen. His health was now beginning to yield under the intensity of his mental activity. Yet he continued to study, and to lecture on theology, for three hours every day, to audiences composed of men of every class and vocation. At length, worn out with labour, he died in September 1755. In the same year was published a new and enlarged edition of his *Institutes*. This work was translated into German by Von Einem and by I. R. Schlegel. There are two English versions,—that of Dr Maclaine, published in 1764; and that of Dr Murdock, published in 1832. The latter, which is by far the more correct, was revised and re-edited by Dr James Seaton Reid in 1848. The *Institutes* of Mosheim introduced a new era in the writing of ecclesiastical history. He

was among the first to separate historical facts from the rubbish among which they had been usually exhibited,—to refer to the characteristics of each separate age,—to trace clearly the mutual reaction between civil and ecclesiastical affairs,—and to use care and candour in narrating the controversies and broils of different sects. Yet his division of events into those *external* and those *internal*, and into those *prosperous* and those *calamitous*, is thoroughly contradictory to the true character of history. He also suffers the dignified neutrality of the historian to suppress completely that expression of sympathy with the good and the true which ought to be shown by every writer. The other work of Mosheim which is well known in this country is his *De Rebus Christianorum ante Constantinum Magnum Commentarii*, 4to, Helmstädt, 1753. An English translation of this treatise, begun in 1813, by R. S. Vidal, was completed and edited by Dr Murdock, in 2 vols. 8vo, New York, 1851.

MOSKONISI, an island of Asiatic Turkey, in the pashalic of Anatolia, is situated in the Gulf of Adramytti, in 39. 20. N. Lat., 26. 40. E. Long. It is about 4½ miles in length, and is joined to the mainland by a sandy isthmus. The surface is mountainous; and the island produces fruits and cotton, which are exported from the small port of Mosko, on the south coast.

MOSQUE, a temple or place of religious worship amongst the Mohammedans. All mosques are square buildings, generally constructed of stone. The Arabian and Syrian mosques have generally vast quadrangles surrounded with numerous columns, while those of the Turks are noted for the elegance of their cupolas. Before the chief gate there is a square court paved with white marble, and low galleries round it, the roof of which is supported by marble pillars. In these galleries the Mussulmans perform their ablutions before they go into the mosque. In each mosque there are a great number of lamps; and between these are suspended many crystal rings, ostrich eggs, and other curiosities, which, when the lamps are lighted, make a fine show. As it is not lawful to enter the mosque with the feet covered, the pavements are covered with pieces of stuff sewed together, each being wide enough to hold a row of men kneeling, sitting, or prostrate. The women are not allowed to enter the mosque, but remain in the porches without. About every mosque there are six high towers, called *minarets*, each of which has three little open galleries, one above another; these towers, as well as the mosques, are covered with lead, and adorned with gilding and other ornaments; and from them the people are summoned to prayers by certain officers appointed for the purpose, called *muezzins*. Most of the mosques have a kind of hospital belonging to them, in which travellers, of whatsoever religion they may be, are entertained three days. Each mosque has also a place called *tarbe*, which is the burying-place of its founders; within it there is a tomb six or seven feet long, covered with green velvet or satin; at the ends are two tapers, and round it several seats for those who read the Koran and offer up prayers for the souls of the deceased.

MOSQUITO SHORE, MOSQUITO COAST, and MOSQUITIA, are terms used to designate a portion of the eastern coast of Central America, on the Caribbean Sea. As geographical, and still more as political designations, they have been very vaguely applied to an extent of coast varying from 200 to 500 miles in length, and of indefinite breadth. It has at times been asserted that the Mosquito Shore embraced the entire coast of Central America between Cape Cameron or Honduras, near the port of Truxillo, in Lat. 16. N., Lon. 85. W., and Boca del Toro, in Chiriqui Lagoon, in Lat. 10. N., Lon. 82. W., a coast-line of not less than 800 statute miles. Amongst geographers generally, however, the Mosquito Shore was understood only as comprehending the coast lying between Cape Gracias á Dios and Bluefields Lagoon, including the latter; that is to say, between 12. and 15. N. Lat., a distance of about 250 miles.

This coast was discovered by Columbus in his fourth voyage, in 1502. He sailed along its entire length, stopping at various points to investigate the country, and ascertain the character of the inhabitants. He gave it the name of *Cariay;* and it was accurately characterised by one of his companions, Porras, as "una tierra muy baja," a very low land. His son, Fernando Columbus, described the inhabitants as "almost Negroes in colour, bestial, going naked; in all respects very rude, eating human flesh, and devouring their fish raw as they happened to catch them." The language of the chroniclers, however, warrants us in believing that this description applied only to the Indians of the immediate sea-coast, and that those of the interior were then, as they still remain, a different people, with a distinct language. A grant of the entire coast, from Cape Gracias to the Gulf of Darien, was made to Diego de Nicuessa, for purposes of colonization, within ten years after its discovery; but the expedition which he fitted out to carry his grant into effect was wrecked at the mouth of the Cape or Wanks River.

Although the attention of Spain was too much absorbed with the other parts of her immense empire in America to enable her to devote much care to this comparatively unattractive shore, nevertheless her missionaries, with the characteristic zeal of that early period, made various attempts to found establishments at Cape Gracias á Dios, and probably at other points on the coast. But the resources of the country were too few for their support, and the Indians too debased and savage to receive the teachings of Christianity.

In the year 1576 this coast was conveyed by royal cedula to the "illustrious Señor Licenciado Diego Garcia de Palacio, Oidor of the Royal Audiencia of Guatemala," and "Captain Diego Lopez, resident of the port of Truxillo," in Honduras, by them to be colonized and governed under certain explicit regulations.

It does not appear that Palacio took any action under his grant, and the coast remained in its primitive condition until the era of the bucaneers, who obtained practical control of the sea of the Antilles about the middle of the seventeenth century. The intricate bogs, creeks, and rivers of this coast furnished admirable places of concealment and refuge for the small and swift vessels in which these freebooters roved the seas. They had establishments at Cape Gracias and Bluefields, whence they darted out like hawks on the galleons that sailed from Nombre de Dios and Carthagena, laden with the riches of Peru. Indeed, Bluefields, the so-called capital of the Mosquito kingdom, derives its name from *Blevelt*, a noted Dutch pirate, who had his rendezvous in the bay of the same name. In like manner, it is alleged, was the name of Wallace, a Scotch sea-rover, transformed, by Spanish pronunciation, to Balice, and finally to Belize.

The piratical establishment at Cape Gracias seems to have been not only the principal one on the Mosquito Shore, but in the entire Caribbean Sea. It is oftenest mentioned in the narratives which the pirates have left us of their wild and bloody adventures. Here they met, by common consent, to divide their booty, and agree upon new expeditions. Their relations with the Indians seem to have been friendly; the pirates, nevertheless, from their superior intelligence and numbers, taking the position of masters.

The accounts of the inhabitants of the coast, as given by the bucaneers, coincide with those left to us by Columbus and his companions. They are described as extremely indolent, "wandering up and down, without knowing or caring so much as to keep their bodies from the rain, except by a few palm leaves," with "no other

clothes than an apron tied around their middle," armed with spears "pointed with the teeth of crocodiles," and living chiefly on bananas, wild fruits, and fish.

At a very early period the Indians on the Mosquito Shore seem to have received a large infusion of Negro blood, which has come to be predominant among the existing inhabitants.

Many of the bucaneers were Englishmen, and all had relations more or less intimate with Jamaica, where, at that period of lax public morality, they often shared their profits with the authorities in return for such indulgences and assistance as the latter were able to afford. Indeed, it is alleged that the governors of the island were often partners in the enterprises of the freebooters. But when the protracted wars with Spain, which favoured this state of things, were brought to a close, it became no longer prudent to connive at bucaneering; and as a kind of intercourse had sprung up with the Mosquito Shore, they conceived the idea of obtaining possession of it on behalf of the British crown. Various plans to this end, drawn up by different individuals, were at this period presented to the royal government, and by it referred to the governors of Jamaica.

But the governors of that island had themselves already taken the initiative. As early as 1687 one of the Mosquito headmen or chiefs had been carried to Jamaica for the purpose of placing his country under the protection of the British crown. Sir Hans Sloane has left us an account of how, having escaped from his keepers, "he pulled off the European clothes his friends had put on, and climbed to the top of a tree." It seems, nevertheless, that he received "a cocked hat and a ridiculous piece of writing," which, according to Jeffreys, was a commission as king, "given by his Grace the Duke of Albemarle, under the seal of the island. Robert Hodgson, writing about 1740, affirms, not only "that the king has his commission or patent for being called so from the governor of Jamaica," but also that "all the other chief people have commissions (as admirals and captains) from his Majesty's superintendent."

In 1740 it would appear that an attempt was made to obtain an absolute cession of the coast to the British crown. In that year Trelawney, governor of Jamaica, wrote to the Duke of Newcastle, suggesting the expediency of rousing the Mosquito Indians against the Spaniards, and proposing an immediate occupation of the coast. He represented that there were about one hundred Englishmen there, "mostly such as could live nowhere else," who might be brought together, reinforced, and, by the help of the Mosquitos, finally induce the other Indians to revolt, "and thus spread the insurrection from one part to another, till it should become general over the Indies, and drive the Spaniards entirely out."

In pursuance of this scheme, Governor Trelawney commissioned one Robert Hodgson to proceed to the Shore, where he arrived, laden with presents, on the 8th of April 1740. He succeeded in getting together some of the head men, including "King Edward" ("Admiral Dilly," "General Hobby," and "Captain Jumper," being unavoidably absent), and on the 16th of the month "proceeded to explain to them, that as they had long acknowledged themselves subjects of Great Britain, the governor of Jamaica had sent me to take possession of their country in his Majesty's name,—then asked if they had anything to object?" No objection being made, Hodgson proceeds:—"I immediately set up the standard, and reducing what I had said into articles, I asked them, both jointly and separately, if they approved, and would abide by them? They unanimously declared they would. Hodgson inclosed the articles to Governor Trelawney, and adds, "As to the king he is very young, I believe not twenty, and is not much observed; but were he to be in England or Jamaica a while, 'tis thought he would make a hopeful monarch enough."

Previously to the mission of Hodgson, on the 28th of October 1739, the Spanish ambassador in London had made complaints that the incursions of the Sambos and Indians of the Mosquito Shore, on the adjacent Spanish settlements, were "at the instigation, and under the protection, of the English of Jamaica, who have a commerce with them, and give them in exchange for the captive Indians, whom they purchase for slaves, fire-arms, powder, shot, and other goods, contrary to the natural rights of these people."

And here it may be mentioned, that subsequent to the era of the bucaneers, during the whole of the eighteenth century, and even as late as 1820, it was the constant practice of the Mosquitos to make forays into the territories of the Woolwas, Cookras, Tonglas, and other pure Indian tribes lying between the coast and the Spanish settlements, for the capture of prisoners, to be sold as slaves to the traders from Jamaica. The scandal finally attracted the attention of Parliament, and was made the subject of a commission of inquiry, which reported, July 10, 1828, recommending the liberation, under certain conditions, of the Indians thus enslaved. From this cause has sprung that settled hostility which still exists between the Sambo-Mosquitos and their Indian neighbours of the interior, and which, until recently at least, led the latter to punish with death any intercourse between their people and the hated Mosquitos.

The "cession" of the Mosquito Shore, procured, as we have seen, by Hodgson, was followed up by occupation. Several Jamaica planters settled there; and Hodgson, in reward for his services, was placed in charge of the new establishment, with the title of "Superintendent of the Mosquito Shore," dependent on the governor of Jamaica.

In 1744 an order was issued in council, despatching a certain number of troops from Jamaica to the Mosquito Shore; and in 1748 another order for sending a supply of ordnance to the "new settlements" established there. At this time everything indicated the purpose of a permanent occupation of the country on behalf of the crown. The Spaniards, alarmed at these encroachments, as they regarded them, were loud in their remonstrances, and in 1750–51 threatened a forcible expulsion of the settlers; whereupon Governor Trelawney instructed Hodgson to represent to them, that "the object of keeping a superintendent amongst the Indians was to restrain them in their hostilities against the Spaniards." The latter were deceived, or from motives of policy accepted the explanation, and even went so far as to confer on Hodgson the title of Colonel for the services which he professed to have rendered them.

It was not long, however, before the settlers on the Shore discovered that the Spanish governors of the adjacent provinces of Honduras, Nicaragua, and Guatemala, were making formidable preparations for their forcible destruction. In their alarm they applied to Governor Knowles, who had succeeded Trelawney in Jamaica, and who at once opened a correspondence with the captain-general of Guatemala, for a suspension of hostilities, until he could hear from England—whither he wrote, that the whole Mosquito affair was "a job," and that if Hodgson were not checked or recalled, "he would involve the nation in difficulties;" and that, between Spanish and English pretensions, "the Indians were so perplexed that they did not know what part to take." In fact, a little later, a number of the Mosquito chiefs went to Guatemala, and there resolved to take up arms against the English; but it does not appear that any decided acts of hostility were committed by them.

These events did not escape the notice of Spain, and were among the causes which led to the rupture, terminated by the treaty of Paris in 1763, by which Great Britain agreed to demolish all the fortifications which she had erected, not only in the Bay of Honduras, but in "other

places in the territory of Spain in that part of the world." It would seem that the Spanish crown was not satisfied with the conduct of Great Britain under these provisions, which were therefore revived, and made more explicit and stringent by the subsequent treaty of 1783, which stipulated that all the English settlers on the Spanish continent should retire within a district defined in the treaty. Nevertheless, relations were still kept up with the coast, and led to severe reclamations on the part of Spain. These were only settled by the supplementary treaty of 1786, which provided that his Britannic Majesty's subjects and other colonists, who have enjoyed the protection of England, shall evacuate the country of the Mosquitos, as well as the continent in general, and the islands adjacent, without exception, situated beyond the line described in the treaty.

By the 14th article of this treaty, "His Catholic Majesty, prompted solely by motives of humanity, promises to the King of England that he will not exercise any severity against the Mosquitos inhabiting in part the countries which are to be evacuated, in virtue of the present convention, on account of any connections which may have subsisted between the said Indians and the English; and his Britannic Majesty, on his part, will strictly prohibit all his subjects from furnishing arms or warlike stores to the Indians, &c."

These provisions met with serious opposition, and a motion was made in the House of Lords, "that the terms of the convention with Spain, signed in July 1786, did not meet the favourable opinion of this House." The motion was negatived; and, in the words of Macgregor, "with the most painful reluctance, and only in obedience to positive orders, the British settlers slowly and discontentedly left their plantations."

From 1786 forward, Great Britain ceased to hold any open relations with the Mosquito Indians, until the decline of the power of Spain and the loss of her American possessions. In the interval the governors of the provinces of Central America had attempted, but with poor success, to make permanent establishments on the Shore, at Cape Gracias and Bluefields. They, however, erected a fort at the mouth of the River San Juan, for the protection of the port of the same name, which was made a port of entry by royal cedula in 1796.

The stringent provisions of the convention of 1786 were revived and confirmed by an additional article to the treaty of Madrid of August 28, 1814. Meantime the continental war withdrew all attention from the Mosquito Shore, which passed entirely out of official view. A few of the old settlers nevertheless remained on the coast, and a commerce in tortoise-shells, deer-skins, and slaves, was kept up with Jamaica.

Roberts, who was on the coast in pursuit of his avocation as trader about the year 1820, has given a very faithful account of the Mosquitos and their political condition at that period. He speaks of a personage called "King," a young man who had been in Jamaica, "where he was semi-educated," and whose authority, if not openly disputed, was divided with sundry chiefs, among whom a "Governor Clementi" was most important. This "king" is described by Macgregor as having "combined the bad qualities of the European and Creole with the vicious propensities of the Sambo, and the capriciousness of the Indian." He was killed in a drunken brawl in 1824, and was succeeded by his half-brother Robert—who, however, was found to be too greatly in the Spanish interest to suit the trading Warwicks of Jamaica, and was accordingly deposed in favour of a Sambo of quite a different family, who received the name of George Frederick. What became of this potentate does not clearly appear from the Mosquito chronicles; he either died or was dropped for another Sambo, called Robert Charles Frederick.

Robert Charles Frederick was taken to the settlement of Belize or British Honduras, and was there duly crowned on the 23d of April 1825. The king was dressed for the occasion in a British major's uniform, and so manifested his admiration for his finery as to impart a ludicrous character to the whole ceremony. Moved by liberal appliances of rum, in the exercise of royal liberality he made extensive grants of lands to his trading friends, which in some instances carried with them the rights of absolute sovereignty. When these proceedings came to the ears of the superintendent of Belize and of the governor of Jamaica, they excited considerable alarm, and an agent was sent to the shore, instructed to disallow the grants in question.

A vessel of war was sent down from Belize to carry Robert Charles Frederick away from the too powerful influences of rum and gay cottons; and he was accordingly taken to Belize, and placed beneath the eye of the superintendent of that establishment. His royal nature, however, rebelled against restraint; he gradually pined away and died; but not until he had affixed "his × mark" to a document styled "a will," in which it was provided that the affairs of his kingdom should be administered by Colonel Macdonald, superintendent of Belize, as regent, during the minority of his heir; that Macdonald should be guardian of his children; and that, in view of the spiritual wants of his subjects, "the United Church of England and Ireland shall be the established religion of the Mosquito nation for ever."

This will bears date February 1840, just one century after Hodgson had obtained the "cession" of the Shore to the British crown. One of the first acts of Macdonald was the appointment of Patrick Walker, his private secretary, to reside on the Mosquito Shore, and take charge and guardianship of the scions of the royal house. Walker at once took up his residence in Bluefields, and having organized a council of government, soon fell into a dispute with the neighbouring Central American states on the question of boundaries.

Aroused and alarmed by the proceedings of Walker, and ignorant as to whether the salic law was recognised in Mosquitia (the name now given to the country), they procured from the eldest child of Robert Charles Frederick, namely, the "Princess Ines Ann Frederick," on the 28th of October 1847, a distinct recognition of the authority of Nicaragua over the Shore, and a queenly command to all interloping foreigners to leave the country.

The restless mind of Walker, who imagined himself a second Hastings, soon forced the quarrel beyond the consular offices of the Crown into the cabinets of Downing Street; and in the same year (1847), when the recreant Mosquito princess passed over to the Nicaraguan interests, he had succeeded in obtaining from Lord Palmerston an instruction to all the diplomatic and other agents of the Crown in Central America and the adjacent countries, requiring them to report "what authentic information they could obtain as to the boundaries claimed by the King of Mosquito;" and also "what, in your opinion, is the line of boundary which Her Majesty's government should insist upon as essential for the security and wellbeing of the Mosquito state." This was soon followed up by a despatch to the same agents, instructing them to inform the states adjacent to the Mosquito Shore, that "Her Majesty's government could not view with indifference any encroachment on the rights or territories of the King of Mosquito, which is under the protection of the British crown." Mr Walker, and Mr Chatfield, Her Majesty's consul-general in Guatemala, both reported that the "well-being of the Mosquito state required an assertion of the rights of the Mosquito king over the entire eastern coast of Central America, from Cape Honduras to Chiriqui Lagoon, an extent of 600 miles; yet his lordship limited himself to the opinion, that the "rights of the King of Mosquito should be maintained, as extending from Cape Honduras down to the mouth of the River San Juan." It may readily be pre-

Mosquito Shore.

sumed that the instruction to communicate the views of Her Majesty's government upon this point to the Central American States, was promptly complied with by Her Majesty's agents, and Mr Chatfield took the latitude of adding, that these limits were to be accepted "without prejudice to the right of the Mosquito king to any territory *south* of the River San Juan."

In the meantime, influenced by Walker's representations, Macdonald, who was a man of action rather than of words, paid a visit to the Shore in a vessel of war, entered the port of San Juan, and, after some mild proceedings, seized the collector, Quijano, carried him off, and finally landed him alone at a desolate point on the coast several hundred miles from the port. The only immediate consequences of this proceeding were vehement reclamations on the part of the Central American States, who now asserted their rights over San Juan in the most positive terms.

Macdonald's conduct in this, as in some other matters, does not seem to have been approved by the home government; but in the month of January 1848 two British vessels of war appeared in the harbour of San Juan, and occupied it without resistance, replacing the Nicaraguan officials by Englishmen, acting as servants of the King of Mosquito. This done, they sailed away; but no sooner did the intelligence of the event reach the interior, than the Nicaraguan government embarked a small force and reoccupied the port, sending the new officials as prisoners to the capital. The British forces, considerably strengthened, thereupon returned, and the Nicaraguans, unable to oppose them, retired up the River San Juan, and erected some rude fortifications on its banks. They were followed by an English detachment, and finally, March 12, 1848, routed with great loss. Walker, who accompanied the expedition, was either killed or drowned during the engagement. Hostilities were further prosecuted, until the Nicaraguans, powerless against the strength of Great Britain, consented to an armistice, which provided that they should not disturb San Juan, or attempt to re-occupy the port, pending the negotiations which it was foreseen would follow on these events. All efforts, however, to induce them to relinquish their claims of sovereignty over the port, or, even by implication, to recognise the Mosquito king, were unsuccessful. A consul-general of Great Britain was at once appointed to the Mosquito Shore, who took up his residence at San Juan, where, with the support of a number of policemen from Jamaica, and the almost constant presence of a vessel of war in the harbour, he assumed and exercised all the functions of government, judicial and executive.

The government of Nicaragua now addressed an exposition and appeal to the nations of Europe, and a particular and fervent one to the United States, for their friendly interference in behalf of what they claimed as their clear territorial rights and violated sovereignty. The American people and government were not slow to believe that the seizure of San Juan was an act of violence on the rights of a weak power, directed to obtaining control of the transit between the seas; as the line through Nicaragua, by way of the River San Juan and the Nicaraguan lakes, had long been regarded as affording the best, if not the only, route for a ship canal between the Atlantic and the Pacific Oceans. The recent acquisition of California also, and the sudden tide of emigration that took place to that country, rendered of importance to them every point where the isthmus could be traversed. The very first act of General Taylor, flushed from the fields of his Mexican victories, and carried almost by acclamation into the presidential chair, was the appointment of a diplomatic agent in Central America, invested with extensive powers, and instructed to look closely after the interests of the United States. Hardly had this agent reached his post, when a detachment of the British squadron in the Pacific, having on board Her Majesty's consul-general at Guatemala, made its appearance in the magnificent Bay of Fonseca, and forcibly took possession of the fine islands commanding it in the name and on behalf of the British crown, by way of enforcing some claims for indemnity to British subjects against the states of Honduras and San Salvador. And as, in the speculations on the questions of an inter-oceanic canal, this bay had come to be regarded as offering the best conditions for the western terminus of such a work, precisely as San Juan was assumed to offer the same for its eastern terminus, this seizure was construed to be only an additional step in the settled policy of Great Britain to obtain control, if not absolute possession, of the highway between the seas.

The government of Honduras having obtained an intimation of the contemplated occupation of the Bay of Fonseca, resorted to the expedient of making a cession to the United States of the islands commanding it belonging to that state. Mr Squier, the American representative, accepted the cession on behalf of his government, which thus was made a party to the disputes between Great Britain and the Central American States. The seizure having taken place, regardless of the previous cession, an independent question was raised between the British and American cabinets, which seemed to threaten an open rupture, but which had the really beneficial effect of directing the serious attention of both governments to the necessity of settling the principles which should govern the policy of both as regarded the isthmus states, and especially as regarded that inter-oceanic highway to which circumstances had given a new importance. As soon as a knowledge of the seizure reached the United States, Mr Clayton, secretary of state, sent a despatch to Mr Lawrence, American minister in London (dated December 29, 1849), which the latter was desired to place before the British government. This despatch set forth that "the United States had no political designs in Central America," and that its interest in that country was confined to securing through it a free route of transit between the seas, which route it was declared to be the purpose of the United States "to protect, with the consent of the states through which it might pass." In conclusion, Mr Clayton directed Mr Lawrence to urge on the British government to disavow the seizure of the Bay of Fonseca, and to represent that if the act were not disavowed, the treaty of cession by which Honduras conveyed the only important positions in the bay to the United States, "would be submitted to the Senate for ratification without delay."

As already said, the serious attention of both governments, as well as of the people of both countries, having been thus arrested, public opinion, equally with common sense, dictated that an understanding should be reached, which should not only avert the possibility of a collision on these questions, but which should best subserve the wants of trade and commerce across the isthmus. It is not necessary to trace the progress of the negotiations which were now opened, and which, in the month of April, subsequent to the date of the despatch above alluded to, resulted in the signature of a special convention between the United States and Great Britain, known as the "Clayton-Bulwer Treaty," defining the policy of both regarding Central America, and giving a joint guarantee to such routes of inter-oceanic communication as might be opened "by canal or railway" through its territories.

A radical defect with this convention was its ambiguity on the subject of the Mosquito protectorate, and disputes arose as to its intent and meaning before the signatures were fairly dry on the parchment. On the one hand, it was claimed that the convention recognised and confirmed the protectorate of Great Britain; on the other, that it deprived it of all vitality, and reduced it to a shadow, and that the ambiguity of the convention was studied and

intentional, to enable Great Britain to retire gracefully from a false position.

While this new dispute was increasing in warmth, circumstances were fast working out a practical solution. An American company, acting under a charter from Nicaragua, had opened a route of transit for passengers through that state, commencing at San Juan, which rapidly filled up with emigrants from the United States. They soon became numerically predominant; and after some ungraceful attempts to proceed with reference to the alleged Mosquito authority, finally met in a primary capacity, and organised an independent local government, composed chiefly of Americans. The British protectorate, so far as San Juan was concerned, expired with an attempt on the part of the commander of one of Her Majesty's vessels of war, more zealous than discreet, to compel one of the transit steamers to pay certain port charges to his Mosquito majesty. The act was disavowed by the government, and San Juan remained, under the direct government of its own people, practically a free city; and as such, looking to its position, it should continue. Its prosperity was much retarded by a dispute with the adventurers into whose hands the transit had fallen, producing an irritation of feeling which resulted in certain alleged insults on the part of the town to an American diplomatic agent, whose belligerent tendencies led him to interfere in matters quite beyond the sphere of his duties. An American vessel of war was sent to inquire into the circumstances of the case. Her commander, acting under improper influences, assumed a most offensive and hostile attitude towards the town, and made various arrogant demands which were not complied with; whereupon he bombarded the place, and, landing a force of marines, burned it to the ground. The annals of this century furnish no parallel to this wanton and cruel procedure, and it stands a lasting disgrace and infamy to all concerned. It is certain that no such act was contemplated by the American government; but as it retained the delinquent officer in its service, and did not formally disavow the deed, it must be held to share the odium consequent upon it. Previously to this event, an effort had been made to adjust the Mosquito question, on the part of Mr Webster, secretary of state, and Mr Crampton, British representative in Washington. A *projét* was agreed upon, assigning a defined territory to the Mosquito Indians, and surrendering the port of San Juan (then called Greytown) to Nicaragua, on condition of certain annual payments to the Mosquito King. A joint English and American commission was sent to Central America to procure the assent of the adjacent states to the arrangement. Costa Rica, after some hesitation, acceded to the plan, but Nicaragua refused her assent; and the terms of the *projét* becoming known in England and the United States, they were found to be distasteful to the people of both countries. In America it was contended that no rights beyond those of occupancy could be acceded to any of the aboriginal tribes of the continent without violation of the leading principle on which the settlement of the continent had been effected, nor without danger to existing territorial rights. Some of the provisions of the Webster-Crampton *projét* were revived, in a convention signed by Lord Clarendon and Mr Dallas, American minister in London, in the autumn of 1856. The limits of the district assigned to the Mosquito Indians, however, were much more circumscribed; the port of San Juan was constituted a free port; and provisions recognising a Mosquito sovereignty, in a political sense, carefully excluded. This convention was ratified, with some slight modifications, by the United States Senate, but failed, in consequence of the non-exchange of ratifications within the time specified in the convention itself. The principles of this convention are no doubt those which will ultimately prevail, and offer the only rational solution of the vexed Mosquito question. A better understanding of the mutual rights and duties of Great Britain and the United States on the American continent is fast removing every obstacle to an amicable adjustment of this and analogous differences.

The final solution of the question will no doubt be hastened and facilitated by the convention of August 27, 1856, between Great Britain and Honduras, wherein the territorial rights of the latter state are recognised over the coast between Cape Gracias and Cape Honduras, with the reservation of the right of occupancy to the Indians within a district of reasonable extent, to be fixed by a joint commission of the two governments. Such is the present political state of the Mosquito Shore.

As regards the Mosquitos themselves, little need be said, except that they are a hybrid race, coming rather under the denomination of Sambos than Indians. The Valiente, Rama, Cookra, Woolwa, Tongla, and Paya or Poyas Indians, who are sometimes claimed as Mosquitos, are quite independent of them, and generally hold a hostile attitude towards them. Some of these tribes, in whole or in part, recognise the rule of the adjacent Central American States, and many of their villages profess the Roman Catholic religion. Exclusive of these Indian tribes, the population of the Mosquito Shore is exceedingly small, certainly not exceeding 2000 souls. Colonel Hodgson (son of the Robert Hodgson elsewhere referred to), who wrote in 1757, estimates the population at "not above 7000;" and a MS. Spanish map of the date of 1777, purporting to be copied from an English original, gives "houses of whites, 17; of Mestizos, 13: number of whites, 28; Mestizos, 27; slaves, 252; Mosquito Indians, 182; Mosquito Sambos, 230;—total, 719." George Chalmers, secretary of the Board of Trade, in 1787, drew up a series of notes on the Mosquito Shore for the use of the Board, in which he observes:—"The present number of the Mosquito Indians is unknown. It happened among them probably, as among the North American Indians, that they declined in numbers and degenerated in spirit as the white people settled among them. Like the Caribs of San Domingo, they consist of three distinct races—the aborigines, the descendants of certain African Negroes wrecked on the coast, and a generation containing the blood of both. If the Spaniards earnestly desired to destroy them, they could not, I think, make a very vigorous resistance." The "Commissioners of Legal Inquiry in the case of the Indians of Honduras, 1828," describe the Mosquito Indians as "a barbarous and cruel people, in the lowest state of civilization—hostile to the other Indian nations, who are a mild, timid, and peaceful race." When Colonel Hodgson wrote, it appears that the inhabitants of the coast were not more homogeneous politically than in blood. He says of them, that then (1757) they were "not so properly a single state as three united, each independent of the others."

"1. Those who inhabit the southern extremity till Bragman's, and are mostly the orginal Indians; their head man is called *Governor*.

"2. Those who extend to about Little Black River, and are mostly Sambos; their chief is called *King*.

"3. Those westward, who are Indians and Sambos mixed; their head man is called *General*. The power of these three head men is nearly equal, with a small difference in favour of the king, who is a little supported by the whites for the sake of his name. The king has his commission or patent for being called so from the governor of Jamaica."

Whatever may have been the former numbers of the Mosquitos, there can be no doubt of the fact, that they are every day becoming fewer under the combined effects of drunkenness and disease. Upon the north, the Caribs, originally from St Vincent, are gradually encroaching on the Sambo Mosquitos, and crowding them down the coast, where their principal establishments are confined to Cape

Gracias, Sandy Bay, Rio Grande, Prinzapulka, Pearl Key, and Bluefields. In character and habits they remain much the same as when described by the pirates, living chiefly by fishing, and having little trade except in tortoise-shells and sarsaparilla. They are without any form of religion, but believe in a certain spirit of the water called *Lewire*, and an evil spirit named *Wulasha*, who consumes the bodies of the dead. They have great faith in a class of sorcerers, who combine the characters of the medicine-men of the North American Indians, and the obi-men of Africa, called *Sukias*, whose authority is often greater than that of the most powerful chief. These pretend to cure diseases by incantations and rude jugglery, directed chiefly to appeasing *Wulasha*, who shares in the reward of the *Sukias*.

The huts of the Mosquitos are mere thatched sheds of palmetto or cahoon leaves, about 6 feet high to the eaves, and projecting 3 or 4 feet beyond the line of posts. Some of the better ones are inclosed with a stockade or fence of palmetto stalks, having the entrance in the gable. The men sleep on the sand floor, or in hammocks, and the women on a rude frame-work of canes, raised a few feet above the ground. Their arts are confined to making *pitpans*, long, flat-bottomed canoes for use in the rivers and lagoons; and *dories*, or large canoes for coasting on the sea. They also make harpoons and implements for fishing, and manufacture a kind of cloth, or *tappa*, from the inner bark of the *ule* or caoutchouc tree. In language they differ wholly from the neighbouring Indians, so that they are unable to communicate with them except through interpreters. From their long intercourse with the English, they have adopted many English words, which, however, are pronounced in a very broken manner, constituting a kind of jargon. Their own language is not deficient in euphony, although defective in its grammar. It has no article, definite or indefinite, but the numeral adjective *kumi* (one) is used whenever the idea of number is prominent. The adjective follows the noun, as do also the numerals. All nouns are understood to be masculine, unless qualified by the word *maisen*, woman or female. The pronouns are twelve in number, but have neither gender nor number, both of which must be inferred from the connections in which they are used. The verbs have mood, tense, and person, but are wanting in number.

The geography of the Mosquito territory is very little known. Upon the coast, however, there are several harbours of fair capacity, and some positions capable of easy settlement. Bluefields Lagoon is a considerable body of water, between 30 and 40 miles in length, and almost completely land-locked. It has a bar at its entrance, but within the bar it has from 4 to 6 fathoms. The great river Escondido, and several small streams, flow into it. On the south bank of this river is situated the town of Bluefields, the residence of the King and his English guardian. It contains nearly 500 inhabitants, including about 50 whites. 30 miles to the northward of Bluefields is Pearl Key Lagoon, affording a tolerable harbour for small vessels. A considerable river, the Wawashaan, falls into this lagoon. Still 30 miles to the northward, a large stream, the Rio Grande, flows into the sea. Its mouth is obstructed by a dangerous bar; but when this is passed, it is said that the river may be navigated for the distance of a 100 miles inland. Further to the northward are the Prinzapulka, Tongla, Brackman, Wava, Duckwara, and other considerable streams. Next in order is the Rio Wanks, the longest, if not the largest river in Central America, which reaches the sea at Cape Gracias á Dios. Towards their sources, amongst the mountains of Honduras and Nicaragua, all these streams are rough and rapid; but as they approach the ocean they lose their turbulent character, and flow majestically into the sea. During the seasons of the rains they usually overflow their banks, and, with the numerous creeks and lagoons, constitute a net-work of lakes parallel to the sea-coast, which permit interior navigation all the way from Bluefields Lagoon to Cape Gracias. The climate of the coast is moist, hotter than the interior, and not so salubrious, although in the latter respect entitled to rank equally high with the West Indian Islands generally. The greater part of the soil is fertile, and capable of producing in abundance cotton, sugar, rice, indigo, and the other tropical staples. There are some extensive tracts of open or savanna land, covered with grass, well adapted for the raising of cattle. There are also certain broad, sandy plains, not fitted for cultivation, but covered with fine pines, some of them large enough for the masts of ships; and the banks of the rivers generally are covered with forests of mahogany, rosewood, India-rubber, and other valuable trees. Altogether the coast has many natural elements of wealth; but it may be doubted if its settlement by a civilized race will be effected until the equally fertile, but more elevated, cooler, and more salubrious regions of the interior and on the Pacific coast, have become filled by an active and enterprising population. Their greater advantages will claim for them the first attention of emigrants, and to these alone can we look for the political and social regeneration of Central America, and for the ultimate rescue of the Mosquito Shore from its present condition of desolation and barbarism. (E. G. S.)

MOSSES. See BOTANY, c. iii., § 1.

MOSTAGANEM, a town of Algeria, in Lat. 36. 10. N., Long. 0. 15. E., is situated on a limestone rock, 233 feet above the sea, and about 1½ miles from the coast. It is divided into two parts by a fertile valley, laid out in gardens and traversed by a small stream. That which stands on the left side of the stream is the town proper, the other part being inhabited exclusively by the military. The town has very much a French appearance, with wide streets and handsome squares. The principal buildings are a theatre and a large hospital. Leather, carpets, jewellery, &c., are manufactured; and an extensive trade is carried on with the interior. The harbour is not good, but it is much frequented. The neighbouring country is fertile and well-cultivated; and grain, wool, hides, and dried fruits are the principal exports. Pop. 6469.

MOSTAR, a town of Bosnia, capital of the province of Herzogovina, is situated on both sides of the Narenta, 72 miles N.W. of Cattaro. It is surrounded by embattled walls, which inclose a much larger space of ground than is actually occupied by buildings. The streets are for the most part unpaved; and the town contains several mosques and churches, and two large bazaars. The name *Mostar*, which signifies "old bridge," is derived from the Roman bridge of a single arch which crosses the river. Swords and fire-arms are manufactured here; and there is an active trade in corn, wine, fruits, cattle, tallow, and wax. Pop. 7300.

MOSTYN, a village and township of Wales, in the county of Flint, situated on the estuary of the Dee, 4 miles N.W. of Holywell. There is an elegant church here, which was built in 1845. The coal-pits in the neighbourhood are numerous, giving employment to the most of the inhabitants, and furnishing large quantities of coal for exportation. Mostyn stands on the railway between Chester and Holyhead; and communication is kept up by steamers with Liverpool. Pop. 2091.

MOSUL, a town of Asiatic Turkey, capital of a pashalic of the same name, is situated on the right bank of the Tigris, 220 miles N.W. of Baghdad. It is surrounded by walls; but these, as well as a castle which stands on an artificial island in the Tigris, and the best buildings of the town, are in a very dilapidated condition; while the whole place is very low, and fast-declining in internal prosperity and commercial importance. The streets are narrow, irregular, and crowded with beggars. The houses, which are built of

stone or brick, have in general vaulted roofs surrounded by flat terraces. The streets of the town are but little raised above the level of the Tigris, and they are thus often laid under water when the river is in flood. The town contains numerous mosques (some of which are of great beauty), a college, coffee-houses, baths, khans, and bazaars. The climate is mild, but occasionally very hot in summer; and though it is in general considered a healthy place, Mosul has several times been exposed to the ravages of pestilence. There are several hot sulphur springs in the neighbourhood of the town, which are much resorted to, from their medicinal qualities. Mosul was formerly celebrated for the manufacture of muslin, which derives its name from the town; but the only manufactures now carried on are those of cotton fabrics, shawls, calicoes, &c. A considerable transit trade is carried on through Mosul between Constantinople, Syria, Baghdad, and the interior of Kourdistan. Pop. estimated at 40,000.

MOTHE-LE-VAYER, François de la, a distinguished French writer, was of noble descent, and was born at Paris in 1588. His attention was early directed by his father to the study of literature, law, and morals. Aided by a tenacious memory and by the power of assiduous application, he became distinguished for his general intelligence, and especially for his intimacy with history. The female wit, Mademoiselle de Gournay, received him into her brilliant circle, and bequeathed to him her library. Although Mothe-le-Vayer had begun to write at an early age, he did not publish any of his works until his forty-eighth year. At length his *Discours de la Contrariété d'Humeurs qui se trouve entre certaines Nations*, and his *Considerations sur l'Eloquence Française*, published in 1636 and 1638 respectively, brought him fully before the public. He was admitted into the French Academy in 1639. His next work, *De l'Instruction de Monsieur le Dauphin*, 4to, 1640, raised him to the height of distinction, since it led to his appointment in 1652 as tutor to the young King Louis XIV. Meanwhile he had become an avowed sceptic, and had published in 1642 a treatise entitled *De la Vertu des Paiens*. On the marriage of his royal pupil in 1660, Mothe-le-Vayer retired from his public office, and gave himself up to his favourite studies. Foreign politics continued till the close of his life to be the subject of his eager attention, and one of his last questions was, "What news of the Great Mogul?" He died in 1672. Mothe-le-Vayer also wrote *Jugement sur les Anciens et Principaux Historiens Grecs et Latins*, 8vo, 1646; and *Du peu de Certitude qu'il y a dans l'Histoire*, 1668. The best edition of his collected works is that of Dresden, in 14 vols. 8vo, 1756–59.

MOTION. See Attraction, Dynamics, Mechanics, and Statics.

MOTRIL, a town of Spain, in the province of Granada, situated in a rich and fertile plain, about a mile from the Mediterranean, and 38 miles S.S.E. of Granada; Lat. 36. 45. N., Long. 3. 34. W. It is irregularly built, but varies considerably in different parts; for some of the streets are narrow, dirty, and unpaved; while others are handsome, regular, and well kept. In the principal square are the town-house, a collegiate church of a clumsy appearance, and a granary. There are several other churches in the town, a nunnery, and several elementary and upper schools. The neighbouring country is rich in fruit; and large quantities of fish are got from the Mediterranean. The people are for the most part employed both in agriculture and in the fisheries. Sugar, rum, soap, earthenware, &c., are manufactured here. The town itself has no harbour, but that of Calahonda is only about 7 miles distant. The greater part of the trade of the provinces of Granada and Jaen passes through Motril. Rice, dried fish, sugar, coal, timber, leather, cotton and woollen stuffs, &c., are imported; and oil, figs, oranges, wine, brandy, &c., are exported. Pop. 10,170.

MOTTRAM-IN-LONGDENDALE, a town of England, in the county of Chester, 9 miles E. by S. of Manchester. It is well built, and contains one Established and three Dissenting churches. There are also print-works and cotton factories in the town, in which the majority of the inhabitants are employed. Pop. (1851) 3199.

MOUFET, Thomas, an eminent English physician and naturalist, was born in London during the first half of the sixteenth century, but at what precise date is not known. He practised medicine in the metropolis with great reputation, and towards the close of his life retired to the country. He died about the year 1600. This physician is best known by a work which was begun by Edward Wotton, and printed at London in 1634, folio, under the title of *Insectorum, seu Minimorum Insectorum Theatrum, olim ab Edwardo Wotton, Conrado Gesnero, Thomaque Pennio inchoatum, Moufeti opera sumptibusque maximis concinnatum auctum, perfectum*. A translation of it into English was published at London in 1658, folio. Martin Lister gives a very unfavourable opinion of this book. "As Moufet," says he, "made use of Wotton, Gesner, and others, an excellent work might have been expected from him; and yet his *Theatrum* is full of confusion, and he has made a very bad use of the materials with which these authors have furnished him. He is ignorant of the subject of which he treats, and his manner of expression is altogether barbarous. Besides this, he is extremely arrogant, to say no worse; for though he has copied Aldrovandus in innumerable places, he never once mentions his name." But Ray thinks that Lister, by expressing himself in this manner, has not done justice to Moufet; and he maintains that the latter has rendered an essential service to the republic of letters. He wrote *De Jure et Præstantia Chemicorum Medicamentorum, Dialogus Apologeticus*, Franc. 1584; *Nosomantica Hippocratica, sive Hippocratis Prognostica cuncta, ex omnibus ipsius scriptis, methodice digesta*, lib. ix., Franc. 1588; *Health's Improvement, or Rules of the Nature, Method, and Manner of Preparing all sorts of Food;* enlarged by Christopher Bennet, London, 1655.

MOUKDEN, a town of the Chinese empire, capital of Manchooria, in Lat. 41. 50. N., Long. 123. 37. E., 500 miles N.E. of Pekin. It is large and populous, and is surrounded by walls. An inner wall incloses the palace, government offices, court-house, &c. The outer city, which is also walled, is inhabited chiefly by the working-classes, and has a circuit of about 10 miles.

MOULD, in the mechanical arts, is a cavity artificially cut, with a design to give its form or impression to some softer matter applied therein. Moulds are implements of great use in sculpture, foundry, and other arts. The workmen employed in melting the mineral or metallic ore dug out of mines have their several moulds to receive the melted metal as it comes out of the furnace; but these are different according to the diversity of metals and works. In gold mines they have moulds for ingots, in silver mines for bars, in copper and lead mines for pigs or salmons, in tin mines for pigs and ingots, and in iron mines for sows, chimney-backs, anvils, caldrons, pots, and other large utensils.

MOULDINGS, in *Architecture*, are projections beyond the naked wall, column, or wainscot, the assemblage of which forms cornices, door-cases, and other decorations of architecture. (See the *Glossary* to the article Architecture.)

MOULE, a town and harbour of Guadaloupe, in the division of Grande Terre, is situated on the N.E. coast of the island, near the mouth of a small river; Lat. 16. 21. N., Long. 61. 27. W. Pop. 10,000.

MOULIN LILLE, a suburb of Lille, which derives its name from the number of wind-mills in the vicinity. Pop. 4317.

MOULINS, a town of France, capital of the department of Allier, is situated on a plain on the right bank of the Allier, which is here crossed by a handsome stone bridge, 164 miles S.S.E. of Paris. The town has a cheerful appearance; and the streets, though not very wide or straight, are clean, well paved, and lined on each side with good houses, built chiefly of brick. It was formerly surrounded by fortifications, but the place of these is now occupied by public walks. The principal buildings in the town are,—the cathedral of Notre Dame, a building in the florid style of the fifteenth century, of which only the choir has been completed; the chapel of the college, which formerly belonged to the convent of the Visitation, containing the monument of the last Duke of Montmorency; the castle, formerly the residence of the Dukes of Bourbon, of which all that now remains is a square tower and some buildings erected by Catherine de Medicis, and serving as barracks; and the town-house. There are also in Moulins a court of first resort and one of commerce, a chamber of manufactures and arts, a normal school and school of design, societies of rural economy and of agriculture, a public library of 19,000 volumes, a museum of natural history, two hospitals, and a theatre. The manufactures are extensive, consisting chiefly of hardware, especially of cutlery, woollen and cotton stuffs, hosiery, glass, leather, silk, &c. There is an active trade in cutlery, corn, wine, cattle, timber, coal, charcoal, iron, &c. The history of the town can be traced as far back as the eleventh century; and in 1368 the Bourbon family took up their residence here. Moulins is also noted as the birthplace of Marshal Villars, the opponent of Marlborough at Malplaquet. Pop. (1856) 16,391.

MOULMEIN, in Hindustan, a town in the British district of Amherst, and the principal place of the Tenasserim provinces. It is situated on a small peninsula formed by three rivers, the Salwein, the Gyne, and the Attaran, and lies opposite to the town of Martaban, and about 30 miles N. of Amherst. Upon its cession to the British in 1826 by the Burmese, the site was selected for a military station; and the town, which now bears all the marks of civilization, a few years since presented a very different aspect, the accumulation of huts of which it then consisted having been converted into a fine seaport-town, with open streets, quays, markets, churches, and schools. The main street runs parallel to the river, and communicates with different parts of the town by means of smaller streets joining it at right angles. The population of the town is given at 17,042. Vast forests in the vicinity yield an inexhaustible supply of teak timber, which, coupled with other local advantages, has enabled Moulmein to supplant Chittagong and other ports on the eastern coast of the Bay of Bengal in ship-building. The East India Company's steamer Tenasserim and Her Majesty's sloop Malacca were built at this port. One of the Indian newspapers, styled the *Moulmein Guardian*, is printed in this town. N. Lat. 16. 30., E. Long. 97. 42.

MOUNTAINS. See Physical Geography.

MOUNT EVEREST, a mountain of the Himalaya range, situated between the peak of Kinchingunga in Sikkim and the city of Khatmandu in Nepaul, and presumed to be the loftiest summit in the world. Its elevation is 29,002 feet above the level of the sea, surpassing that of the highest peak of the Andes by above half a mile of perpendicular altitude. This mountain, which has been recently discovered, has been named Mount Everest, in compliment to the late surveyor-general of India.

MOUNTMELLICK, a market-town of Ireland, in Queen's County, situated on a bend of the River Owenass, 45 miles W.S.W. of Dublin. The houses are well built; and the town contains a parish church, and four other churches, belonging to Roman Catholics, Methodists, and Quakers; a court-house, a bank, several schools, a dispensary, and a poor's-house. The manufacturing industry of the place is active; and there are flour-mills, an iron and brass foundry, breweries, soap-works, tanneries, and potteries. The trade is considerable; and eight yearly fairs are held here. The population consists to a large extent of Quakers, and amounts to 3657.

MOUNTRATH, a market-town in Queen's County, Ireland, is situated on a tributary of the Nore, 53 miles W.S.W. of Dublin. The principal buildings are,—a parish church, Roman Catholic and Methodist churches, a court-house, a market-house, and a jail. There are also a monastery, a nunnery, several schools for the higher and lower classes, and a dispensary. The chief manufacturing establishments are cotton and worsted factories, an oil-mill, and a large brewery. Several annual fairs are held here. Pop. 2100.

MOUNT'S BAY, a large bay on the S.W. coast of Cornwall, lying between two promontories,—Lizard Point on the E., and Land's End on the W. It is 18 miles wide, and runs 8 miles into the land; while its depth varies from 3 to 30 fathoms. The name is derived from St Michael's Mount, which is situated on its shore.

MOUNTSORREL, a market-town of England, in the county of Leicester, on a steep hill near the Soar, from which it derives its name, 7 miles N. of Leicester. It contains two Established churches, Methodist and Baptist chapels, and several schools. The inhabitants are employed in the manufacture of hosiery, and in the quarries in the vicinity, where a very hard trap rock is obtained, of which the town is built. Pop. 1536.

MOURNING, a particular dress or habit worn to signify grief upon some melancholy occasion, particularly the death of friends or of great public characters. The modes of mourning are various in different countries, as are also the colours used for that purpose. In Europe the ordinary colour for mourning is black, in China it is white, in Turkey blue or violet, in Egypt yellow, in Ethiopia, brown. White formerly obtained in Castile on the death of their princes; and Herrera observes, that the last time it was used was in 1498, on the death of Prince John. The Kings of France mourn in violet. Each people pretend to have their reasons for the particular colour of their mourning: white is supposed to denote purity; yellow indicates that death is the end of human hopes, because leaves when they fall, and flowers when they fade, become yellow; brown denotes the earth, whither the dead return; black signifies the privation of life, as being the privation of light; blue expresses the happiness which it is hoped the deceased enjoys; and purple or violet betokens sorrow on the one side and hope on the other, as being a mixture of black and blue.

Mourning amongst the ancients was expressed in a great variety of ways. Amongst the Jews, on the death of their relations or intimate friends, grief or mourning was signified by weeping, tearing their clothes, smiting their breasts or tearing them with their nails, pulling or cutting off their hair and beards, walking barefooted, lying upon the ground, fasting, &c. They kept themselves closely shut up in their houses, covered their faces, and abstained from all work, even reading the law and saying their usual prayers. They neither dressed, nor made their beds, nor cleaned their persons, nor saluted anybody; so that sulkiness appears to have been an indication of sorrow, and dirtiness of distress. The time of mourning amongst the Jews was generally seven days, though this was lengthened or shortened according to circumstances; but thirty days were thought sufficient upon the severest occasions. The different periods of the time of mourning required different degrees of grief, and different tokens of it.

The Greeks, upon the death of friends, showed their sorrow by secluding themselves from all gaiety, especially

entertainments, games, public solemnities, the enjoyment of wine, and the delights of music. They sat in gloomy and solitary places, stripped themselves of all external ornaments, put on a coarse black stuff by way of mourning, tore their hair, shaved their heads, rolled themselves in the dust and mire, sprinkled ashes upon their heads, smote their breasts with their palms, tore their faces, and frequently cried out with a lamentable voice and drawling tone, reiterating the interjection ε, ε, ε, ε. Hence funeral lamentations were called Ελεγοι. If they appeared in public during the time of mourning, they had a veil thrown over their faces and heads. During the funeral procession, certain persons, called *ἐξαρχοι θρηνων*, marched before, and sung melancholy strains. These vocal mourners sung thrice during the procession round the pile and round the grave. Flutes were also used to heighten the solemnity. At the funerals of soldiers, their fellow-soldiers who attended, as a testimony of their affliction, held their shields, their spears, and the rest of their armour inverted.

The tokens of private grief amongst the Romans were nearly the same as those amongst the Greeks. Black or dark brown were the colours of the mourning habits worn by the men, and they were also common to the women. The mourning of the emperors at first was black. In the time of Augustus the women wore white veils, but the rest of their dress was black. From the time of Domitian they wore nothing but white habits, without any ornaments of gold, jewels, or pearls. The men let their hair and beards grow, and wore no wreaths of flowers on their heads whilst the days of mourning continued. The longest time of mourning was ten months. This was Numa's establishment, and included his whole year. During this time it was infamous for a widow to marry. Mourning was not used for children who died under three years of age. From this age to ten they mourned as many months as the child was years old. A remarkable victory, or other happy event, occasioned the shortening of the time of mourning. The birth of a child, or the attainment of any remarkable honour in the family, certain feasts in honour of the gods, or the consecration of a temple, had the same effect. After the battle of Cannæ the commonwealth decreed that mourning should not be worn for more than thirty days, that the loss sustained might be forgotten as soon as possible. When public magistrates or persons of great note died, also when any remarkable calamity happened, all public meetings were intermitted; the schools of exercise, baths, shops, temples, and all places of concourse, were shut up; and the whole city put on an appearance of sorrow; the senators laid aside the *laticlare*, and the consuls sat in a lower seat than ordinary. This was also the custom of Athens, and was observed upon the death of Socrates, not long after he had been sentenced to death by their judges. *Præficæ*, or mourning women, went about the streets. This was also customary amongst the Jews as well as the Greeks and Romans. (Jerem. ix. 17.)

MOURZUK. See Fezzan.

MOUT, or Moot, a town of Asiatic Turkey, in the pashalic of Itshili, is situated 88 miles S.E. of Konia. The principal building is a castle, surrounded by embattled walls, with several square towers, and a round one in the centre. There are some mosques and baths, but these are mostly in a ruinous condition. The inhabitants live for the most part in huts of clay and reeds. The streets and the sites of the principal buildings of an ancient city (supposed by Beaufort to have been Philadelphia, but by Leake to have been Claudiopolis), may be distinctly traced among the more modern edifices; and many marble columns and other ornaments, lying neglected and half buried in the earth, or built into Turkish mosques, now also in ruins, attest the former magnificence of the Grecian city.

MOUTON, Jean, an eminent French musician, born in 1461, of whose life very little is known. Glarean, who was personally acquainted with Mouton at Paris in 1521, declares him to have been a native of France. Some writers have stated that Mouton was chapel-master to Louis XII. and Francis I. of France, but there is no evidence for that. He was a pupil of Josquin Deprès, according to Adrian Willaert, his scholar. Several of his motets were published at Venice and at Paris in the earlier part of the sixteenth century. Hawkins and Burney gave specimens of his music; and Forkel, in the second volume of his *History of Music*, pp. 660–7, published Mouton's motet for four voices, *Confitemini Domino*. In the article Music will be found an elegant air by Mouton, and a very remarkable passage of unprepared dissonances from one of his motets. (G. F. G.)

MOVEMENT, in music, usually relates to the degree of slowness or quickness with which a piece of music is to be performed. The different degrees of movement are divided into five principal kinds, designated by the following terms in their order:—*1st*, Largo or Lento; *2d*, Adagio; *3d*, Andante; *4th*, Allegro; *5th*, Presto. All other movements, such as Grave, Larghetto, Andantino, Tempo giusto, Tempo di Minuetto, Allegretto, and Prestissimo, are mere modifications of the preceding five kinds. It is found necessary, however, to employ other auxiliary terms to indicate not only the degree of movement, but also the style and manner of performance required. These auxiliary terms are,—*affettuoso, agitato, amoroso, grazioso, maestoso, sostenuto, giusto, moderato, cantabile, con brio, vivace, spiritoso assai, con energia, appassionato*, &c., &c. But all these terms are vague; and the right movement, as well as the best expression, suitable to this or that piece of music, must be left to the skill and feeling of the accomplished performer who has studied musical composition and the styles of the various schools of music, ancient and modern. The composer may fix precisely the time-movement of his piece of music by means of the metronome; but he has no means of showing exactly, by any written signs, what style and expression he wishes the performer to employ. (See Metronome.) (G. F. G.)

MOWEE, or Maui, an island of the Sandwich group, situated in Lat. 20. 44. N., Long. 155. 58. W., 24 miles N.W. of Hawaii. It stretches from N.W. to S.E. for about 40 miles, and consists of two elevated portions of an oval shape, joined together by a low sandy isthmus, 9 miles wide. The south-eastern portion rises almost perpendicularly to a height of more than 10,000 feet in Mount Haleakala; while the north-western elevation is much inferior in height. The structure of the island, like that of the others in the same group, is volcanic, and exhibits a striking contrast between the barrenness of the mountains and the luxuriant vegetation of the valleys and lower regions. Mowee is considered the richest in soil and the most productive of the Sandwich Islands; but the cultivated ground does not exceed one-tenth of the whole area. The town of Lahaina, which is situated on a bay of the same name on the S.W. coast, contains a church, schools, a market-house, and a reading-room. Missionaries from the United States first settled here in 1832, and have since acquired great influence over the natives. The church consists of about 300 members. The population of the town is probably about 3000. The harbour of Lahaina is formed by two projecting rocks, and is much resorted to by whaling vessels for supplies of provisions. Pop. estimated at more than 20,000.

MOZAMBIQUE, a name applied to a large extent of the seaboard of Eastern Africa, belonging to Portugal; as well as to the chief town of the same. The former is bounded E. by the Mozambique Channel, N. by Cape Delgado (S. Lat. 10. 38.), and S. by Delagoa

Bay (S. Lat. 26.), and has an extent of about 1200 miles. The entire territory, with the exception of some settlements on the River Zambesi, is confined to the coast, and cannot be said to have any definite interior boundary. It was discovered in 1498 by Vasco de Gama, the great Portuguese navigator, and the chief town was founded by Affonso de Albuquerque in 1506. The coast is characterized by the two prominent headlands of Cape Corrientes in the S., and Cape Delgado in the N.; and also by several large bays, the chief of which are Delagoa, Mocambo, and Pamba. Between Delagoa Bay and Cape Corrientes, and from Mozambique city to Cape Delgado, the shores are described as high and precipitous; while reefs and numerous islands lie off the land nearly throughout its entire length. Many large streams discharge themselves here. Of these the principal are,—the Manisa and Inhampura, between Delagoa Bay and Inhambana town; the Inhambana and Great Sofala, between the towns of the same name; and the Buzú, N. of Sofala, which is navigable up to Mossiquire. The Zambesi, the largest river of Eastern Africa, discharges itself by several mouths at the middle point of the Mozambique coast. The principal branches of the delta are the Luabo and Kilimane, the former, and southernmost, having the largest volume of water. (For further information on this river, see the article ZAMBESI.) The St George enters the sea between Kilimane mouth and Mozambique city; while the Fernando Veloso, and Mangaló enter Tungué Bay further to the north. Settlements have been established along the coast at the most accessible points, and where easy communication may be had with the interior. The Portuguese, however, have so neglected their possessions, that in every instance the trade and government are now in a very feeble condition. Indeed, at some stations the government may be said to rest more with the influential chiefs of the neighbouring tribes than with the Portuguese governor or representative, who frequently holds his position as much from the clemency or indolence of the natives as from any fear they have of his power. The military force is very small for such an extent of territory, and is composed of the worst class of soldiers, who are either convicts from Europe, or cowardly disaffected half-castes or natives. The coast, for administrative purposes, is divided into six sub-districts, and Mozambique is the head district. The former are (going from N. to S.) Cape Delgado, Kilimane (with military stations at Senna and Tete in the interior), Sofala, Inhambana, and Lorenzo Marques. A governor-general and secretary, appointed by the crown, administer the government, assisted by a *junta*, which is composed of a president, treasurer, and twelve members. The judicial staff includes a high judge and substitute, as well as an attorney and delegate. The established religion is Roman Catholic, and is superintended by a prelate, a prior, and twelve parochial priests. Education, which, like religion, is here at a very low ebb, is dispensed by sixteen teachers in all, four of whom are females. Most of these, moreover, reside in the capital. The military staff consists of two commanders; and the regular force amounts to 1096 men,—distributed into the Mozambique foot battalion, 368 men; the district company of Cape Delgado, 161 men; and the district companies of Kilimane, Senna, Tete, Zumbo, Inhambana, Sofala, and Lorenzo, 81 men each. Most of these stations are commanded by a major and adjutant. A militia force, composed of natives, is nominally extant; but, with the exception of its officers, who are native chiefs, receiving from their appointments from L.4 to L.20 a year, its very numbers are not ascertained. The cost of the military establishment amounts annually to about L.9522, and that of the marine, which consists of a brig and a smaller vessel, to L.2552. The territory contains an estimated population of 300,000 souls, including 22,000 slaves; but of that number there were only 3600 regular Portuguese subjects in 1848, and 3250 in 1852.

Little is known of the condition or resources of the country, except at the few stations placed along the coast; and these we shall now notice shortly in their order from N. to S., thereby giving a general idea of those parts not yet within European influence.

San João, on the island of Ibo, lying close upon the mainland, is the northernmost of these settlements, and is situated between S. Lat. 12. 20. and E. Long. 40. 30. It is defended by three forts, and belongs to Cape Delgado district; which abounds in cotton, coffee, tobacco, gum, and amber, but has comparatively little trade. Pop. 140 Christians, 800 free blacks, and 600 slaves.

Mozambique city, on an island of the same name, in S. Lat. 15. 1., E. Lon. 40. 5., and a short distance from the continent, was founded in 1763, and incorporated as chief town in 1813. The cognominal district to which it pertains extends on the mainland from Pamba Bay, in S. Lat. 12. 58., to the Moma River, in S. Lat. 16. 45., a length of about 300 miles; but its interior frontier is undefined. Many of the African tribes here, who do not formally acknowledge the sovereignty of Portugal, yet pay tribute annually. The site of Mozambique city was chosen for its security, and supposed advantageous position for controlling the coast; but otherwise a worse place could not have been selected on the whole shore. It is barren, confined, and very ill watered. Three forts command the island, and could supply ample accommodation for a large garrison. The town, which is notorious for its filthiness, has nevertheless some good private houses as well as public buildings. Among the latter there are a marine arsenal, an hospital, and a *casa da misericordia;* while a military hospital and public baths are situated in the south part of the island. The trade of the place is at its height in the autumn, when the blacks from the interior or adjacent ports bring their goods hither for barter. Direct communication, however, with the interior is much obstructed by want of a fort on the mainland opposite. The slave trade thrives here, connived at by the authorities, who are said to make great gains from the prices required from the traders by way of bribes or licenses; and large numbers are still kept on the island for the purposes of trade, in spite of art. 145, § 8, of the constitution. These poor creatures, who number 20,000, are said to be ill clothed, ill fed, and shockingly ill treated. It is, moreover, a matter worthy of remark, that the blacks who have received their freedom here are a peaceful and industrious class, true to the government, and ever ready to receive religious instruction. Pop. of city, 270 Christians, 102 Banyans or Portuguese Hindoos from Goa, 1150 blacks, and 7000 slaves; total 8522.

Farther down the coast, between the last-mentioned town and Kilimane, is Quizango or Angozha, an old settlement of the Portuguese, but which, being attacked and destroyed in 1847 by a rebel chief of European origin, was abandoned. Kilimane, or Quillimane, a small town 12 miles above the mouth of the Kilimane, a delta branch of the Zambesi, is situated S. Lat. 17. 53., and E. Lon. 36. 56., in a cognominal district, comprising the Zambesi delta, with the two stations of Senna and Tete. It stands on a mud bank on the left side of the stream, surrounded by swamps, which render the ground on which the town is situated so soft that the walls of the houses are always sinking. The climate is very unhealthy, and fevers are extremely prevalent. A large trade in slaves is carried on here surreptitiously. They are collected in the town from the interior, and remain there till the ships from Rio de Janeiro and other ports of America arrive in the river. Pop. of town, 200 Christians, 32 free blacks, and 3260 slaves.

Mozambique.

Senna, a decayed town of the interior, on the right bank of the Zambesi, about 200 miles above Kilimane, contains about 30 houses, and is surrounded by conical hills, on one of which there is a dismantled fort. Though once a thriving station, it has now, from repeated attacks by the neighbouring tribes, and from an insufficient garrison, become of little consequence as a place of trade. The vicinity, however, has all the resources to render it an important town, possessing as it does rich iron and copper deposits, as well as producing oil, fruits, and cereals in abundance. Pop. of town, about 108 Christians and 2850 slaves.

Tete, about 300 miles farther up the Zambesi, on the right bank of the same, is a walled town containing nearly 1200 huts, and defended by the fort Santiago Maior. It is well situated for trade, and was, before the formal abolition of the slave trade, the most important commercial port on the Zambesi. Recently, however, the town has much declined, although not to the same extent as Senna. It has frequently, like it, suffered from attacks made by the neighbouring tribes and rebel half-castes. Excellent iron, coal, copper, and marble, abound in the vicinity, but are left unworked. Gold also exists, but is not collected to so great an extent as formerly. Dr Livingstone, who visited this place in March 1856, says that 130 lb. of gold were annually obtained here before a stoppage was put to the slave trade, but now the amount has diminished to from 8 to 10 lb. annually. Pop. of town estimated by Livingstone at 2500.

The next station belonging to Portugal is Sofala, situated on the sea-coast, about 250 miles S.E. of Kilimane, S. Lat. 20. 12., and E. Lon. 35. 20., formerly the chief town of a large district of the same name, but now much fallen in importance. Its harbour, however, is one of the best on the shore, and the neighbourhood abounds in gold, ivory, and precious stones.

Inhambane, situated on a peninsula at the mouth of a cognominal river, more than 200 miles south of Sofala, in S. Lat. 23. 51., and E. Lon. 35. 30., has a considerable trade in slaves and ivory. The river here has little fall of water, and its entrance is dangerous; while the country round the town is flat, subject to inundation, and very unhealthy. A hill a little beyond, however, is much resorted to by the inhabitants for its comparative salubrity. Regular government is all but extinct here. Pop. 182 Christians, 205 free blacks, and 1852 slaves.

The last station on the Mozambique coast is that of Lorenzo Marques, situated in Delagoa Bay, S. Lat. 26., and E. Lon. 30. 30., and surrounded by a swampy district of land, subject to periodical inundation, and very unhealthy. The bay, however, forms a secure and convenient harbour for vessels rounding the Cape; while the vicinity is famous for its fertility in all the articles of South African produce. Excellent Indian corn, rice, cassia, and coffee grow here with little culture, and building timber of the best quality is abundant. The trade is mostly contraband, on account of the impotency of the government, and consists in the export of ivory, hides, and amber, in return for cheap calicoes and beads from America and the Cape Colony. Numerous mutinies have occurred here, ending with the murder of the governor,—an atrocity which has brought the place into disrepute, and hastened its fall. Pop. about 50 Christians and 256 slaves.

From what has been said of the condition of the various settlements on this shore, it must be evident that a new system of administration is urgently required. The resources of the country are great and various; and were the government steady and liberal in its policy, their development would be easily accomplished, and attended with great profit both to the home government and to the tribes of Africa. A company, called the East Africa Company, was formed lately in Portugal avowedly for this purpose, and laid certain conditions before the King, on which they bound themselves to re-open the country to European enterprise, but these were not accepted by the government.

Mozambique Channel | Mozart.

MOZAMBIQUE CHANNEL, a wide strait of the Indian Ocean, separating the island of Madagascar from the continent of Africa, between S. Lat. 12. and 25., and E. Lon. 35. and 45. It has a length of about 1000 miles, and a breadth of from 300 miles at Mozambique city to about 600 miles at the widest part. The Comoros, a numerous cluster of islands, are situated at its northern outlet.

MOZART, JOHANN-CHRYSOSTOM-WOLFGANG-GOTTLIEB, the illustrious musical composer, was born at Salzburg on the 27th of January 1756. He was the son of Leopold Mozart, a musician in the employment of the Prince-Archbishop of Salzburg, and Anna Maria Pertl. Both parents were noted for their uncommon beauty. Mozart was scarcely three years old when he manifested the most astonishing disposition for music. With an instinctive perception of beauty, his great delight was to seek for *thirds* on the piano, and nothing could equal his joy when he found this harmonious chord. At the age of four his father taught him some minuets and other pieces of music. Mozart would learn a minuet in half an hour, and a longer piece in less than twice that time; and immediately afterwards he played them with remarkable clearness, and perfectly in time. Before he was six he had invented several small pieces himself, and even attempted compositions of some extent and intricacy. The vivacity of his mind led him to attach himself easily to every new object that was presented to him. He pursued the usual tasks of childhood with ardour; and when learning arithmetic, covered the tables, chairs, and walls with figures which he had chalked upon them. Music, however, soon became his favourite study, and in his juvenile efforts in composition he showed a consistency of thought and a symmetry of design which promised a maturity of the highest genius.

One day his father, returning from church with a friend, found his son busy writing. "What are you doing there, my little fellow?" he asked. "I am composing a concerto for the harpsichord, and have almost got to the end of the first part." "Let us see this fine scrawl." "No, I have not yet finished it." The father, however, took the paper, and showed his friend a sheet full of notes, which could scarcely be deciphered for the blots of ink. The two friends at first laughed at this heap of scribbling; but after regarding it a little more seriously, the father's eyes overflowed with tears of joy and wonder. "Look, my friend," said he, with a smile of delight, "everything is composed according to rule. It is a pity the piece cannot be made any use of; but it is too difficult; nobody would be able to play it." "It is a concerto," replied the son, "and must be studied till it can be properly played. This is the style in which it ought to be executed." He accordingly began to play, but succeeded only so far as to give them an idea of what he intended.

The extraordinary precocity of his son's genius induced Leopold Mozart to exhibit him at the different courts in Germany. As soon, therefore, as Wolfgang had attained his sixth year, the Mozart family, consisting of the father, mother, and a young daughter who had made very considerable proficiency on the harpsichord, and Wolfgang, took a journey to Munich. This expedition succeeded in every respect. The young artists, delighted at the reception which they had met with, redoubled their application, and acquired a degree of execution on the piano which no longer required the consideration of their youth to render it remarkable. During the autumn of the year 1762 the whole family repaired to Vienna, where the children performed before the court. Here they met with the celebrated Wagenseil. When Mozart, who knew already how to esteem the approbation of a great master, sat down to play before

the Emperor Francis, he asked his Majesty, "Is not M. Wagenseil here? we must send for him; he understands these things." The Emperor sent for Wagenseil, and gave up his place to him at the side of the piano. "Sir," said Mozart to the composer, "I am going to play one of your concertos; you must turn over the leaves for me."

Hitherto the young Mozart had only played upon the harpsichord. On his return from Vienna to Salzburg, he brought with him a small violin, and amused himself with it. Wenzl, a skilful violin-player, came to consult Leopold Mozart about some trios he had written. It was proposed to try the music. The father played the bass, Wenzl the first violin, and Schachtner, the archbishop's trumpeter, was to have played the second; but Wolfang insisted so much on being allowed to take this part, that his father at last consented to his playing it on his little violin. It was the first time he had heard his son seriously attempt this instrument, which, to the astonishment and delight of the party, he played with marvellous precision.

Every day afforded fresh proofs of Mozart's exquisite organization for music. He could distinguish and point out the slightest differences of sound; and every false or even rough note, not softened by some chord, was a torture to him. It was from this cause that during the early part of his childhood, and even till he had attained his tenth year, he had an insurmountable horror for the trumpet when it was not used merely as an accompaniment. The sight of this instrument produced upon him much the same impression as that of a loaded pistol does upon other children when pointed at them in sport. His father thought he could cure him of this fear by causing the trumpet to be blown in his presence, notwithstanding his son's entreaties to be spared that torment; but at the first blast the boy turned pale, fell upon the floor, and would probably have been in convulsions if they had not immediately ceased.

In 1763, when Mozart was in his seventh year, his family set out upon their first expedition beyond the boundaries of Germany; and it is from this period that the celebrity of the name of Mozart in Europe is to be dated. They visited Paris and many other cities on the Continent; and in the year 1764 came to London, where the children played before the King. Mozart also played the organ at the Chapel Royal; and with this the King was even more pleased than with his performance on the harpsichord. During this visit he composed six sonatas, which he dedicated to the Queen. He afterwards returned to France, whence he proceeded to Holland and Switzerland; and on his arrival at his native place in 1768, he composed, at the request of the Emperor Joseph, the music of an opera-buffa called the *Finta Semplice*, which was approved of by Hasse and Metastasio. At the dedication of the church of the Orphans he composed the music of the mass, and directed this solemn service, in the presence of the imperial court, although he was at that period only twelve years old.

In the month of December 1769 his father took him to Italy, and in every city met with an enthusiastic reception. Young Mozart had not as yet ventured out of the beaten track of composers; but preserving the old forms of melody and harmony, he wrote in a style which was particularly learned and correct. His operas at this period were thought to have an air of stiffness, from the contrapuntal knowledge which they exhibited. What principally distinguished him from other composers, was the facility with which he scored, and the extraordinary fluency of his ideas. It was probably, too, from reading Metastasio at this period that Mozart's taste in lyric poetry was formed; for in maturer life he was fastidious in the choice of the words he set to music, and the uninterrupted flow of melody and versification distinguished his airs from those of any other composer. Another circumstance of the Italian tour which proved influential upon the after life of Mozart, was the daily hearing of the highest and most pathetic style of church music, Italy having in the latter part of the last century produced some of her greatest ecclesiastical works. In the celebrated *Requiem*, which was composed purely from love of the *expressive* in sacred music, we may discover the result of the author's young devotion to this branch of the art, the consequence of listening to choral effects in the cathedrals of Italy.

Mozart having engaged to produce the first opera for the carnival of Milan, our travellers proceeded to Bologna, where Wolfgang found an enthusiastic admirer in Padre Martini, who was astonished to find a boy of fourteen years old capable of giving answers instantly in the *rigore modi* to any subject of fugue laid before him. In Rome Mozart gave a miraculous attestation of his quickness of ear and extensive memory by bringing away from the Sistine chapel the *Miserere* of Allegri, a work full of imitation and repercussion, mostly for a double choir, and continually changing in the combination and relation of the parts. He drew out a sketch of this celebrated composition upon the first hearing, and filled it up from recollection at home. He then repaired to the second and last performance with his manuscript in his hat, and corrected it. He afterwards produced his copy at a concert in Rome, and one of the singers who sang at the performance of the *Miserere* pronounced it perfect. Mozart thus became famous in Rome, a city where it was most difficult to excite attention in anything relating to the fine arts, on account of the numerous productions of art which were then every day presented, and formed subjects of constant and familiar contemplation.

On December 26, 1771, the first representation of his opera *Mitridate Re di Ponto* took place at Milan. It met with remarkable favour, and was performed twenty-two nights in succession. He afterwards wrote several other operas, one of which, entitled *Lucio Silla*, was likewise represented twenty times. But the epoch at which Mozart's genius ripened may be dated from his twentieth year. Constant study and practice had given him ease in composition, and ideas came thicker with his early manhood. The fire, the melodiousness, the boldness of harmony, the inexhaustible invention, which characterize his works, were at this time apparent. He began to think in a manner entirely independent, and to perform what he had promised as a regenerator of the musical art.

Mozart produced his first great opera, *Idomeneo*, in his twenty-fifth year. He was then enamoured of Mademoiselle Constance Weber, a celebrated actress, whom he afterwards married. The family of his mistress having opposed the match on account of his unsettled habits and situation, he was desirous of showing them that, although he had no recognised rank in society, he nevertheless possessed the means of obtaining consideration; and his attachment to Constance supplied him with the subject of the impassioned airs which his work required. The love and vanity of the young composer, thus stimulated to the highest pitch, enabled him to produce the opera of *Idomeneo*, which he always regarded as one of his best, and from which he has frequently borrowed ideas for his subsequent works.

Mozart being now happily married and settled, gave himself up to his profession. In 1786 he produced *Le Nozze di Figaro*; in 1787, *Il Don Giovanni*; and in 1788, *Cosi fan Tutte*; and in 1791, his operas *La Clemenza di Tito* and *Die Zauberflöte*, also his *Requiem*, which remained unfinished. He wrote only three German operas, *Die Zauberflöte*, *Die Entführung aus dem Serail*, and *Der Schauspiel-director*.

His works composed for the stage consist altogether of

fourteen operas. He left seventeen symphonies and instrumental pieces of all kinds, besides masses and other church compositions. He was one of the first piano-forte performers in Europe. He played with extraordinary rapidity, and the execution of his left hand was especially admired. Haydn said, "I never can forget Mozart's playing; it went to the heart."

Entirely absorbed in music, this great man was a child in almost every other respect. His hands were so wedded to the piano, that he could use them for nothing else. At table his wife carved for him; and in everything relating to money or to the management of his domestic affairs, or even the choice and arrangement of his amusements, he was entirely under her guidance. But seated at the piano-forte, he appeared a being of another order. His mind then took wing, and his whole attention was directed to the development of his art. His health was very delicate, and during the latter part of his too short life it declined rapidly. At times he laboured under a profound melancholy, and in this state he wrote *Die Zauberflöte*, the *Clemenza di Tito*, and his celebrated mass in D minor, commonly known by the name of his *Requiem*. The circumstances which attended the composition of the last of these works are too remarkable to be omitted in any notice of the life of Mozart.

One day, when his spirits were unusually oppressed, a stranger of a tall, dignified appearance was introduced. The manners of this stranger were grave and impressive, and he told Mozart that he came from a person who did not wish to be known, to request he would compose a solemn mass, as a requiem for the soul of a friend whom he had recently lost, and whose memory he was desirous of commemorating by this solemn service. Mozart undertook the task, and engaged to have it completed in a month. The stranger begged to know what price he set upon his work, and having immediately paid him a hundred ducats, took his leave. The mystery of this visit seemed to have a very strong effect upon the mind of the musician. He brooded over it for some time, and then suddenly calling for writing materials, began to compose with extraordinary ardour. This application, however, was more than his strength could support; it brought on fainting fits, and his increasing illness obliged him to suspend his work. "I am writing this requiem for myself," said he abruptly to his wife one day; "it will serve for my own funeral service;" and this impression never afterwards left him. At the expiration of the month, the mysterious stranger appeared, and demanded the requiem. "I have found it impossible," said Mozart, "to keep my word; the work has interested me more than I expected, and I have extended it beyond my first design. I shall require another month to finish it." The stranger made no objection; but observing, that for this additional trouble it was but just to increase the premium, laid down fifty ducats more, and promised to return at the time appointed. Astonished at the whole proceedings, Mozart ordered a servant to follow this singular personage, and if possible find out who he was; the man, however, lost sight of him, and was obliged to return as he went. Mozart, now more than ever persuaded that he was a messenger from the other world sent to warn him that his end was approaching, applied with fresh zeal to the requiem, and in spite of the exhausted state both of his mind and body, completed it before the end of the month. At the appointed day the stranger returned, but Mozart was no more. He died on the 5th December 1791, before he had completed his thirty-sixth year.

The distinguishing characteristic of the music of Mozart is its power of touching the deepest feelings of the soul. He has been justly styled the Raffaelle of music. He had many of the fine qualities and modest perfections of the great painter, whom also he resembled in the fertility and variety of his genius. Mozart embraced his art in its whole extent, and excelled in all its departments. When, indeed, we bring into view all his qualifications as a composer and a practical musician, the result is astonishing. The same man, under the age of thirty-six, was at the head of dramatic, sinfonia, and piano-forte music; he was eminent in the sacred style, and equally at his ease in every variety, from the elaborate concerto to the simplest pieces of music. He put forth about 800 compositions, including masses, motets, operas, and fragments of different kinds; at the same time supporting himself by teaching and giving public performances, at which he executed concertos on the piano-forte, the violin, the organ, or played extempore.

Of his operas, he esteemed most highly *Il don Giovanni* and *Idomeneo*. He seldom spoke of his own works; but of the *Don Giovanni* he one day observed, "This opera was not composed for the public of Vienna; it is better suited to Prague: but, to say the truth, I wrote it only for myself and my friends." In this extraordinary production, so remarkable for exquisite melodies and profound harmonies, the playful, the tender, the pathetic, the mysterious, the sublime, and the terrible may be distinctly traced. The composer exhibits throughout the work the most romantic imagination; and in the awful accompaniment to the reply of the statue we have a specimen of composition replete with terrific expression, but at the same time perfectly free from inflation or bombast. The ghost scene in the last act may be considered as the greatest effort of dramatic composition. Well has the style of Mozart been described as that of Shakspeare in music. The fear of Leporello is painted with true comic spirit; a thing rather unusual with Mozart. But melancholy is the prevailing passion in this masterpiece; and so strong, so distinct, so real is the imagery in which it is presented to the soul, that minds possessed of the least enthusiasm are sure to be moved.

We have already seen that the *Idomeneo* was the first work produced by Mozart that raised his name to celebrity as a dramatic composer. This opera, and the *Clemenza di Tito*, are, in the opinion of judges, considered as the two best serious operas extant. His opera of *Le Nozze di Figaro* is also much admired. In this piece it must be admitted that Mozart has changed the picture of Beaumarchais. The spirit of the original is preserved only in the situations; all the characters are altered to the tender and impassioned. But although the brilliant wit of the French author has not been conveyed, yet, as a work of pure tenderness and melancholy, entirely divested of any unsuitable admixture of the majestic and the tragical, the *Nozze di Figaro* is unrivalled. It is difficult to form any idea of the *Zauberflote* without having seen it. The story, which is like the wandering of a delirious imagination, harmonizes admirably with the genius of the musician. The subject of *Cosi fan Tutte* is unsuitable to Mozart, who could not trifle with love. The tender parts of the characters in this opera are the best.

The sacred compositions of Mozart are celebrated all over Europe, and frequently performed in the Roman Catholic churches. Of these works, the most sublime is the *Requiem*; but several of his other masses and motets are noted for their grandeur and beauty. His symphonies, quartetts, and other works for the orchestra and stringed instruments, rank in estimation with those of Haydn and Beethoven. His piano-forte writings are also justly esteemed. Mozart's sympathy was most extensive; he participated with Sebastian Bach in the beauty of the fugue, with Handel in the grandeur of church music, with Gluck in the serious opera, with Haydn in instrumental music, and in the universality of his genius surpassed them all.

In the exterior of Mozart there was nothing remarkable; he was diminutive in person, and had a very agreeable countenance, which, however, did not at the first glance discover the greatness of his genius. His eyes were tolerably large and well shaped, more heavy than fiery in the expression; and when he was thin they were rather prominent. His sight was quick and strong; but he had an unsteady, abstracted look, except when seated at the piano-forte, and then the whole form of his visage changed. His hands were small and beautiful, and he used them so softly and naturally upon the piano-forte, that the eye was no less delighted than the ear. His head was rather large in proportion to his body, but his hands and feet were in perfect symmetry. The stunted growth of Mozart's body may have arisen from the efforts of his mind. He was always good-humoured, but very absent, and in answering questions seemed to be thinking of something else. Mozart had six children, but two sons only survived him. His widow married M. von Nissen at Vienna, who published in 1828 a full and excellent biographical account of the composer.

(See the Baron de Grimm's *Correspondance Littéraire* for some interesting notices of Mozart in his boyhood; the Honourable Daines Barrington's notice of Mozart in the *Philosophical Transactions*, 1770; A. H. F. von Schlicthegroll's biographical notice of Mozart in vol. i., for 1791, of *Necrologie der Deutschen*, Gotha, Perthes; and also the same author's *Musikalische Correspondenz* for 1792; a Life of Mozart, and æsthetic examination of his works (in German), Erfurt, 1803; Ginguené, "Notices sur Mozart," in vol. xxxi. of *Decade Philosophique;* Schizzi, *Elogio Storico* on Mozart, Cremona, 1817; G. N. von Nissen, *Biographie* of Mozart, Leipsic, 1828, 8vo, pp. 702, and Supplement, in the same year, pp. 219 (this contains portrait and list of musical compositions); Herr Otto Jahn's *Life of Mozart* (in German), with two engraved portraits and a lithographed fac-simile of his handwriting on a folio sheet, large 8vo, xl. and 716 pages, Leipsic, Breitkopf and Härtel, 1856). (A. H.)

MOZDOK, a town of European Russia, in the government of Caucasus, is situated on the Terek, near the pass of the Caucasus named Derial, 136 miles S.E. of Stavropol, and 148 N.N.W. of Tiflis. It is built principally of wood and clay, and the houses are in general no more than one storey high; but the numerous and beautiful gardens which the town contains give it an appearance of great cheerfulness. There is a Greek and a Roman Catholic church, the latter of which is a fine edifice. The inhabitants depend chiefly on the produce of their gardens and vineyards. Manufactures of leather and brandy are also carried on to some extent. Mozdok has also a considerable trade with Georgia and the other parts of Russia. Pop. (1849) 10,869.

MOZUFFURNUGGUR, in Hindustan, a British district in the lieutenant-governorship of the N.W. provinces, extending from N. Lat. 29. 10. to 29. 50., E. Long. 77. 6. to 78. 10. It contains an area of 1617 square miles, and a population of 672,861. The tract was ceded to the East India Company by the Mahratta chieftain Scindia in 1803. The town of Mozuffurnuggur is situated in N. Lat. 29. 28., E. Long. 77. 45.

MSTISLAVL, a town of European Russia, in the province of Moghilev, is situated on the right bank of the Vekhra, 55 miles E.N.E. of Moghilev. It contains six churches and a synagogue, several convents, and a college formerly belonging to the Jesuits. Linen is manufactured here; and an active trade is carried on with Riga in corn, hemp, and flax. This province formed a part of the ancient duchy of Lithuania. Pop. (1851) 6675.

MUDGE, WILLIAM, one of the superintendents of the grand trigonometrical survey of England and Wales, was born at Plymouth in 1762. He was one of a race of gifted men. His grandfather, the Rev. ZACHARY MUDGE, was an intimate friend of Dr Johnson, and the author of a well-known volume of sermons; his uncle, THOMAS MUDGE, was pronounced by the scientific men of his day to be "one of the first watchmakers which this country has produced;" and his father, Dr JOHN MUDGE, is known in the history of science as the improver of the reflecting telescope. William Mudge was trained for the army in the Royal Military Academy at Woolwich, and served abroad as a lieutenant in the Royal Artillery. It was after his return to England that he was appointed to assist in the trigonometrical survey under the superintendence of Lieutenant-Colonel Edward Williams, R.A. The rank of captain was then conferred upon him. In course of time he became superintendent, and was raised to the successive dignities of major, lieutenant-colonel, and major-general. The results of his surveys were published from time to time in the *Philosophical Transactions*, and secured for him much distinction. He was elected a correspondent of the Institute of France, and a fellow of the Academy of Sciences at Copenhagen and of the Society of Antiquaries at London. During the latter part of his life he also held the office of lieutenant-governor of the Royal Military Academy at Woolwich. He died at London in April 1821.

MUFTI, the name given to the head doctors of the law of the Koran in Turkey, of whom there is one in every large town. The authority of the mufti is very great in the Ottoman empire; for even the Sultan himself, if he would preserve any appearance of religion, cannot, without hearing his opinion, put any person to death, or so much as inflict any corporal punishment. In all actions, especially criminal ones, his opinion is required by giving him a writing in which the case is stated under feigned names, and which he subscribes with the words, "He shall (or shall not) be punished," without assigning any reason for his judgment. Such outward honour is paid to the mufti, that the Grand Signior himself rises up and advances seven steps to meet him when he comes into his presence. The mufti of Constantinople, or "Sheikh-ul-Islam" (Chief of the Elect), is the chief functionary of the Turkish church, and has a jurisdiction over the muftis of the provinces. He holds his office at the will of the Sultan.

MUGGLETON, LUDOWICK, the founder of the sect of the *Muggletonians*, was born in 1609, and was bred to be a tailor. Abandoning his trade in 1651, he set up himself and his companion John Reeves as the "two last witnesses" mentioned in the Apocalypse as having power to prophesy and to smite mankind with plagues. They began to fulfil their "commission" by denouncing all religious sects, and especially the Ranters and the Quakers. An exposition of their doctrines was published in 1656 under the title of *The Divine Looking-Glass*. In this work, among other wild vagaries, were propounded the views that the Trinity are merely the three different names, and not the three distinct persons, of one God; that God has a real human body; and that he left Elias as his vicegerent in heaven when he came down to the earth to die on the cross. Such profane heresies provoked much opposition. They were attacked by the famous Quaker William Penn in a book entitled *The New Witnesses proved Old Hereticks*, 4to, 1672. Muggleton himself, in 1676, was arraigned at the Old Bailey on the charge of blasphemy. He died in March 1698. His collected works were published in 1756. In 1832 appeared a complete collection of the works of Reeves and Muggleton, together with tracts by others of the same sect, in 3 vols. 4to.

MUHALICH, or MIKALITZA, a town of Asiatic Turkey, in the pashalic of Anatolia, is situated in a plain near the confluence of the Susuelu and the Ulubad, about 15 miles from the mouth of the united stream, which takes the name of Muhalich, and 35 miles W.N.W. of Brusa. The town contains nine mosques and several khans, and is chiefly inhabited by Greeks and Armenians. It has a considerable trade in silk produced in the neighbourhood, and in the melons and other vegetables which are conveyed by water from the east shore of Lake Apollonia, down the Ulubad, to Muhalich, and thence by the Muhalich River and the sea to Constantinople. Pop. about 11,000.

MÜHLENBACH, or MÜHLBACH, a town of Transylvania, is situated on a river of the same name, 12 miles S. of Alba Julia, and 30 W.N.W. of Hermannstadt. It is surrounded by walls, beyond which there are two suburbs; and is defended by two regularly-built forts. There are here a Lutheran and a Catholic church, a Franciscan convent, and a Protestant school. Weaving is the principal branch of industry carried on; and there is a considerable trade in wine. Pop. 4200.

MÜHLHAUSEN, a town of Prussia, in the government of Erfurt, pleasantly situated on the Unstrut, 29 miles N.W. of Erfurt. It is surrounded by walls with towers, and was formerly a free town of the empire. It has four churches, of which the High Church is the most handsome; a high school; and several hospitals and other benevolent institutions. Manufactures of leather, linen and woollen fabrics, and tobacco are carried on; and there are also breweries and distilleries in the town, and copper and iron mines in the neighbourhood. Mühlhausen was in 1524 the head-quarters of the Anabaptist rebel and fanatic Munzer, who excited to insurrection a large number of peasants from the surrounding country. The town preserved its liberty and popular government till 1802, when it was ceded to the kingdom of Prussia, to which it has since belonged. Pop. 13,723.

MULA, a town of Spain, province of Murcia, 22 miles W. of that town. It contains a great square, wherein are built a town-house, prison, and clock-tower; besides which are also an hospital, a theatre, a nunnery, and several churches. The manufactures of the place include pottery, copper, soap, wool, and brandy. Pop. 6500.

MULCASTER, RICHARD, a distinguished scholar of the sixteenth century, was born at Carlisle about 1535. He received his elementary education at Eton under the celebrated Udal, and entered King's College, Cambridge, in 1548. He removed to Christ Church, Oxford, in 1555, and took his degree in arts during the following year. He began to teach in 1559, and from his great reputation for philological attainments, was chosen in 1561 first master of Merchant Tailors' School, London, then just established. For a period of twenty-five years he continued "to fill St John's College, Oxford, with excellent scholars;" and in the Latin plays acted before Queen Elizabeth and James I. at Oxford, the pupils of Mulcaster carried the palm. Fuller tells us that Mulcaster was a severe teacher, but much beloved by his pupils. After being connected for some time with St Paul's School, he was promoted to the rectory of Stanford-Rivers in Essex, where he died in 1611. Many of his panegyrics in Latin verse were prefixed to the works of his contemporaries. His works are,—*Positions, wherein those Primitive Circumstances be examined which are necessarie for the training up of Children, either for Skill in theire Book, or Health in theire Bodie*, London, 1581, 4to, which did carry him on to promise, and bind him to perform, *The first Part of the Elementarie which entreateth chefelie of the Right Writing of our English Tung*, London, 1582, 4to, a work of which Warton speaks highly; also a *Catechismus Paulinus in usum Scholæ Paulinæ conscriptus*, London, 1601, written in long and short verse, and once very popular. (Warton's *History of English Poetry*, vol. iii., p. 282, 1840; and Wilson's *History of Merchant Tailors' School*, vol. i.)

MÜLHEIM-AM-RHEIN, a town of Rhenish Prussia, in the government of Cologne, and 3 miles N.E. of that town, is situated on the Rhine, which is here crossed by a suspension-bridge. It contains two churches and a synagogue. The manufactures of the place are extensive, consisting of leather, silk, cotton, candles, soap, tobacco, brandy, &c.; and there is also an active trade in corn and timber. The activity and prosperity of the town are chiefly owing to its Protestant citizens, who came hither from Cologne in the beginning of the seventeenth century. Pop. 5643.

MÜLHEIM-AM-RUHR, a town of Rhenish Prussia, in the government of Dusseldorf, is built on the Ruhr, which is here crossed by a suspension-bridge, 15 miles N.N.E. of Dusseldorf. It contains three churches and a synagogue. The manufactures are considerable, consisting of cloth, paper, soap, starch, tobacco, gunpowder, machinery, &c.; and there is a coal mine in the neighbourhood which furnishes the principal article of trade. The River Ruhr is navigable as far as this town. Pop. 10,181.

MULHOUSE, or MÜLHAUSEN, a town of France, in the department of Upper Rhine, on the Ill, 27 miles S. of Colmar, 61 miles S.S.W. of Strasburg, and 16 N.W. of Basle. It consists of an old and a new town,—the former standing on an island of the Ill, and approached by several bridges; the latter, on the right bank of that river, lying between it and the Rhine and Rhone Canal. The old town is irregularly but well built, and the streets are broad, well paved, and clean. The principal buildings are the Roman Catholic and Protestant churches, synagogue, town-hall, school, arsenal, and hospital. The new town is handsomely and regularly built; and contains an exchange, a chamber of commerce, a hall belonging to the Society of Industry, and many other fine houses. Mulhouse is one of the greatest manufacturing towns of France. The principal articles produced are muslins and cotton prints, of which probably a greater quantity is made here than in any other place in the world. This branch of manufacture was not introduced here till 1746, and has contributed very much to the great and rapid progress of the town since that time. Cotton-spinning is also extensively carried on; but in this branch the manufacturers of Mulhouse cannot compete with those of Manchester and Glasgow, and the manufacture also labours under the disadvantage of the necessity of the raw material being conveyed from Havre or Marseilles. The supply of coal is also difficult to obtain, as it has to be brought from some distance by the Rhine and Rhone Canal. The other manufactures of Mulhouse consist of woollen cloth, silk, linen, hosiery, paper, leather, beer, &c.; and the trade is considerable in the produce of the manufactures, as well as in corn, wine, brandy, raw cotton, &c. Mulhouse has a court of commerce, a chamber of manufactures, and a council of *prud'hommes*. It was formerly the capital of a small independent republic in alliance with the Swiss cantons, but was united to France in 1798. Mulhouse is remarkable as the birthplace of Lambert the mathematician, born in 1728. Pop. (1851) 28,142.

MULL ISLAND, one of the Western Isles of Scotland, Argyllshire, bounded W. by the Atlantic; N. by the same and Loch Sunart; N.E. by the Sound of Mull, a narrow strait which divides it from the mainland; and S.E. by the Atlantic; N. Lat. (of centre) 56. 30., and W. Long. 6. 4. It is of an irregular shape, deeply indented on the west by Lochs Na Keal and Seriden, as well as by numerous smaller inlets round its entire coast-line, and measures 29 miles in length, by from 24 miles of maximum breadth to 3½ miles at the head of Loch na Keal. The coast is rocky, and the surface rugged and covered in some parts by extensive tracks of moorland. With the exception of a

Müller.

narrow belt of limestone on the S., the entire rock of Mull belongs to the igneous system of rocks, especially of trap, which on the western coast presents numerous horizontal terraces; while at its S.W. extremity a fine whitish granite occurs, used in the construction of the Skerryvore lighthouse. A Tertiary stratum, however, has been lately found between the newer trap deposit and that of an earlier date. Many caverns occur round the shores of the island, varied here and there by castles and columns of basalt. The interior, however, presents no aspect of interest, excepting Ben More, which rises to 3097 feet. The soil is almost wholly devoted to pasturage, the only spots where grain is grown being in the more sheltered spots near the coast. Excellent sheep and small hardy cattle are reared here for the lowland markets. The farms have recently been much enlarged at the expense of the small holders, who have since 1841 left the island in considerable numbers. In its climate Mull resembles the neighbouring islands, being mild and humid, and subject to severe storms from the S.W. A considerable number of the inhabitants are employed in the herring fishery; while abundance of white fish is to be had round the coast. The island is divided into the three parishes of Torosay, Kilninian and Kilmore, and Kilfinichen and Kilvickeon. The amount of poor rates collected here in the year ending May 14, 1856, amounted to L.2269, against L.2049 expended; and there were in the same year 432 persons who received relief. Pop. of island (1841), 10,064; (1851), 8369, of whom 4243 were females. (For the history of Mull, see HEBRIDES.)

MÜLLER, GERHARD FRIEDRICH, a German traveller and author, was born at Herford in Westphalia in 1705. By Professor Mencke, under whom he studied at Leipsic, he was recommended to the government of Russia. Having been admitted into the newly-founded Academy of St Petersburg, he taught Latin, history, and geography, and was afterwards promoted to the chair of history. His unwearied devotion to his duties, and his elegant scholarship, soon recommended him to higher appointments. Employed in 1740 to accompany De Lisle into Siberia, he spent ten toilsome years in studying the geography and antiquities of that barbarous and desert country. Soon after his return he was nominated historiographer to the Russian empire. The office of keeper of the archives was added in 1766. He was next appointed to draw up a collection of the diplomatic treaties of Russia, on the model of the *Corps Diplomatique* of Dumont. In the discharge of all these duties he acquired a knowledge of the history of the empire equally minute and extensive. His unflagging industry embodied that information in a number of works which have proved an inexhaustible source of information to succeeding annalists, and which entitle their author to the appellation of the "father of Russian history." Müller died in October 1783. His principal work is a *Collection for the History of Russia*, in 9 vols. 8vo, St Petersburg, 1722–64.

MÜLLER, *Johann*, surnamed, from the Latinized name of his native place, *Regiomontanus*, the greatest mathematician of the fifteenth century, was born in 1436 at Königsberg, but whether at the town of that name in Franconia or in Prussia is disputed. At the age of twelve he was sent for his education to Leipsic, and at the end of four years he rivalled his teachers in arithmetic, geometry, and astronomy. His studies were next prosecuted under Peuerbach, the astronomical professor in Vienna. Here his talents and acquirements recommended him to the notice of his teacher and the celebrated Cardinal Bessarion. On the death of the former in 1461, he was appointed to the vacant chair, and was encharged with the completion of a new translation of Ptolemy's *Almagest* which had been begun by the deceased professor. But before entering on these arduous tasks he repaired to Italy, to acquire a thorough knowledge of the Greek language. While studying philology at Rome, Ferrara, and Padua, he was also engaged in writing his *De Triangulis*, a treatise which proved an important acquisition to trigonometrical science. Shortly after 1464 he returned to Venice. Before, however, his stay in that city had been prolonged over many years, an invitation from the King of Hungary drew him to Buda. There his time was employed in constructing his *Tabula Directionum Profectionumque*, &c., a work which was afterwards printed in 1475, and which contained the first table of tangents ever published in Europe. A great stimulus was given to his studies by his removal to Nuremberg in 1471. By a wealthy inhabitant of that town named Bernard Walter he was supplied with astronomical instruments and with a printing-press. He was thus enabled to carry on that important series of observations which were continued after his death by Walter, and which were long afterwards, in 1544, published under the title of *Observationes Triginta Annorum*, 4to, Nuremberg. Another important work which he produced about this time was the *Kalendarium Novum* for the three years 1475, 1494, and 1513. It passed into Hungary, Italy, France, and England, was speedily sold off, and increased the fame of its author. In 1475 he was appointed archbishop of Ratisbon, and was invited to Rome by Pope Sixtus IV. He had only lived a year in that city when he was cut off, at the age of forty. His remains were interred with great honour in the Pantheon. Gassendi appended a *Life of Muller* to his *Life of Tycho Brahe*, 4to, Paris, 1654. (For an account of the services of Regiomontanus to the cause of science, see DISSERTATION IV., § i.)

MÜLLER, *Johann*, an eminent Swiss historian, was the son of a clergyman, and was born at Schaffhausen in Switzerland in 1752. He received his elementary education at the gymnasium of his native town, and was early intended for the church. But chancing to be sent to the university of Göttingen, he acquired, under the tuition of Schloezer, an irresistible bias towards historical studies, and published at the age of twenty a History of the Cimbric War. His classical acquirements were also considerable, and procured for him the appointment to the Greek chair at Schaffhausen. This position, however, his desire for a society more learned than that of his native town soon induced him to abandon. He repaired to Geneva in 1774, and there he lived for six years, writing a course of lectures on universal history, meditating his great historical work on the Swiss confederation, and enjoying the society of his bosom friend Bonstetten. In 1780 he set out for Germany. His fame had gone before him. Frederick the Great tried in vain to attach him to the Academy of Berlin; and the landgrave of Hesse placed him in the chair of history at Cassel in 1781. Meanwhile, in the previous year the first volume of his *Geschichte der Schweizerischer Eidgenossenschaft* had appeared at Berne. It was characterized by dignity of style, depth of research, and liberality of sentiment, and it speedily came to be considered the masterwork of its author. In 1783 the shifting propensity of Müller led him to abandon his professorship, and he returned to Switzerland to live in the house of Bonstetten. He was nominated in 1786 a counsellor to the elector of Mentz, and continued in this capacity to occupy himself with politics till the occupation of that city by the French in 1792. The next twelve years were spent at Vienna under the patronage of the emperors Leopold II. and Francis II. Then he repaired to Berlin, and accepted a place in the Academy of that city. His mind had now thrown off those political engagements which had so long detained it from its proper province, and began to be occupied with a projected Life of Frederick the Great. But before he could accomplish anything more than the plan, the subjugation of Prussia by the French in 1806 diverted him once more from his literary studies. Bona-

parte during his stay at Berlin took notice of him, and in 1807 appointed him secretary of state to the new kingdom of Westphalia. This office was soon exchanged for that of director-general of public instruction. Müller applied himself to his new duties with all his wonted ardour, but success did not seem likely to follow. His health sank under anxiety and intense exertion, and he died at Cassel in May 1809. His complete *History of the Swiss Confederation*, bringing the narrative down to the end of the fifteenth century, had been published at Leipsic in 1786, and had been translated into French by Labaume, in 12 vols. 8vo, Lausanne, 1795–1803. A collection of his works was published in 27 vols. 8vo, Tübingen, 1810–19.

MÜLLER, *Johann Friedrich Wilhelm*, an eminent German engraver, son of Johann Gothard von Müller, was born at Stuttgart in 1782. Under the able tuition of his father he made notable progress in his art, and at the age of twenty had executed several excellent engravings of portraits. He was then sent to Paris to prosecute his studies in the Academy, and to perfect his taste among the masterworks of art in the Louvre. With a devotion that endangered his health, he applied himself to his profession. His cunning hand soon acquired the auxiliary art of painting. He produced engravings of the statue of "Venus d'Arles," and of several portraits. At length, in 1808, his print of Domenichino's "St John" established his fame. Immediately afterwards he undertook to engrave for a printseller the "Madonna di San Sisto" of Raphael in the Dresden gallery. All his energies were forthwith summoned to the task. After visiting Italy for the purpose of becoming more intimate with the works of the great master whom he was about to copy, he settled down at Stuttgart to steady and long-continued labour. The professorship of engraving at Dresden was conferred upon him in 1814. But change of residence did not produce any change in his application. Day and night he was absorbed in studying and transcribing the great masterpiece of painting before him. At length the engraving was completed, and despatched to Paris to be printed. Müller soon after fell into a hopeless state of debility, and died on the 3d May 1816, several days before his plate reached its destination. The engraving on which his life had been sacrificed is pre-eminently his masterpiece. His other works, chiefly portraits, include likenesses of William, King of Wurtemberg, Jerome Bonaparte, Jakobi the poet, Professor Hebel, Dr Hufeland, and Schiller. He also executed a medallion of Napoleon.

MÜLLER, *Johann Gotthard von*, a German engraver, was born at Bernhausen in Wurtemberg in the year 1747, and was educated at the college of Stuttgart. He was intended at first for the church, but his own strong bias towards the study of design ultimately decided his profession. He became a pupil of the court painter, Guibal, in 1764. Yet his talents soon appeared to be more fitted for engraving than for painting; and therefore, by the advice of his master, he resorted to Paris in 1770 to study under the engraver Wille, a countryman of his own. He continued there until he had become a proficient in his art, had gained several prizes, and had been elected a member of the French Academy. Then an invitation from Duke Karl summoned him to Stuttgart in 1776 to teach engraving. After being settled here for more than nine years, he was recalled to Paris to engrave a portrait of Louis XVI. This work, and an engraving of Trumbull's "Battle of Bunker's Hill," were his chief productions during his second sojourn in Paris. On his return to Stuttgart in 1802, he was appointed professor of his art in that city, and experienced the gratification of seeing his own son Johann Friedrich far outstrip the rest of his pupils. His fame was now established, and honours flowed in upon him. He was elected a member of the several academies of Berlin, Vienna, Munich, and Copenhagen; and he received from the government of Wurtemberg the Order of Civil Merit in 1808, and a knighthood in 1818. Yet his industry in the prosecution of his art did not slack. He was engaged in engraving a series of portraits of celebrated contemporaries, when the debility of an advanced age forced him to retire from his profession. His death took place at Stuttgart in March 1830. His engravings are chiefly portraits, and include a likeness of Schiller after A. Graf.

MÜLLER, *Karl Ottfried*, an eminent writer on the mythology and history of Greece, was the son of a chaplain in the Prussian army, and was born at Brieg in Silesia in 1797. After attending the gymnasium of his native town, he entered the university of Breslau in 1813, and began to study at Berlin in 1815. In 1817 a little treatise, entitled *Algineticorum Liber*, betrayed the depth of his mythological knowledge, and laid the foundation of his fame and fortune. Two years afterwards, when scarcely twenty-one, he was promoted to a chair in the university of Göttingen. Here he continued for more than twenty years to lecture on archæology and art, and to produce works with a rapidity which sometimes entailed carelessness and false generalizing. In 1820 his *Orchomenos and the Minyans* appeared, and communicated to philological studies in Germany an impulse which was felt in the course of time throughout the rest of Europe. By his method of analyzing the mythical cycles, and thus detecting the historical elements around which these had grown, he bade fair to evolve a history of Greece of the same satisfactory nature as Niebuhr's *History of Rome*. He continued to follow out this plan in his *Dorians*, published at Breslau, in 2 vols. 8vo, 1824. The new and striking feature in this work was the attempt to show that the natives of Doris were the happiest, the wisest, the bravest, and the best of all the Greek races. Such a view, so directly opposed to the received opinions, contributed in no small degree to secure for the book a European reputation. It was hailed, even by those who dissented from its novel opinions, as a cheering improvement on the dull round of those compilations that had hitherto been palmed off upon the world as histories of Greece. An English translation by H. Tuffnell and G. C. Lewis, with emendations and additions by the author himself, appeared at Oxford in 1830. Prevented by certain scruples from advancing any further in the path of investigation which he had hitherto pursued so successfully, he had published a great work, entitled *The Etruscans*, in 2 vols. 8vo, 1828. His *Manual of the History of Ancient Art* appeared at Breslau two years afterwards. This work, characterized in an especial degree by his usual keen thinking, curious research, and forcible style, was considered one of his finest productions, and passed through a second edition in 1835. All this time his restless and rapid intellect was producing numerous articles for periodicals and encyclopædias, and was planning a History of Greek Literature. The first volume of this work appeared at Göttingen in 1839, and was translated into English soon afterwards. Müller now laid aside his pen. He had long desired to visit that land whose poetry and mythology had been his life-long study, and whose rich scenery and glorious sky had so often passed before the eye of his imagination. Accordingly he set out for Greece in 1839. On his arrival his bodily activity was as enthusiastically exercised as his intellectual in searching for the remnants of antiquity. During the heat of a July day, while conducting an excavation among the ruins of Delphi, he was seized with a fever. He was conducted to Athens, and died there on the 1st August 1840. An appropriate resting-place was found for this great Hellenistic scholar in the precincts of the old academy. His merits were celebrated by Lücke in a work entitled *Erinnerungen an Karl Ottfried Müller*, 8vo, Göttingen, 1841.

Among the works of Müller which have not been mentioned above are,—*Minervæ Poliadis Sacra et Ædem in Arce Athenarum illustravit M.*, 4to, Göttingen, 1820; *On the Abode, the Descent, and the Ancient History of the People of Macedonia*, 8vo, Berlin, 1825; *De Phidiæ Vita et Operibus*, 4to, Göttingen, 1827; and editions of the *Eumenides of Æschylus*, 4to, Göttingen, 1833, the *De Lingua Latina* of Varro, 8vo, Leipsic, 1833, and the *De Verborum Significatione* of Festus, 8vo, Leipsic, 1839. His *History of the Literature of Greece*, composed of the volume which had appeared in his lifetime and the volume which he had left unfinished, was edited by his brother, in 8vo, Breslau, 1841. The *Dorians* and the *Orchomenos and the Minyans* were published together by F. W. Schneidewin, under the title of the *History of Hellenic Races and Cities*, in 3 vols., Breslau, 1844.

Müller, *Othon Frederik*, an eminent Danish naturalist, was the son of poor parents, and was born at Copenhagen in March 1730. He commenced to study for the church, and supported himself by the exercise of his musical talents. His learning, and the strength of his moral character, soon raised him to notice. He was appointed tutor to the young Count Schulin in 1753. It was the advice of his pupil's mother, a woman of great penetration, that induced him to turn his attention to natural history. With all the determination and concentrative power of his character, he commenced his new studies. He examined patiently both animals and plants, executed exact sketches of them, and wrote a Danish treatise on Fungi, and two Latin works respectively entitled *Fauna Insectorum Friedrichsdaliana*, and *Flora Friedrichsdaliana*. At the same time his travels through different countries with his pupil were affording him an excellent opportunity for extending his scientific observations, and for becoming intimate with other naturalists. After his return to Copenhagen in 1767, a high rank in the general estimation was assigned to him. He was honoured with several titles, he was installed in several important offices, and he was appointed to continue the *Flora of Denmark*, a great work which had been begun by Oeder in 1761 by the command of Frederic V. An advantageous marriage soon afterwards enabled him to resign his official appointments, and to consecrate all his efforts to his favourite study. He first turned his observation upon those annulose animals which are called by Linnæus "Aphroditæ and Nereides." His numerous and interesting discoveries on the structures and habits of these creatures were given to the world in a work entitled *On Certain Worms found in Fresh and Salt Water*, 4to, Copenhagen, 1771 Even more successful were his studies on the Infusoria. By the patient employment of powerful microscopes he discovered many new species, and was the first among naturalists to attempt the extremely delicate task of arranging these animalcules into distinctive genera. His observations in this field of inquiry were published in his *Vermium Terrestrium et Fluviatilium seu Animalium Infusorium Helminthecorum et Testaceorum non Marinorum succincta Historia*, 2 vols. 4to, Copenhagen and Leipsic, 1773–74. The attention of Müller was next occupied with the Hydrachnæ or water-spiders. He was the first who discovered that these animalcules swarm by millions in all our fresh-water streams. His treatise on them was carefully written in lucid and elegant Latin, was copiously illustrated with faithfully-executed plates, and was published at Leipsic in 1781, under the title of *Hydrachnæ in Aquis Daniæ Palustribus detectæ et descriptæ*. He was in the midst of his favourite investigations when he was cut off by death on the 26th December 1784. Two posthumous works, the one on the Entomonstraca, small crustaceans belonging to Linnæus' genus of the Monoculi, and the other on the Infusoria, were published in 1785 and 1786 respectively. Müller had commenced in 1779 the *Zoologia Danica*, a gigantic work which was continued first by Abildgaardt and afterwards by Rathke. The two parts which he wrote were reprinted in 1788.

"The three works on the Infusoria, Monoculi, and Hydrachnæ," says Cuvier in the *Biographie Universelle*, "have procured for Müller a place in the front ranks of those who have enriched science with original observations."

Müller, *Wilhelm*, a German poet, was the son of a mechanic, and was born at Dessau in 1795. After studying philology and ancient German literature at the university of Berlin, and serving in the Prussian army in the campaign of 1813, he devoted himself to the cultivation of his literary tastes. He produced his *Blumenlese aus den Minnesinger* in 1816, and a translation of Marlowe's *Faustus* in 1818. About this time a sojourn which he made in Vienna afforded him an opportunity of acquiring modern Greek. Soon after his return he was appointed classical teacher in the newly-established school of Dessau, and keeper of the ducal library. His undivided attention was now given to the composition and study of poetry, and his works appeared in quick succession. He published his *Gedichte aus den hinterlassenen Papieren eines reisenden Waldhornisten* and *Homerische Vorschule* in 1824, his *Lieder der Griechen* in 1825, and his *Bibliothek Deutscher Dichter des 17 Jahrhunderts* in 1822–27. He was also a contributor to several periodicals and encyclopædias. Müller died in 1827. A collection of his works, accompanied with a Life, was published by the poet Schwab, in 5 vols., Leipsic, 1830.

Müller, *William John*, an eminent English landscape and costume painter, was the son of a German, and was born at Bristol in 1812. He was instructed in landscape-painting by J. B. Pyne, and was greatly assisted in the study of his art by a knowledge of natural history, which he acquired from his father, the curator of the Bristol Museum. His most valuable lessons, however, were received in the great school of nature. Setting out in 1833, he travelled with unwearied enthusiasm through Germany, Switzerland, and Italy, studying devotedly every feature of the striking landscapes through which he passed, and enriching his portfolio with numerous valuable sketches. On his return to his native place in 1834, the progress he had made in his art was not great enough to satisfy himself. He therefore spent 1838 and 1839 in wandering amid the colossal remains of Egyptian architecture and the classic scenes of Greece. His pictures of "Athens" and "The Memnon," completed after his return, and exhibited in the Academy in 1840, proved that he had now attained the skill of a master-artist. They brought him into notice, and were the means of procuring for him employment in London. Two years afterwards, his "Picturesque Sketches of the Age of Francis I." carried his fame beyond his own country. Yet his ardent striving after perfection did not flag. He accompanied the Lycian expedition of Sir C. Fellows in 1843. The results of this tour, consisting of five pictures, were sent to the Royal Academy's exhibition of 1845; but happening to be hung in a disadvantageous position, they failed in a great measure to strike the spectators. This misfortune deeply wounded his sensitive and sanguine temperament, and prostrated his previously impaired constitution. He died of heart disease at Bristol in September 1845.

MULLINGAR, a market-town of Ireland, capital of the county of West Meath, is situated on the Brosna, 44 miles W. by N. of Dublin, with which it is connected by the railway to Galway and by the Royal Canal. The principal street, which is about a mile in length, extends from E. to W., and the other streets and lanes extend in different directions from it. The houses are well built of stone, and covered with slates. The principal buildings are,—the parish church, with a tower and spire; a large and hand-

some Roman Catholic church; Presbyterian and Wesleyan churches; a court-house, jail, infirmary, and nunnery; barracks for 1000 soldiers; and several schools. Tanning and brewing are carried on; and wool constitutes the principal article of trade. Mullingar formerly sent two members to the Irish Parliament, but was disfranchised at the Union. A weekly market is held here on Thursdays; and there are four annual fairs. Pop. 5026.

MUMMY, a body embalmed, or dried and preserved in the manner practised by the ancient Egyptians. There are two kinds of bodies denominated *mummies*. The first are only carcases dried by the heat of the sun, and by that means preserved from putrefaction. Some well-known specimens of this class of mummies are to be found in the church vaults of Strasburg, Toulouse, and Bordeaux. The second kind of mummies are bodies taken out of the catacombs in which the Egyptians deposited their dead after embalming. (See EMBALMING; also Sir G. Wilkinson's *Ancient Egyptians*, vol. ii.)

MÜNCHHAUSEN, HIERONYMUS KARL FRIEDRICH VON, the original of Bürger's wonder-narrating hero, was a German officer about the beginning of the eighteenth century. He entered the Russian army, and served in several campaigns against the Turks. An irresistible propensity towards exaggeration was his ruling passion. Accordingly, on his return to Germany, he was wont to describe, with all the intense earnestness and minute particularizing of a true narrator, the prodigious feats he had done in Turkey. It was at Pyrmont that the poet Bürger happened to be one of his auditors, and to hear some of those extravagant fictions which afterwards formed the groundwork of the humorous *Wunderbare Abentheuer und Reisen des Herrn von Münchausen*. The hero of the book was very much enraged and chagrined at the notoriety which soon became attached to his name. He died in 1797.

MUNDAY, ANTHONY, an English dramatist of the age of Shakspeare, was born in 1553. After having been successively a stage-player and an apprentice, he visited Italy, and was a student, or, as he himself called it, "the Pope's scholar," in the English college at Rome. On his return he became connected with the theatres, both as an actor and as a writer. His ready pen was also employed by the booksellers in compiling and in writing pamphlets. *The Mirrour of Mutabilitie*, a tract published in 1579, was the first of a series of ephemeral prose works which began to proceed from his hand. Several of these were devoted to the confutation of Popery, the religion in which he had been trained, and from which he had been recently converted. But not until the close of the sixteenth century did Munday attain his celebrity as a dramatist. He then wrote several dramas in conjunction with other authors, especially Chettle and Drayton. One of the most popular of these, *The Death of Robert, Earl of Huntingdon*, is enlivened by a gay and spirited description of Robin Hood's life in "merrie Sherwood." Shortly after this period he became a city poet and a composer of city pageants. In this office he seems to have found his proper sphere; for Meres calls him "the best plotter," and Webbe mentions him as having written "very excellent works, especially upon nymphs and shepherds, well worthy to be viewed and to be esteemed as rare poetry." He even became a worthy object for the envy of Ben Jonson, and was ridiculed, in the character of Don Antonio Ballendino the pageant-poet, in *The Case is Altered*. Towards the close of his life Munday appears to have held a respectable position as a tradesman, since he was fond of styling himself, on the title-pages of his later works, "citizen and draper of London." His death took place in August 1633, and he was buried in St Stephen's church, Coleman Street. A monument was erected over his grave. Fourteen of the dramas which Munday contributed to write are enumerated, and two of them are reprinted in Collier's supplementary volume to Dodsley's *Old Plays*.

MÜNDEN, a walled town of Hanover, in the government of Hildesheim, is situated between the Fulda and Werra, which unite below the town and form the Weser, 14 miles W.S.W. of Göttingen. The principal buildings are the church of St Blaise, an edifice of the fourteenth century; and the old castle, founded in 1571 by Erich II., Duke of Brunswick-Lüneburg. There are also two other churches, a synagogue, and several schools. Leather, beer, and brandy are manufactured here; and the Weser is navigable up to the town, where there is a harbour, by which a considerable trade was formerly carried on. The town was also in former times a great seat of the linen trade. Pop. 5900.

MUNDEN, JOSEPH SAUNDERS, a distinguished comedian, was born in London in 1758. Becoming an apprentice to a law-stationer, he was employed in writing out the parts of actors, and in course of time was smitten with an irrepressible fondness for the histrionic art. He made his first appearance as a player on the stage of a strolling company. His humour, venting its exuberance in the drollest grimaces, and deepening often into the most touching pathos, gradually came to be appreciated. After acting for some time in the Canterbury theatre, he appeared before a London audience in 1790. For the next twenty-three years he was the comic favourite at Covent Garden. He was then transferred to the stage of Drury Lane, and continued to win fresh laurels, especially by his impersonation of "Old Dornton" in *The Road to Ruin*. He retired from the stage in May 1824, and died in February 1832.

MUNDI, in Hindustan, a tract of the Punjab, comprising several valleys, with their inclosing ridges, on the southern slope of the Himalayas, and containing an area of 759 square miles, with a population of 113,000. Upon the conquest of the Punjab, Mundi became tributary to the British; and upon the death of the rajah in 1851, and the succession of his infant son, arrangements were made for the government of this petty state. Mundi, the capital town, which is situated at the confluence of the Sukyt with the Beas, is in Lat. 31. 43., Long. 76. 58.

MUNDINGOES, or MANDINGOES. See MANDINGO.

MUNDOTE, in Hindustan, a tract of country in the British province of Sirhind, extending along the left bank of the Sutlej, and containing an area of 780 square miles, with a population of 116,000. It was held by a Patan chief, whom it has recently been found necessary to depose, in consequence of the oppressive and tyrannical character of his government. The town of Mundote is in N. Lat. 30. 53., E. Long. 74. 26.

MUNEEPOOR, in Hindustan, a native state on the eastern frontier of India, 125 miles in length and 80 in breadth, and containing an area of 7584 square miles. The principality was taken under British protection previously to the breaking out of the first Burmese war, and under the treaty of Yandabhoo, concluded in 1826, the King of Burmah renounced all claim to the territory. It pays no tribute to the British. Muneepoor, the chief town, is situated in N. Lat. 24. 49., E. Long. 94. 1.

MUNICH (Ger. *München*), a town of Germany, capital of the kingdom of Bavaria, and the seat of an archbishop, stands on the left bank of the Isar, 1650 feet above sea-level, and 225 miles W. of Vienna; N. Lat. 48. 8. 40., and E. Long. 11. 34. 40. It is situated in the middle of an uninteresting plain, bounded on the E. by a range of low hills, and on the S. by the Tyrolese Alps, which rise to a considerable height some 20 miles from the town. Their contiguity, coupled with the great elevation of Munich, render it very subject to sudden changes, as well as to extremes of temperature. The city consists of an old and new town, the former occupying the centre round which the new town or suburbs

have been erected. These are six in number, and comprise the Ludwig, Max, and Schoenfeld suburbs, on the W., N., and E.; the Isar and St Anna's suburbs, between the old town and the river, and the Au suburb, on the other side of the same. Great additions have been made to Munich during the last fifty years. Possessing neither manufactures nor trade of any importance, it owes its increase solely to the amount of court favour bestowed on it; and now there are few, if any, towns in Europe of the same size which contain so many public edifices and institutions devoted to the purposes of art and science, as this the capital of Bavaria and acknowledged metropolis of Southern Germany. The streets of the old town are generally straight, but many of them are narrow, and the houses exceedingly lofty and quaint-looking. In the suburbs, on the other hand, the streets have been laid out at right angles, and the houses are more modern in appearance. From the extent of ground devoted to those environs, however, many of the streets and squares are not fully occupied by houses, but display frequent gaps. Between the suburbs and the old town there are several open places occupying the site of the old walls; the principal are Maximilian's and Karl's squares. Of the old ramparts, the only remnants are several of the gates. Among the numerous public buildings which give character to the town, the churches are first worthy of remark. The Frauenkirche, or cathedral, commenced in 1468, is built about the centre of Munich, off the Kaufinger Strasse, the main street of the town. It is a plain, massive building of brick, with two towers surmounted by domes, each rising to the height of 336 feet. The nave of the church measures the same length as the towers, and is 170 feet in breadth; while the windows are 66 feet in height. A number of small chapels, formed by the buttresses, which in this edifice are brought within the building, are ranged round its sides. In front of the altar is the mausoleum of Ludwig IV., Emperor of Germany, erected in 1622 by the Elector Maximilian I. It is formed of black marble, supported on each side by statues of the dukes Albrecht V. and Wilhelm V.; while at each of the four corners there is the figure of a fully-harnessed knight resting on one knee. It was designed by Candido, whose works are highly estimated in Bavaria. St Michael's church, formerly a chapel of the Jesuits, and standing a short distance from the cathedral, was commenced in 1583, and belongs to the later Italian style of architecture. Its interior, however, presents but few objects of attraction, excepting Thorwaldsen's monument of the Duke of Leuchtenberg which exhibits great power of grouping. St Peter's, in the Rinder market, is the oldest church in Munich; it was built in 1370, and restored in 1607, having been injured by a stroke of lightning in that year. The churches of more recent date are,—St Ludwig's; All Saints'; St Boniface's, with a Benedictine monastery attached; and Mariahilf, in the suburb of Au. The first was commenced in 1829, and belongs to the Byzantine style; it is surmounted by two towers, each 208 feet high, and the length of the nave is 237 feet. All Saints' chapel is in the same style, but of smaller dimensions; while the Basilica of St Boniface is an imitation of St Paul's at Rome; it was commenced in 1835, and completed in 1850. Many admirable frescoes adorn the walls of these churches, from designs by Cornelius and Hess, and no expense has been spared in the carvings and statuary of the buildings. There are also a Protestant place of worship, a synagogue, and a Greek chapel.

But the largest edifice in Munich is the royal residence, comprising the old palace, flanked by the Koenigsbau and the Festsaalbau. The first was designed by Candido, and commenced at the end of the sixteenth century, but it is not remarkable for architectural beauty. The chapel attached, however, is very richly ornamented, and contains, among other relics, what is said to be the veritable hand of John the Baptist. The old portion of the palace contains the treasury chambers, where the crowns of the realm are preserved, along with many valuable jewels, one of which, a blue diamond, weighs 36 carats. Flanking this building, and fronting the Max-Joseph Square, is the *Neuer Koenigsbau*, or New Palace, a fine massive building in imitation of the Pitti Palace in Florence. The floors of the apartments are inlaid with variegated woods, and the walls are covered with frescoes representing scenes from the *Niebelungen Lied*, the poems of Walter of Vogelweide, and other works. The *Festsaalbau*, or building devoted to court receptions, balls, &c., is even more gorgeously fitted up than the New Palace. Among other apartments, the "halls of the beauties," adapted for card-playing, displays great taste in arrangement, and contains portraits of a number of modern beauties by Stieler. The Charlemagne rooms, so named from the number of pictures therein representing the chief scenes in the life of that monarch, is on the west side of the great ball-room, which measures 123 feet in length, by 47½ in width, and is profusely decorated with reliefs and paintings in the Pompeian style. The palace is provided with a royal garden; while the court theatre is in close proximity, occupying a prominent position in the Max-Joseph Square, where the General Post-office likewise stands. The *Pinakothek*, or picture gallery, one of the most extensive in Germany, stands in an open place in the suburb of Max. Directly opposite is the New *Pinakothek*, and in an adjoining square is the *Glyptothek*, or sculpture gallery. These three buildings form together the centre-point of art in South Germany. Their collections have been brought together and maintained by the zealous care of the court. The Old *Pinakothek*, commenced in 1826 and finished in 1836, was designed by Klenze, and is a long building, with wings on either side. The paintings are arranged historically, and occupy different rooms. They belong chiefly to the German and Dutch schools; but there is also a large collection of pictures by Rubens, and a considerable assortment of the Italian, French, and Spanish schools. The New *Pinakothek*, a smaller edifice, was opened in 1853, and is devoted to paintings of the nineteenth century. But perhaps even more interesting than either of the foregoing is the *Glyptothek*, containing a most valuable collection of ancient statuary and reliefs, formed by the late King Ludwig. It is an elegant building, in the Ionic style, designed by Klenze, and opened in 1830. Various apartments are occupied with Egyptian, Etruscan, and Æginetan antiquities; also with the statues from the temple of Jupiter Panhellenius, which are deservedly famous. There are separate rooms for the statues of Apollo, Bacchus, and the sons of Niobe, besides others devoted to coloured sculpture and to Roman and modern works. For students of the fine arts few towns, indeed, present such advantages as Munich. Besides the great institutions above mentioned, there are many of less pretension, containing valuable collections of ancient coins, sculptures, paintings, &c. A polytechnic institution, an academy of painting with eleven professors, and schools of architecture and music, are likewise established here for the advancement of art. The Royal Library, a very fine new building in Ludwig's Strasse, contains the largest number of volumes in Germany. They are variously estimated from 400,000 to 800,000, with 22,000 MSS., among which are a copy of Demosthenes, written on cotton paper from Chios, and the oldest manuscripts of the *Niebelungen Lied*, which formerly belonged to a convent in the Grisons. The other most important institutions of Munich are as follows:—The university, transferred here from Landshut in 1826, having faculties of theology, law, political economy, medicine, and philosophy, attended by 1700 students, and possessing a library of 147,000 vols. and 5294 MSS.; a veterinary seminary, with 8 instructors; a female school

Municipal Corporation.

of midwifery; and a military academy, attended by 142 cadets; also a school for the deaf and dumb; a royal blind asylum, with 7 teachers and 66 inmates; and a seminary for lame children, having 3 teachers and 15 scholars. There is also a royal institution, open to the children of the nobility, who are brought up here at the royal bounty till they are old enough to enter the cadet school or the university; the inmates number 24, and the teachers 16. The Royal Academy of Munich, comprising the three departments of philology, natural philosophy, and history, is composed of about 320 members, and has two commissions connected with it for the advancement of natural science and technology in Bavaria. An observatory, a botanical garden, and several museums, are also here. The general prison is remarkably well conducted, on the principles of a reformatory more than of a gaol. The inmates are forced to work at their respective trades, and any profits that may arise thereon are paid over to them on leaving. Munich is ornamented with a fine park, called the English Garden, and also with many fine monuments, the most interesting of which is the bronze obelisk in Caroline Platz, raised to the memory of 30,000 Bavarians who were lost during the Russian campaign of 1812-13, in which they formed part of Napoleon's army.

The manufactures of the town are unimportant, and are mostly connected with science and the fine arts. They comprise philosophical instruments, paint-colours, lithographic stones, gold and silver lace, carriages, and cloth-stuffs, besides paper, oil, &c. There is a considerable trade in literature, and twelve newspapers are published in the town. Munich is connected by railway with France and North Germany, and will shortly have the same means of communication with Austria and Italy.

The history of Munich commences with the thirteenth century, when it was known as a walled town, whose arms or shield bore the representation of a monk. The Emperor Ludwig took up his residence in it in the beginning of the fourteenth century, and restored and enlarged it in 1327, after a destructive conflagration. It became the capital of Bavaria about the beginning of the next century, and for many years after increased slowly but steadily in importance. In 1632 the town was entered by Gustavus Adolphus, and its arsenal demolished; but with the exception of this event, its history has been one of undisturbed peace. The ultimate advancement of Munich, however, to the rank of a first-rate town was reserved for the reign of Ludwig I., at the commencement of the present century. This monarch, both when crown-prince and king, used his utmost efforts, by means of erecting new galleries of art, and building additional suburbs, to raise this town to the position of the Athens of Germany, and his endeavours have certainly to a great extent been crowned with success. The population of the town has increased more rapidly perhaps than any town on the Continent. Pop. of town and suburbs (1812) 40,638; (1846) 113,384; (1855) 132,112.

MUNICIPAL CORPORATION; MUNICIPALITY. The institutions so familiarly known throughout Christendom by these or similarly-derived names, owe their origin to the peculiar internal constitution of ancient Rome. Her citizens, self-relying and impatient of control, adjusted their method of internal government to republican and representative principles, while their haughty spirit of domination over the rest of the world led them to demand conformity among their dependents, and to stamp the character of their own peculiar institutions over the wide arena of their conquests. The protracted vitality which carried the municipal system, through the breaking up of the empire, to a resuscitation in amalgamation both with southern feudality and the Saxon institutions of Britain, forms one of the most curious and eventful features in the constitutional history of the modern European nations. One of the leading social contrasts between modern Europe and the ancient communities with whom we have acquaintance is, that the feudal system rendered the country equal, if not superior, to the towns; while in ancient nations all greatness, power, and wealth seem to have been concentrated in cities, as in Babylon, Nineveh, Tyre, and Carthage. If there were nomadic leaders of rank and mark, they bore scarcely a higher relative position towards the rulers and other great men dwelling in cities, than an Australian squatter might bear in the present day to the head of some great territorial house among the British aristocracy. Egypt seems to have possessed wealth and greatness beyond the walls of a predominant city; but, peculiar in its geographic character, as a narrow stripe of marvellously fertile land, it might be deemed one continuous city. In Greece, too, although a common spirit of nationality prevailed, and no central city exercised unrivalled control, yet the prevailing political power was in the cities. But to whatever extent the constitution in other ancient cities may have influenced that of Rome, they have had no direct effect on the creation of the municipalities of the middle ages and modern times, which naturally take whatever they have derived through the ancient world from that one great municipal corporation, which professed to govern all the nations of the earth.

Municipal Corporation.

The governing bodies in modern municipal corporations —the mayors, aldermen, bailies, common council, &c.—are the direct representatives of the *comitia curiata* and the senate of ancient Rome. It is of course in the form which it had developed in the later days of the empire that we must seek for the chosen models on which later municipalities were formed. The formation of the Roman constitution, as a separate and more extensive object of inquiry, goes back to far earlier periods; but the time when it was dispersed over multitudes of smaller communities as a form of provincial burgal government, corresponds with the establishment of the imperial authority over what is called the Roman world. Hence the subsidiary municipalities were modelled on Rome, not as a republic, but as an empire. The republican forms, however, subsisted after the empire had been long established, and were thus communicated to the municipalities. Cicero, in his second phillipic against Anthony, desiring to describe the several elements of the Italian organization in their order, says, "Horum flagitiorum iste vestigiis, omnia *municipia, præfectura, colonias*, totam denique Italiam, impressit."

After the two principal classes of municipal institutions, the *municipia* and the *colonia*, Savigny enumerates as inferior corporations *fora*, *conciliabula*, and *castella*,—all communities partaking more or less of the elements of the highest and most perfect municipal organization, the municipium. When the citizens elected their magistrates and made laws in Rome, they did the like in the municipalities; and when the power was transferred to the emperor and the senate in the imperial city, it fell into the hands of the *curia*, or council of decuriones, in the cities or municipalities, acting under the Roman governor of the province, who represented the emperor. The magistrates were chosen from the curia, as those of modern corporations are elected by the council; and a practice arose by which those leaving office presented their successors for adoption. The supreme elective magistrates in the municipalities—the representatives of the consulate in Rome—were termed *duumviri* or *quatuorviri*, according as their regulated number was two or four.

Such appears to have been the prevailing character of the municipium; but there were many varieties in the constitution of Roman cities, as there are in those of the present day. In some the elective rulers were called *quinquinales*, because they retained office for five years; while in others the magistrate virtually supreme was a censor or a prefect sent from Rome. In all in-

stances, however, the electoral offices became a mere form after the consolidation of the empire; and when the prætor was superseded by the imperial advisers and judges in the capital, the imperial governors became supreme in the provinces. The very curia, or close council, which usurped the power of electing the magistrates, became, in the end, degraded by the uses to which it was made subservient by the imperial government. They were made responsible for the payment of the taxes; and from a supreme legislative and administrative body degenerated into the mere instruments which the imperial officers employed for carrying into effect the more disagreeable functions of government. Before the revival of municipalities the office had become a burden instead of an honour, and it was thrown, as a sign of contempt and oppression, on Jews, heretics, and other persons whom the government desired to mark with disrespect.

We know little on the very interesting point, how far the Roman municipal system existed in Britain. Two English towns are known to have had municipalities, York and Verulam; and it may be supposed that London, mentioned by Tacitus as a considerable place, had the rank of a municipality. There were several coloniæ and other sub-municipalities in Britain; and if the map of Richard of Cirencester can be believed, they penetrated as far northward as Inverness. Some English towns have retained through all intervening changes names which stamp their Roman origin, as Manchester, Winchester, and all those ending in *chester*. It is a natural supposition that a portion of the municipal constitution imparted to the more southern British towns by the Romans might have lived through the Saxon period. But archæologists have found no real evidence of such vestiges, and on this matter we have no better guide than mere conjecture.

How the continental municipalities lived through the troubles which attended the fall of the empire, so as to retain that vitality which enabled them to grow to a second maturity, is among the problems belonging to that epoch of confusion. In most instances the ancient municipal principle ruled or modified the administration of communities which had otherwise grown up. It is certain, however, that several cities of Italy, some in the south of France, and a few in Germany, such as Cologne, may be said at this day to be under the authority of a magistracy who date their origin from the Cæsars. Savigny and other writers have proved that the Roman law never died in Europe, to be raised from the grave by the discovery of the Pandects at the siege of Amalphi, according to the old popular belief. Through the strange confusion of nations, ever restless and transitory, an arrangement was adopted, as it were by common consent, that each tribe or people should, as far as consisted with the rights, or rather with the power of their neighbours, use their own laws. Thus the descendants of the Roman citizens, poor, obscure, and ever diminishing by absorption into other communities, kept up the more familiar and daily applicable principles of their own law; and when the world became settled, these, from their comprehensive and symmetrical character, gradually predominated, forcing out of use a more or less proportion of the original customs of the people in every country. The remnant of the Romans were essentially *cives*, or citizens. Their city was the state; and the term which they used to express attachment to the city has, in the words citizen, civism, citizenship, and the like, been used in France, and other countries which derive their language from Rome, to express attachment to one's country or state. But in the narrower acceptation of the term, the Romans were still citizens after the fall of their empire, since they were especially the dwellers in towns, while the conquering tribes occupied the open country. Hence, in a general way, we see how they preserved their own laws, and how those laws which affected the constitution of the places in which they lived were the most sedulously tended. In Italy, besides Rome itself, several of the cities of Tuscany and Lombardy continued to possess municipalities, modelled after the imperial city, with consuls at their head, a senate, and occasionally a tribune. So vital was the municipal system among them, that in the days of Italy's mediæval prosperity they were sufficiently strong to constitute very powerful governments, aristocratically republic; and Europe, when she had become thoroughly feudalized in her notions, looked with astonishment at the anomaly of mercantile or banking citizens, who not only vied with the highest feudal aristocracy, but were, as in the example of the Medici family, virtually royal houses. Nothing is more curious in the preservation of the Roman municipalities, than the method in which an equivalent to the broken authority of the empire was supplied to them from a totally different source. It is needless to remark, that the form of European history and institutions owes much to the fact, that while the civil power of the empire was destroyed, its ecclesiastical power, being attached to the destinies of Christianity, continued to exist, and even to take up many of the elements of the civil power as they dropped from time to time from the imperial grasp. The municipalities required leaders and directors, and the hierarchy of the church was at hand to lead and direct them. In Italy it came to be an almost constitutional rule, that the archbishop or bishop was the head of the leading town, smaller towns being headed by ecclesiastical persons of a lower grade. The system penetrated through part of France and of Germany. It did not reach England in its original purity, but became there mixed with the feudality which made a borough sometimes hold by tenure of an ecclesiastical dignitary. It is a matter of dispute by what original title the bishops sit in the House of Lords, and it has been said that they are a remnant of the old feudal baronage by tenure, sitting among the peers in right of the temporal lordships attached to their sees. But old as this origin is, the lordships which bishops may have held over city municipalities is of a still older date. We retain a relic of the municipal authority of the bishop in the notion of a city, which is stated in many legal books of reference to be a town in which there is a bishop's cathedral. The municipal bishop has almost disappeared from Europe, but the prototype of his civic authority still remains in the regal authority exercised by the bishop of Rome as a temporal prince.

Before feudality had come to its maturity, the towns had generally assumed their natural condition as communities governed by their own civic officers, the church betaking herself to things which were, or which she claimed to be, solely within her proper spiritual function. As the feudal system grew in strength, the municipal system, its natural rival and antidote, waxed powerful along with it. The two great types of the character of the age were the feudal lord's castle and the free or regal city,—both invested with characteristics unknown, at least in their fulness, to any previous social conditions of which we have an account. From those peculiarities in the condition of the European powers which divided the territories of the empire, so often discussed and so well known, the dominion over land and the dwellers in it became the great source of feudal eminence, suspending all the other elements of superiority,—such as great moveable wealth, the possession of many slaves, high office, or the privilege of taxation. The feudal lord lived in the country in his domains, and there built a fortalice; which was not a place of strength to which an invaded people might retire for refuge, but an edifice of a new and totally different character,—a fortress overawing the surrounding country, a prison for the refractory, and a mansion for the feudal chief,—all in one. The peasantry and other feudal inferiors nestled round this place of strength

for their own safety, and thus made a town which, while it continued small, was under the dominion of the lord, but sometimes became sufficiently large, wealthy, and powerful to assert its independence, and join the community of free cities which arose in rivalry of the chief and his stronghold. The aggressive spirit of feudalism, bringing all within its grasp as the dependents of some superior lord or other, left no room for separate independence. The *aremanni*, *allodials*, or other men of substance, who were neither lords nor vassals, found themselves crushed out, and naturally took refuge in the same sanctuaries where the remnants of the Roman population had found a congenial retreat—the municipalities. Various events tended to increase the strength and influence of these. The Crusades brought them trade, the object for which they were best suited, and at the same time weakened the hands of their rivals and oppressors. The revival of the study of the Roman law in the twelfth and thirteenth centuries was virtually the revival of the peculiar institutions which separated and protected them from feudalism. The Roman law had been promulgated in a despotism, yet it was peculiarly fitted to introduce elements of freedom to a state of society where feudalism was prevalent. It countenanced no distinctions in position among subjects; all under the emperor were equal, with the same rights and obligations, unless, indeed, it were the superiority conferred by citizenship, which yet did not confer power on one man over another. So much for freemen; on the other hand, the slaves were mere property or chattels. Feudality, however, was antagonistic to abstract slavery, having ever a tendency to the serfdom which attached the subordinate to a particular estate or a particular house, in reference to which the theory of the law, at least, gave him rights as well as obligations. The citizens could not well possess that power over their fellow-men which was denied to the feudal lord, and a pure republican freedom, of which the Roman law was an effective and suitable interpreter, prevailed in the cities.

Still the aggressive spirit of feudalism pressed hard on these communities. Except in the case of those which, like the great Italian cities, were powerful enough to be virtually states, in the European system, the towns generally found it necessary to come, in some shape or other, into the feudal hierarchy. If the citizens could not be made vassals individually, the community might acknowledge a superior in a collective capacity; and it became the interest of the towns in this manner to choose a protector. Still the hereditary principle, the several feudal exactions, and, above all, the subinfeudation which put a long hierarchy of masters over the humbler grade of vassals, was resolutely and, in many instances, effectually resisted. Laws still in full practice show vestiges of this long contest between the Roman and the feudal law. They are very distinctly seen in Scotland, where the owner of land or houses in a royal burgh is always a vassal, and can hold by no other tenure, but is a vassal of the crown only, no overlord having been able to intervene between the burgess and the sovereign. In all the surrounding territory there is a system of subinfeudation, by which the owner of land can sell it to another as his vassal, thus reserving, in the shape of the vassal's dues, a sort of perpetual rent called a feu-duty. But the owner of property in burgage tenure can only substitute a purchaser in his own place as a vassal of the crown.

This vassalage to the crown was indeed one of the great elements of strength which carried the municipalities of the middle ages through their difficulties and dangers. Arising from common causes, it had common effects over Europe. As some of the great lordships enlarged themselves into kingdoms, their reigning heads naturally felt that the most dangerous opponents of their rule were the feudal aristocracy, above whose position they had soared. They found on their territories municipal communities possessed of some wealth and strength, whose interests and feelings were opposed to those of the aristocracy; and it was always among the temptations to which a monarch was subject in his hour of feebleness, to make common cause with these communities. When the feudal lord who held a municipality in vassalage was tired out in a long contest with the insurgent citizens, or when he was offered a considerable tribute, he came to terms with them, agreeing to allow them certain exemptions from feudal exaction. The document acknowledging these exemptions, when it became matter of uniform practice, was called a charter. But if such a treaty with a subject lord, whose observance of it could not perhaps be very implicitly trusted, were of any value, far more precious was that royal charter in which a monarch embodied the terms of his alliance, and his protection of the citizens against their oppressors. Thus the municipal corporations became an integral part of the feudal hierarchy,—a fact which, as we shall presently see, had an influence on the national constitution of the European kingdoms, separate from its influence on the constitution and condition of each separate municipality. Hence, when the system was at its prime, the municipalities or boroughs of Europe might be divided into three great classes: *1st.* The free cities, which enjoyed such an independent municipal constitution as the Italian and other cities of the Roman world enjoyed before the encroachments of the empire—such as Florence, Venice, Genoa, Hamburgh, Lübec, and Novogorod. Some of these independent cities had been Roman municipalities which shook themselves free at the dissolution of the empire; others had arisen in feudality, and accomplished their freedom by war or purchase, or partly by both; but in all cases they were large, rich communities, capable of maintaining fleets or armies, and of holding a diplomatic character among the European powers. In a feudal hierarchy these held the position of sovereigns, sometimes exercising a very tyrannical sway over districts of which the people and their lords owned them as feudal superiors in the highest grade. It is almost needless to say that the power of the crown prevented such independent municipalities from arising in Britain. London, however, with peculiar privileges and powers, which even at the present day seem sometimes to bid defiance to the power of the legislature, approached very close to municipal independence and the establishment of a free city. The asserted right to exclude the royal troops from the precincts of the city, which possessed its own peculiar army, and the semi-sovereign rank and etiquette enjoyed by the lord mayor, seem to have been very incomprehensible to foreign writers, who have sometimes greatly exaggerated the actual privileges of the city. In the *Dictionnaire de Trevoux*, for instance, it is authoritatively laid down that the lord mayor is the principal *milord* of the realm, and in the case of a vacancy in the throne is, for the time being, governor of England. The second great class of municipalities were those which held royal charters, and were therefore, like the great lords, in the position of prime vassals of the crown. These in many instances had vassals under them, sometimes in the shape of small municipalities or corporations, sometimes in the shape of individual holders of feudal tenements more or less important. The chief cities in the United Kingdom were of this class; and wherever the crown was strong, it did not permit subject superiors to hold considerable towns in vassalage,—although frequently a neighbouring lord might exercise a very powerful influence in the councils of a royal municipality near his castle, and such a person was often propitiated by being invited or allowed to hold the highest office in the city, becoming its patron and to some extent its ruler. The lowest class of municipalities were those holding, not of sovereign princes, but of lords or subjects-superior, themselves bound to do homage to a sovereign. These were virtually the communities which, from

Municipal Corporation.

their smallness or poverty, had not been able to achieve their freedom, and are only to be considered as municipal corporations in name, from their being so ranked in the feudal hierarchy.

There were, of course, many minute distinctions and variations in the municipalities of the different European nations; but they will generally be found capable of classification into these leading divisions, since a remarkable uniformity pervades their constitution throughout Europe. This uniformity had its origin in the universal study of that Roman law from which the notion of municipalities was derived, and also, in some measure, from the uniformity of the feudal system itself. The necessary admission of the crown municipalities as an integral part of the feudal system, has been productive of signally important political consequences. It came thus to pass, that in the feudal assemblages which acquired more or less vitality in every country in Europe, and in Britain grew in strength until it became the imperial Parliament, the municipalities bore a part. Without them there would have been a gap in the feudal edifice. But all those who enjoyed the privileges of the municipality could not attend at the king's high court; the community must select certain citizens to pay suit and service as it elected its superior officers. Hence came the principle of representation, which made the House of Commons in Britain, and has repeatedly struggled into existence in France; arising fresh from the old municipal system, in the memorable instance of the meeting of the States-General, which began the first revolution.

It may now be appropriate to notice the leading peculiarities in the history and constitution of the municipalities of the United Kingdom. From the causes already noticed, the general uniformity pervading the municipal system extended even to England; but there were fundamental peculiarities in the real nature of the English municipal system which it has never lost. It has already been shown, that though it is not impossible that Roman municipalities may have lived in Britain through the Saxon invasion, no corporation has been actually traced among us to such an origin. The materials on which the corporation system was remodelled under the Norman kings, were evidently those institutions of the Saxons which divided the country into communities of tithings and hundreds, on the principle of common responsibility among the tithing men, and the duty of attendance at the hundred court. There are but faint contemporary traces of the constitution of the Anglo-Saxon towns; but their condition, as the Conqueror found them, may be gathered from Domesday Book, and is in a great measure reflected by the subsequent charters granted to them when they were incorporated by the Norman kings.[1] There is a difficulty in understanding the precise nature of the Saxon town; because it was not in its constitutional character any otherwise distinct from other parts of the country, than so far as a thickly-peopled must be distinct from a thinly-peopled place. There existed nothing in the form of a corporation, such as it afterwards became under the feudal system, mixed with the Roman law. The institution nearest to it in character was the body of traders, sometimes united together in a town, with the Saxon designation of a *guild*. It is possible to find other distinctions, both in name and reality, between the habits and institutions of the town's-people and the country-men. The term borough was in use, having found its way from expressing a pledge or surety, through some course which can be only hypothetically followed, to apply to a body of men associated together, and of course subject to the Saxon law of mutual suretyship. The term alderman, so familiar in later days, does not appear to have been originally burgal, though it became so in the later periods of the Saxon monarchy, after having designated an officer who represented, and was next in rank, to the king, over a shire or some wider district. There came to be such distinctions between county and town as are represented by the shire-reeve or sheriff for the county, and the borough-reeve or port-reeve for the town, with the corresponding shire-gemote and borough-gemote, at which the freemen attended and gave their pledges. The term "freeman" has been well known in late municipal history, chiefly from the easy political virtue of the men who bore so honourable a title. Its origin among the Saxon communities was not associated with general freedom. It was used to distinguish the freemen from the *thrals* or slaves. There was indeed a greater analogy in social condition between our Saxon ancestors and the southern states of North America, with their republicanism and their slavery, than it is always agreeable to acknowledge.

Although in all such matters broad classifications are open to doubt and criticism, it seems to be a fair conclusion, that at the time of the Conquest, and during the reigns of the early Norman kings, the constituency of a burgh, those who voted in its great affairs and chose its officers, were the free male inhabitants,—that is, those who were not slaves. As freemen, they were in municipal matters equal among each other. The feudal usages of the Norman dynasty naturally broke in upon the abstract division into freemen and slaves, communicating to the latter the modified slavery of feudal vassalage. But the condition of free men still attached to the citizens, and came to be communicated as a valuable privilege, by birth, marriage, apprenticeship, or acceptance into the free body of citizens. The serfs of the feudal lords were thus often rescued and enfranchised, much to the annoyance of their masters. Among the corporation records of Hythe are the following entries in the year 1399:—"Thomas Goodeall came before the jurats in the common hall on the 10th day of October, and covenanted to give for his freedom 20d., and so he was received and sworn to bear fealty to our Lord the King and his successors, and to the commonalty and liberty of the Port of Hethe, and to render faithful account of his lots and scots as freemen there are wont.

"Be it remembered, that on the last day of the month of March, in the Common House, John Brandon covenanted to give for his freedom 6s. 8d., and he was sworn to bear fealty to the Lord the King and to the commonalty and liberty of the Port of Hethe: and to render faithful account of his lots and scots when they shall accrue, as persons are wont to do—and the said John Brandon is admitted."[2]

The obligation of "scot and lot," to which these men became liable on their admission to the franchise, is another familiar expression connected with municipal constituencies. It very expressively applied to those who participated in common in the taxation and services of the burgess. The word *scot* means a tax, coming from the same origin as *scutage*, and the Danish *skat*, a tax or tribute, a word still of practical use in the Orkney Isles. The *lot* means the obligation to perform the public services which might fall to them by due rotation. The freemen—burgesses, or whatever they may be termed—transacted their business by common council; and here we have the origin of another term familiar in modern municipal nomenclature. The *commune concilium* evidently referred to the collective decision in council of the burgesses—their vote, in short, after

[1] For an ample store of information derived from Domesday Book, the charters, Acts of Parliament, litigations, Parliamentary inquiries, and other sources of information on this head, reference may be made to the three large volumes of *The History of the Boroughs and Municipal Corporations of the United Kingdom*, by Mereweather and Stephens. The chief defect of this book is the large quantity of superfluous matter contained in it.

[2] Mereweather and Stephen's *History of Boroughs*, 746.

consultation or debate. The term seems, by a metamorphosis which would be interesting if it could be traced, to have come at last to apply, not to the act of the burgesses in transacting their business, but to the select body who transacted it for them. It was not until after incorporation had for some time been in use that the management of the municipal affairs fell into the hands of a select council.

The early Norman kings granted charters to the towns. These did not grant them privileges, but secured to them those privileges and systems of internal organization which they had long been accustomed to. It cannot be said, as Guizot says of France, that the charters were gained by an insurrection and a war, and were in fact the terms of a treaty between the monarch and the insurgents. That act in the drama of the feudal history had passed over before the system in its maturity came over to Britain. But the charters were in some measure extorted from unwilling granters. It was contrary to the spirit of the feudal monarchy, that there should be within itself acting constitutions not owning the monarch as the author and regulator of their functions. The choice lay between the destruction of the privileges of the boroughs and a frank acknowledgment of them. The latter alternative was of necessity adopted. Many separate local reasons concurred in rendering the granting of charter after charter an act of politic discretion. Not the least of these was the facility of collecting the taxes. If the king appointed a bailiff to collect the revenue of a borough, his task was difficult and dangerous, if in the end successful; it therefore served the interest of both parties, that the citizens should agree to collect among each other, and remit the proper sum, on the condition of their being privileged from the intrusion of the royal bailiff. Sometimes the charters granted not only exemptions from vexatious interference, but special and exclusive privileges; and in the acquisition of these, London, from its predominating influence, was from the first conspicuous. Thus the Conqueror himself, in what may be called the earliest charter of the city, says with emphatic brevity,—"William the King friendly salutes William the Bishop, and Godfrey the Portreeve, and all the Burgesses within London, French and English. And I declare that I grant you to be all law-worthy as you were in the days of King Edward, and I grant that every child shall be his father's heir after his father's days: and I will not suffer any person to do you wrong. God preserve you!" (Mereweather and Stephens, 287.) The terms of peace thus hastily communicated were matured into the charter of Henry I., which, among other things, concedes, "that the citizens might place whom they would of themselves to be sheriff, and also one to be justiciary for keeping the pleas of the crown; that none other should be justiciary over the same men of London; that the citizens should not plead within the walls for any plea; that they should be free from scot and lot, danegelt, and of murder, and none of them should wage battel. If any of the citizens should be impleaded concerning the pleas of the crown, the man of London should dicharge himself by his oath to be adjudged within the city. No one was to have lodging assigned him within the walls: nor any one of the King's household, nor of any other, have lodging assigned to him by force. That all men of London should be quit and free with their goods throughout England and the ports of the sea, of toll passage, lastage, and all other customs."[1]

In the royal charter we have the foreign municipal system, consisting as it did of a mixture of the old Roman municipalities and of feudality, brought over and superinduced on the Saxon burgal communities. This could not happen without the introduction of the Roman law, cordially as it was hated by the common lawyers. It made a uniformity in appearance between the English and the continental municipality, but the fundamental principles of the old Saxon system still directed the spirit of the English borough. There was, however, a further change at hand. The early charters were not charters of *incorporation*. The corporation, indeed, was an ingenious result of the joint labours of the civilians and common lawyers. The law books speak of all the boroughs as having been corporations from the beginning; and great caution is necessary in referring even to printed records and acts of Parliament on this point, because the later copyist or editor, saturated with the legal phraseology of his own age, would insert the word "corporate" beside the word "town," as if its omission in the original had been a mere clerical oversight. Among many other such instances, the title of the act 6th Rich. II., stat. i., chap. 9, in the ordinary printed editions of the statutes is, "that no victualler shall execute a judicial place in a city or town *corporate;*" while the qualification of being "corporate" does not occur in the body of the act itself. Perhaps the earliest known record of an incorporation dates in the year 1412, when the citizens of Plymouth "state that their town is a great port and resort for ships coming there, and that oftentimes it had been destroyed by the king's enemies, because it had not been enclosed between any walls or defensible fortress to resist the enemy: and pray that His Majesty would grant to them, their heirs and successors, inhabitants and resiants within the same town, power annually to elect a mayor for the good governance of the same town: and that they, their heirs and successors, may be a body corporate to purchase free tenements for term of life or in fee without the King's royal license."[2] In such charters as this, the citizens at large were to be incorporated; but subsequent incorporations narrowed the sphere of the corporate basis, for the purpose of including only that small body of official persons by whom the complex and artificial character of an English corporation could be kept up. There had been ecclesiastical corporations of an earlier date, and the corporation was thus in fact a mechanism calculated for ecclesiastical rather than for civil purposes. A few considerations will render obvious how it gradually modified, and in the end totally changed, the constitution of the English boroughs. In the first place, the charter itself gave to the office-bearers of the municipality an authority from above, competing with their authority from below, as the elected of the freemen. The power of this sanction was strengthened by the incorporation, because the persons incorporated were in reality the officers, not the citizens. There is a tendency in all elected bodies to strengthen their position and become independent of their constituencies; and the royal charter giving certain privileges and functions to the elected, with that perpetual succession and uninterrupted vitality which are the boasted merits of the English corporation, naturally aided the office-bearers in the assertion of a power independent of the community. But it was the nature of a charter of incorporation not merely to acknowledge but to confer privileges, and their extent and character were dictated by the royal authority which conferred them. The difference between such a process and the mere confirmation of established privileges is obvious. If the rights and privileges of the freemen or burgesses in any ancient city were confirmed by the crown, their character had been originally adjusted by these freemen or burgesses themselves, and in their own way. When the crown absolutely conferred the privilege, the crown could impose conditions on it, and could, in particular, limit the class who were to enjoy it. Thus, after the system of incorporation came to its maturity, the municipal corporations fell into the hands of bodies of men more or less restricted, who

[1] Mereweather and Stephen's *History of Boroughs*, p. 295.

[2] Ibid.

could admit or reject applicants for freedom or citizenship, could lay down factious or capricious regulations for the franchise, or in many other ways impart the character of their own opinions or interests to the community. At the same time, what could be conferred by the absolute will of the crown was liable to be revoked. The law said, that if a municipal corporation was false to the tenor of its charter, that charter should be annulled; and as it had come to be a fiction of law, that every municipal privilege and power must be founded on charter, though none could be produced, the whole municipal system was at the mercy of the courts of law at a time when these were under the influence of the crown. Hence came those proceedings by writ of *quo warranto*, for stripping their privileges from municipalities acting independently, which preceded, and in a great measure caused, the revolution. That event did not put an end to charters of incorporation or improve their character, though, of course, no attempt has since been made to attack and demolish in a body the corporations acting offensively towards the ruling interest. During the reign of William III., and subsequently, the influence of the crown in creating municipal corporations, and adjusting them to the objects of the ministry in power, was profusely employed, and became too conspicuously connected with British history and politics to require commemoration here.

Soon after the era of the Norman conquest we find traces of a municipal system in Scotland closely resembling that of England. From the time of Malcolm IV. downwards, charters were profusely granted; but although they were named charters of erection, and are supposed to have created the municipalities to which they refer, yet they generally contain internal evidence that the communities acknowledged by them enjoyed an earlier existence. In muniments of the reign of David I., chiefly relating to ecclesiastical houses, there are references to towns which are the king's own or royal burghs (*e.g.*, *Burgum meum de Haddington*). A capitulary of laws of considerable antiquity is called the Laws of the Four Burghs (*Leges Quatuor Burgorum*). If the collection as a whole be perhaps no older than the fourteenth century, it is supposed that some of the laws themselves may belong to a far more distant date. The four burghs to which it applied were Edinburgh, Stirling, Berwick, and Roxburgh. It is remarkable that several of these laws refer to foreign commerce and the loading and unloading of vessels; and could thus have scarcely applied to any of the four burghs except Berwick. These four burghs formed an important court, of the authority of which there is a curious testimony in the year 1292, when a great part of Scotland was in the hands of Edward I. A question of private right, which came before a Parliament held by Edward in Newcastle, was referred to the court of the four burghs, as expositors of Scottish municipal customs. The similarity of these laws to many of the charters of the English burghs is a striking evidence of the similarity of the municipal customs of the two kingdoms. Many portions of the charter of Newcastle are identical with the laws of the four burghs;[1] and these bear evident marks of a unity of customs and laws, even when compared with the earliest charters of London. As in England, there is no trace of the corporation proper in the early Scottish municipalities. To be a free inhabitant, watching and warding, and paying the imperial dues, was to be a burgess, with the elective rights and other privileges of a burgess; and there was no higher grade but that which was conferred by office. In some instances the possibility of incorporation is negatived, by the charter being granted to all the burgesses spread over a district of country. One charter of William the Lion confers privileges on all burghs in Moravia or Moray; another confers *liberum ansum* (the right of trading, a term having the same origin as the name of the Hanse towns) on all the burgesses north of the Mount, or of the Grampian chain. The system of free election without a corporation, which separate documents show to have belonged to the English boroughs, is distinctly embodied in the burgh laws of Scotland. The whole election code is translated as follows in a Scottish version, probably of the fifteenth century, of which it is necessary slightly to modify the spelling:—"At the first mute next efter the feast of Sanct Michael, the Aldermen and the Bailhes sall be chosen thruch the counsale of the gud men of the toune, the whilk awe to be lele and of gud fame, and they sall swear fewte to the Lord the King, and to the burges of the toune, and they sall swear to keep the customs of the toune, and they sall not hald laugh [hold law] on any man or woman for wroth na for hatred na for dread or for lufe of ony man, but through ordinance counsel and dome of good men of the toun. Alsua they sall swear that neither for rudness na for lufe na for hatred na for cosynage na for tinsel of their silver—they sall nocht spare to do right to all men." In this succinct little code it will be observed that there occurs the same expression, the *counsale*, and in the Latin original the *commune concilium*, which became so curiously perverted in England.

The analogy between the Scottish and the English municipalities remained until the war of independence separated the two nations as hostile kingdoms. During the Saxon dynasty there was no more national division between the north of England and lowland Scotland, than between one province of Saxon England and another; nor was this community of nationality entirely severed even by the Norman conquest of England. After the war of independence however, Scotland, alienated from England, allied herself to England's greatest enemy, France, and the Scottish institutions became more or less tinged by the influence of the alliance. In the early municipal documents we find reference to the mayor, the aldermen, and the coroner, as in England. But afterwards the chief magistrate became the provost, or prevost; the inferior magistrates were bailies; the head of the craftsmen and of the merchant guild became the deacon, dean, or doyen. The towns, as every traveller in Scotland knows, were built after the French fashion; and in their records the streets are sometimes called "rues," a word which, by a natural transition, was corrupted into rows.

The example of France, which had probably given encouragement to the narrowing of the municipal franchise in England, was boldly embodied in an act of Parliament in Scotland. In the year 1469 it was enacted, touching the election of officers in burghs,—"Because of great trouble and contension yearly for the chusing of the same through multitudes and clamour of commons, simple persons, it is thought expedient that nane officers na council be continued after the King's laws of burrows further than a year, and that the chusing of the new officers be in this wise—that is to say, that the auld council of the toun shall chuse the new council in such number as accords to the toun; and the new council and the auld of the year before shall chuse all officers pertaining to the toun." This deliberate system of self-election, after meeting with some resistance at first, was the general rule followed, with local modifications and peculiarities, throughout Scotland down to the year 1833.

Long before this period the municipal system had come under deep discredit. In England the charges against it were, political corruption; general waste and extravagance; the mismanagement, misdirection, or appropriation of the property devoted to public purposes; and a general abuse of the powers and privileges of municipal offices for party

[1] See the passages compared side by side in the preface to the Record edition of the *Scots Acts*, p. 33.

Municipal Corporation.

or personal ends. In all parts of the empire it was remarked that, instead of being places of refuge for oppressed liberty, the corporations were frequently centres of oppression and extortion,—those privileges and immunities which were conferred on them for protection against feudal and regal power, being converted into personal monopolies and privileges, which invidiously excluded the public at large, to the detriment of the national welfare. In England the exclusive trading privileges asserted by the corporations were from an early time checked and modified by acts of Parliament. In Scotland monopolies were held and rigidly enforced down to the pursuits of the humblest craftsman. In the *Book of Advice*, written by King James for his son, there occur the following unexpectedly sagacious remarks on this subject:—"The craftsmen think we should be content with their work how bad and dear soever it be, and if they in anything be controlled—up with the blue blanket. But for their part, take example of England, how it hath flourished in wealth and policy since the stranger craftsmen came in among them."

The Scottish system, which was admitted to be far more exclusive than the English, was reformed in the year 1833; but the exclusive privileges of trade were not abolished until 1839. In England a general act "for the regulation of municipal corporations," abolishing trading privileges, and providing for vested rights connected with the freeman system, passed in 1835. The English municipal franchise is in the resident householders; the Scottish in the ten-pound parliamentary voters. The Irish municipal system, which was not indigenous, but a mere artificial imitation of the English, exhibiting many of its vices, but none of its virtues, was not reconstructed until the year 1840.

The demand for municipal reform was the companion of the demand for parliamentary reform. It was often said, that could the old municipal system be restored, it would be a rallying-point for the protection of free principles against a corrupt Parliament. Both the reforms were conceded at the same time; and the result has been to place reformed municipalities in an unfavourable contrast with a reformed Parliament. There is no doubt that, had the municipal improvement been achieved earlier and alone, its importance would have been more keenly felt. At present the high public spirit represented in the House of Commons, and the stringent responsibility which that body is enabled to exact in all quarters where power is exercised, supersede other popular safeguards; and it is often thought that the public languidness towards municipal representation and responsibility, is apt to leave such power as local corporations possess, at the absolute disposal of any clever citizens whose activity or ambition prompts them to conduct public business.

In most parts of the Continent, those municipalities which were not strong enough to exist as independent governments fell before the aggrandizing progress of their sovereignties. In France, in one shape or other, the royal authority had by degrees displaced all the substantial powers of the municipalities. In the great towns there was still the *maire*, presumed to be the elective head of the municipality, with a body of *adjoints*, *assesseurs*, and *conseillers*, selected from the chief inhabitants. But in great cities the *maire*, who was the agent of the central government, as well as the head of the municipality, came to be chosen by the crown. In garrison towns the governor or his lieutenant was supreme; and in others the intendant of the province had a supreme authority over all civic bodies. At the first revolution the municipalities, such as they had become, were swept away. In the re-distribution of the country in 1791 into departments, cantons, and communes, the smaller towns were amalgamated with their communes; but the towns containing 5000 or more inhabitants obtained a separate municipality under the new system. Under Napoleon all the local electorates of any importance were superseded by the intervention of the *chef de l'état*. Under the government of Louis Philippe the king had the nomination of *maires* and *adjoints* in the communes which had 3000 inhabitants or upwards; and the royal influence was indirectly exercised by giving the appointment in the inferior communes to the *préfet*. This arrangement, shaken by the revolution of 1848, was re-adopted under the second empire as convenient and suitable to the policy of the imperial system. From the first revolution downwards, the word *municipal*, like many others in familiar use in ancient France, has practically dropped out of the constitutional nomenclature of the country. (J. H. B.)

Munster.

MUNSTER, the most southern of the four provinces of Ireland, bounded on the N. by Connaught, on the E. by Leinster, and on the S. and W. by the Atlantic Ocean. It measures 150 miles in its greatest length, from Brow-Head, the most southern point of Ireland, to Meelick, the northern extremity of Tipperary; and about the same breadth in an eastern and western direction, from Dunmore Head in Kerry to Waterford harbour; extending over a superficies of 6,064,579 acres, of which 3,874,613 are arable, 1,893,477 uncultivated, 130,415 in plantations, 14,693 occupied by towns and villages, and 151,381 are under water. Of the uncultivated land, 634,000 acres are coarse pasture over 800 feet above the sea, and 1,259,000 under that level, including flow-bogs, &c. It has been estimated that 390,000 acres are improvable for cultivation, 630,000 improvable for pasture, and that the remaining 873,000 are incapable of improvement.

The ancient name of the province was *Mumhan* (in Latin, *Momonia*.) According to the older geographers, its maritime regions were peopled, commencing eastwardly, by the Brigantes, the Velabori, the Ibernii, the Luceni, the Vodii, and the Cangani; whilst its interior was occupied by the Scoti. At a later period it contained the eight following principalities:—1. Hy Breoghan, now the county of Waterford; 2. Osragii, afterwards Ossory, and now forming parts of the Queen's County and of Tipperary; 3. Oir-Mumhan, East Munster, now Ormond, comprehending the baronies of Ormond and of Owney and Arra in Tipperary; 4. Tuath-Mumhan, Thomond, or North Munster, now the county of Clare; 5. Aine-Cliach, or Eoganach Aine-Cliach, now Limerick; 6. Ciar or Cerrigia, now Kerry; 7. Aoibh-Liathain, containing the northern part of the county of Cork; and, 8. Corcaluighe, the southern part of the same county, and the ancient kingdom of Cork. The principal toparchs or heads of septs in those divisions, several of whom assumed the title of King, but acknowledged the supremacy of the King of Munster, were the O'Briens, the Barrys, the M'Arthys, and the O'Sullivans. After the arrival of the English the greater part of the province became the property of the Butlers, and of different branches of the Fitzgerald family; amongst the latter of whom the Earl of Desmond long ruled the whole of its southern portion with an authority almost independent of that of the English crown. The old Irish proprietors were dispossessed, and the Anglo-Normans extended their feudal tenures to Ireland; the ancient Irish inhabitants becoming the occupying tenants of the confiscated land. On the death of the last Earl of Desmond, and the subsequent confiscation of his immense estates by Elizabeth, in consequence of his rebellion, the greatest part was again parcelled out amongst English adventurers, amongst whom were the celebrated Sir Walter Raleigh and Spenser the poet. The province is now divided into the six counties of Clare (formerly included in Connaught), Cork, Kerry, Limerick, Tipperary, and Waterford.

According to the ecclesiastical arrangements of Ireland, Munster formerly constituted the province of Cashel, consisting of the archbishopric of the same name, with which were united the diocese of Emly; the bishopric of Limerick, Ardfert, and Aghadoe; the bishopric of Waterford and

 Lismore; the bishopric of Cork and Ross; the bishopric of Cloyne; and the bishopric of Killaloe and Kilfenora. This arrangement was altered by the Church Temporalities Act, 3d and 4th William IV., cap. 37, which reduced the archbishopric of Cashel to the rank of a bishopric, subordinate to the archiepiscopal see of Dublin, and consolidated the whole province into four dioceses, in the following manner:—Cashel, with Emly, Waterford, and Lismore; Cloyne, with Cork and Ross; Killaloe, with Kilfenora, and also the sees of Clonfert and Kilmacduagh (hitherto forming part of the archiepiscopal province of Tuam); and Limerick, with Ardfert and Aghadoe, as hitherto.

The northern parts of Munster are, generally speaking, level. Towards the S. and S.W. the land rises into elevations of considerable height, Macgillicuddy's Reeks, in Kerry, being the highest mountain range in Ireland. Carrantuo Hill, the most elevated of its peaks, is 3414 feet above the level of the sea. The mountains in the county of Cork stretch in the direction of E. and W., and the lofty range of Slieve-Bloom forms the eastern boundary of the province. The River Shannon passes through its northern part, separating the county of Clare from those of Tipperary, Limerick, and Kerry. The Suir, Blackwater, Lee, and Bandon water the southern districts. The only lakes of note are those of Killarney in Kerry, which owe their celebrity more to the picturesque beauty of their scenery than to the extent of their surface. The bays, creeks, headlands, and islands, which are numerous, and in most instances worthy of special notice, have been already mentioned in the general description of the island. (See Ireland.)

The climate, though moist from its exposure to the prevailing south-western winds, which pass over it loaded with the humid exhalations of the Atlantic, is peculiarly mild. The severity of winter is but slightly felt even in its more elevated regions; whilst in its more level parts, along its southern shores, the unsheltered myrtle blooms richly, and the *Arbutus unedo*, indigenous in Kerry, attains an unusual size.

The soil throughout the level parts is peculiarly fertile, producing abundantly rich crops of every kind of grain, and many species of fruits which in other parts of the island are capable of being ripened only by means of an artificial atmosphere. The tract of land stretching across the counties of Limerick and Tipperary, from Askeaton to the limits of Kilkenny, has long been distinguished by the name of the Golden Vale, an appellation justly bestowed upon it from its singular fertility.

The extent of land under each description of crop in 1856 and 1857 was—

	1856. Acres.	1857. Acres.
Wheat	179,982	199,779
Oats	373,385	351,904
Barley, bere, rye, beans, and peas	70,918	76,378
Potatoes	287,219	309,447
Turnips	121,207	114,983
Other green crops	28,032	30,745
Flax	3,575	2,883
Meadow and clover	384,097	404,686
Total	1,448,415	1,490,805

The total quantity of live stock in the province in the same years was—

	1856.	1857.
Horses	145,850	152,566
Cattle	1,073,625	1,084,256
Sheep	993,082	892,217
Pigs	343,176	427,340

As to its geological relations, the northern parts of Munster are included within the limits of the great plain of carboniferous limestone which constitutes the central formation of Ireland. The southern parts are mostly of the sandstone and carboniferous formation; the former being more developed in the mountains, the latter in the more level parts. Bog is abundant and very generally distributed, although the province lies without the great central band, which embraces most of the soil of this description. Coal is found in the interior. There are two fields of this mineral,—one in Tipperary, where a branch of the great Leinster coal-field stretches into the province; the other, peculiarly termed the Munster coal-field, is of great extent, occuring in several portions of the counties of Clare, Cork, Limerick, and Kerry. The contortions of the strata, however, cause irregularity and uncertainty in the workings, and the district has not yet been sufficiently examined to ascertain the economical value of this great development of the coal strata in Ireland. The most extensive collieries hitherto worked are in the barony of Duhallow, in the county of Cork. In both places the mineral is of the non-flaming or anthracite species. Several mines of copper, lead, and iron were worked with profit until stopped by the failure of timber for fuel, notwithstanding which a few are still carried on successfully. Mineral springs are numerous; that of Mallow, which is of the same nature with the hot wells near Bristol, maintaining a high character for its medical efficacy.

The population of Munster in 1821 was 1,935,612 souls; in 1831, 2,227,152; in 1841, 2,396,161; and in 1851, 1,857,412. The peasantry are a large, athletic, and handsome race, exhibiting in their oval faces and dark hair strong traces of similarity with the Spaniards. Their occupation is chiefly agricultural. The raising of grain, and the pasturage of cattle, which are exported in great numbers from Cork, Limerick, and Waterford, form their chief employment. The manufacture of frizes and coarse woollens, as also of coarse linen cloth for domestic consumption, is still carried on; and formerly the country round Carrick-on-Suir was the seat of an extensive woollen trade.

The province contains several of the largest cities in Ireland: Cork, with a population in 1851 of 65,745; Limerick, with 53,448; and Waterford, with 25,297 inhabitants. (H. S—R.)

Münster, a town of Prussia, capital of the government of the same name and of the province of Westphalia, is situated on the Aa, a tributary of the Ems, 78 miles N.N.E. of Cologne. It is well but irregularly built, and has an air of great antiquity, the principal streets being lined with arcades, on which the upper storeys of the houses are supported. It was formerly surrounded by fortifications, but these have been destroyed, and their place is occupied by public walks, beautifully shaded with trees. The cathedral, begun in the thirteenth century, is a Gothic building with two transepts and two pyramidal spires. The oldest church in Münster is that of St Leger, built in the twelfth century, but its tower is in the later Gothic style of the fifteenth century. The church of St Lambert, also in the Gothic style, is a very fine building, and on its spire may still be seen the iron cages in which John of Leyden and the other Anabaptist leaders were exposed before their execution. Besides these, the town contains numerous other churches. The town-house of Münster is remarkable for its beautiful Gothic front, and contains in the interior the hall in which the peace of Westphalia was signed in 1648. Here are to be seen portraits of the ambassadors who then met, and also the seats and cushions on which they sat. The castle, which was formerly the residence of the bishops, is now occupied by the commandant. It is a handsome building; and the ground behind it, formerly occupied by the citadel, is now used as a botanical garden belonging to the Academy. Münster was formerly the seat of a university, but this was closed on the foundation of that of Bonn; and all that remains of it now is an academy, containing theological and philosophical faculties, besides a medical school and clinical institute. There are also a deaf-and-dumb

institution, two normal seminaries, a grammar school, art union, school of design, and two scientific institutions. The town has also an orphan asylum, several hospitals, and other charitable institutions. Munster is the see of a bishop, and is the seat of the highest law court in the province of Westphalia. The manufactures consist of woollen, cotton, and linen goods, starch, tobacco, sugar, &c.; and there is a considerable trade in these articles and in Westphalian hams, wine, &c. There is a canal between this town and the Ems; and it is connected by railway with the principal towns in the vicinity. Münster was for a thousand years (802–1803) an independent see, governed by its own archbishops, who were in many instances remarkable for their warlike achievements. The most important event in its history was its occupation in 1535–6 by the Anabaptists under John of Leyden; after which it was recovered by the archbishop, and the ringleaders were executed. Pop. 24,664.

The government of Münster forms the north-western part of the province of Westphalia, and is bounded on the N. by Hanover, E. by the government of Minden, S. by those of Arnsberg and Dusseldorf, and W. by Holland; area 2432 square miles. The surface is generally flat, except a small portion towards the N.E., and it consists partly of cultivated ground and partly of sandy and heathy tracts. Iron and coal are obtained here in considerable abundance; but the soil is in general not very fertile, and the produce not more than enough for domestic use. Flax and hemp are the principal crops raised. The pastures are large and good, and great numbers of live stock are reared in this government. Linen is the chief article of manufacture; but iron, leather, cotton, silks, &c., are also produced. The government is divided into ten circles, and has a population of 421,935.

MÜNSTER, Sebastian, one of the most learned scholars of his day, was born at Ingelheim in 1489. At the age of sixteen he repaired to Tübingen to sit at the feet of Reuchlin and Stoffler. There his passion for study induced him to seek the quiet of a Franciscan convent. But becoming in course of time a convert to the opinions of Luther, he threw off his monastic habit, and was appointed professor of Hebrew at Basle in 1529. His days and nights were now devoted to study, and several elaborate treatises on geography, mathematics, and philology proceeded from his pen. At length the robust constitution which had carried him through so many severe labours was smitten by the plague, and he died in May 1552. The most important of Münster's works are the following:—An edition of the *Biblia Hebraica*, in 2 vols. fol., Basle, 1534–5 and 1546; *Grammatica Chaldaica*, 4to, Basle, 1527; *Dictionarium Chaldaicum*, 4to, Basle, 1527; *Dictionarium Trilingue, in quo Latinis Vocabulis, Græca et Hebraica respondent*, fol., Basle, 1530; *Horologiographia*, 4to, Basle, 1531; *Organum Uranicum*, fol., Basle, 1536; *Cosmographia Universalis*, fol., Basle, 1544; and *Rudimenta Mathematica*, fol., Basle, 1551.

MÜNSTERBERG, a town of Prussia, capital of a circle of the same name, in the province of Silesia and government of Breslau, is situated on the Oklau, 37 miles S. of Breslau. It is walled, but not very well built; and contains several churches, a synagogue, an hospital, and several courts of law. It has breweries, distilleries, tobacco manufactories, dye-works, &c. Pop. 4500.

MUNTZER, Munzer, or Muncer, Thomas, an insurrectionary leader of the German Anabaptists, was born at Zwickau about the end of the fifteenth century. He was a priest, first at his native town, and afterwards at Altstadt, and he was at one time a follower of Luther. But at length his tenets assumed a fanatical tone, and his hot-headed zeal drove him forth to be the apostle of a revolution. Travelling into Thuringia and Suabia, he preached the abolition of all legal penalties and all distinctions of rank, the establishment of a community of goods, and the speedy coming of Christ to set up the New Jerusalem. Such startling doctrines, falling among a population already excited with discontent against their rulers, hurried the ignorant peasantry into open revolt. A force of 8000 Thuringians rallied round Muntzer, and acknowledged him as their prophet and leader. He fixed his head-quarters at Mülhausen. Thither the neighbouring princes, headed by the landgrave of Hesse, advanced to attack him. Terms of capitulation were offered to him in vain. He animated his troops by assuring them that a miracle from heaven would foil and confound their foes. A battle ensued, which ended in the complete rout of the insurgents. Muntzer was soon afterwards caught lurking at Frankenhausen. He was carried back to Mülhausen, and beheaded in 1625.

MURAL CIRCLE, a principal fixed instrument in all the great public observatories, is generally of large dimensions, and is attached to a stone wall, or pier of solid masonry, placed in the meridian. It is employed to measure the zenith distances of stars. Tycho Brahe was the first who used the mural arc in his observations; and Flamsteed erected the first one at Greenwich in 1689. Mural arcs and quadrants were superseded at that observatory by the mural circle of Troughton in 1812, an instrument of much greater accuracy, and much less liable to derangement. (See Astronomy, part iv., chap. iv., § 5.)

MURAT, Joachim, a distinguished French general whom Napoleon created King of Naples, was born on the 25th of March 1771 at La Bastide, near Cahors, where his father was an innkeeper. He acquired some slight degree of elementary instruction at a school in Toulouse, but his taste for dissipation and adventure soon drew him away from his studies. Having returned to the hostelry of his father, he engaged in the service of the house along with the domestics, and then enlisted in the chasseurs of the Ardennes, from which he soon afterwards either deserted or was dismissed. Having gone to Paris, he fell into such distress that he was obliged to serve at the table of a restaurateur. Being remarked for his activity and bearing, and his father having resolved to send him some assistance, he was admitted into the constitutional guard of Louis XVI.; and, on the disbanding of that body, which followed soon after its formation, he obtained a sub-lieutenancy in a regiment of chasseurs. Here he showed himself a furious revolutionist, and in consequence obtained rapid promotion. He was already lieutenant-colonel, and one of the most fervent adherents of Marat, when, upon the death of that ferocious tribune of the people, he wrote from Abbeville, where he was then in garrison, requesting the Society of the Jacobins at Paris to grant him permission to change his name into that of Marat. It is not known whether his request was positively complied with; but it is certain that, after the fall of Robespierre, he was, like Bonaparte, dismissed as a terrorist. Being restored to his rank at the epoch of the 5th October 1795, he served under the orders of Bonaparte, when the latter was employed to disperse the Parisians who had armed against the Convention. Attaching himself more and more to this young general, Murat showed much intelligence and bravery at the opening of the campaign of Italy in 1796, and became the confidential aide-de-camp of Bonaparte. During all that campaign, and the subsequent one of 1797, he greatly signalized himself by his bravery and success. In March 1798 he proceeded at the head of a column to the confines of the Valteline, and united that province to the new Cisalpine republic. He likewise preceded Bonaparte when, after the peace of Campo Formio, that general traversed Switzerland and Alsace on his way to Rastadt. Being sent to Rome with Berthier, he marched against the insurgents of Marino,

Murat.

Albano, and Castello, killed a great many of them, and caused to be arrested a considerable number of monks and prelates, reputed enemies of France. When the expedition to Egypt had been resolved on, he declared he would follow Napoleon through the world; and throughout the whole course of that expedition he distinguished himself, particularly at Mount Tabor, where, by a series of brilliant charges, he completed the dispersion of the Turkish army, and was rewarded with the rank of general of division. On his return to France with Napoleon, Murat rendered him effectual service at St Cloud, when he changed the form of the government and took possession of power. It was Murat who, at the head of sixty grenadiers, dispersed the Council of Five Hundred. He was immediately named commandant of the consular guard, and henceforth enjoyed unlimited favour. To draw still closer the ties which united them, Napoleon gave Murat his sister Caroline in marriage. He also employed him as one of his lieutenants in the army of reserve, and in this capacity Murat entered Milan, occupied Piacenza, and commanded the cavalry at the battle of Marengo. In the following year he commanded the army of observation, and governed, with the title of general, the Cisalpine republic. On the 1st of January 1804, he was appointed governor of Paris, with the rank of general-in-chief, and directed the military force when Napoleon was proclaimed emperor. A few days after this event he was elevated to the rank of marshal of the empire, and in the following year he was raised to the dignity of prince and of high admiral.

On the breaking out of hostilities with Austria in 1806, he passed the Rhine, pursued vigorously the Austrian corps under the Archduke Ferdinand, overcame the corps of Werneck, and entered Vienna on the 11th of November. He then marched against the Russians, and contributed to the victory of Austerlitz. Being invested with the grand-duchy of Berg, he assumed the style of a sovereign; figured in the two subsequent campaigns, particularly at the battle of Jena; made his public entry into Warsaw on the 28th of November 1807; and commanded the cavalry at the battle of Eylau, and also at that of Friedland.

In April 1808 he entered Spain at the head of a numerous army, and imprudently provoked an insurrection in the capital, which spread the flame of discontent throughout the whole of Spain. Being recalled from Spain, he was, on the 1st of August 1808, proclaimed King of the Two Sicilies, under the name of Joachim-Napoleon. As he succeeded Joseph Bonaparte, whom the Neapolitans despised, the comparison was to his advantage; whilst by the pomp he displayed, and his martial air and bearing, the *beau Sabreur* readily won the favour of the people. The invasion of Russia in 1812 recalled him under the banners of his former master. Being placed at the head of the cavalry, he took part in all the operations which preceded the capture of Moscow; he also commanded a separate corps at Kaluga, where at first he obtained some advantages, but subsequently experienced great reverses; and after the departure of Napoleon from the army, he was intrusted with the command of it in its disastrous retreat from Smorgoni. Fatigued and discontented, however, "the best cavalry officer in Europe," as Napoleon called him, also abandoned the army, and took the road to Naples. On his return to his capital, he made overtures to the court of Vienna, with a view to the formation of an alliance with Austria; but the campaign of 1813 soon afterwards opened, and as the first events proved favourable to Napoleon, Murat quitted Naples, and once more repaired to the head-quarters of the French army. After the loss of the battle of Leipsic he withdrew to his states, and considering the star of Napoleon as for ever eclipsed, he opened his ports to the English, and renewed the negotiations for the accession of Naples to the European alliance against France. His title of "king" had turned his head; and he incurred the double reproach of treachery and ingratitude, without deriving the slightest advantage from his dereliction of principle. Though brave as a lion in the field of battle, he showed himself one of the weakest of men when not in presence of the enemy. He had no moral courage. His invasion of Italy after the return of Napoleon from Elba was in every view a most headlong and irrational proceeding. In the space of two months he had lost his army, his fleet, part of his treasures, his crown, and even his field equipage; and now, after the second abdication of the man in whose fortune alone he could repose any hope for the future, all seemed irrecoverably lost. He escaped to the island of Corsica, where he had many partizans, and began to form new projects. Resolved to make an attempt to recover his power, he sailed from Corsica for Italy on the 28th of September 1815, with seven transports, containing 250 men, and on the 8th of October reached the Gulf of St Euphemia, where one only of his barks had rejoined him, the rest being separated in a gale of wind. When he landed at Pizzo he was accompanied by only thirty men, and knew not what course to follow. Having attempted to raise the country, the inhabitants flew to arms, and attacked his troop, upon which the two small vessels immediately stood out to sea. Murat attempted to launch a fishing-boat which he found upon the beach; but the task exceeded his strength, and escape was impossible. Having been made prisoner, he was lodged in the castle of Pizzo, tried by a military commission, condemned, and sentenced to be shot. The judgment of the court was carried into execution on the 13th of October, when this singular man, whom death had spared in a hundred battles, fell ingloriously in an obscure town of Calabria, the victim of his own folly and ambition. He appears to have died in a manner worthy of his reputation for courage. He refused to allow his eyes to be bandaged, saw the arms charged, placed himself so as to receive the concentrated fire of the soldiers, and exclaiming "Sauvez le visage, visez au cœur," instantly fell dead under the discharge. Murat perished in the forty-eighth year of his age, after having experienced every variety of fortune; indeed, he was a man whose destiny may, in some respects, be considered as the most extraordinary in modern times. Sprung from the lowest class of society, and raised to supreme rank, his elevation was the more surprising that he had neither the great qualities nor the great vices which seem to command events. Fortune had so blinded him, that he neither perceived the inevitable dangers with which the fall of Bonaparte and the restoration of the Bourbons had surrounded him, nor could he turn to account the resources which circumstances still placed in his power. (J. B—E.)

Muratori.

MURATORI, Ludovico Antonio, a learned Italian scholar and antiquary, was born at Vignola, in the duchy of Modena, on the 21st of October 1672. He received his elementary education at the college of Modena, where he signalized himself by his application and the rapidity of his progress in the ancient languages and in literature. He then entered the university, where he passed through the ordinary curriculum, applying himself with equal ardour to the study of philosophy, jurisprudence, and theology. Father Bacchini, the learned librarian of the Duke of Modena, inspired him with a taste for historical researches, and taught him to read manuscripts; and so much did he profit by his advantages, that at the age of twenty he was considered a prodigy of talent and erudition. In 1694 he was called to Milan by Count Carlo Borromeo, who had appointed him a keeper of the Ambrosian Library. But before quitting Modena he wished to take his degree of Doctor *in utroque jure;* and the theses which he maintained on this occasion were universally applauded. Having established himself at Milan, and taken sacred orders, Muratori

entered upon a course of study and research calculated to justify the hopes which his talents had inspired; and having made a selection from the numerous manuscripts intrusted to his care, he published them, with dissertations intended to throw light upon various disputed points in archæology. The reputation he thus acquired was great, and the Duke of Modena, regretting that he had parted with a man who seemed destined to attain such distinction, offered him, as an inducement to return, the situation of conservator of the public archives of the duchy, together with that of keeper of his library, vacant by the resignation of Father Bacchini. Muratori returned in 1700 to Modena, which he never quitted, except to visit the public collections of the principal cities of Italy. In 1734 Apostolo Zeno offered him the chair of belles-lettres in the university of Padua; but Muratori declined accepting a situation which would have withdrawn him from his favourite pursuits. The publication of a number of valuable tracts on the history of Italy during the middle ages, besides various learned dissertations, added every year to his growing reputation; and this indefatigable writer also found leisure to cultivate polite literature, nay, even to take part in the theological discussions which then occupied so much of the public attention. Indeed, all the journals and all the literary collections of the time were enriched with some of his productions. The freedom with which he communicated the result of his researches, had put him in communication with the most distinguished scholars of Italy, France, and Germany, who had recourse to him on all subjects of difficulty. Literary societies vied with one another in sending him diplomas of admission; and many who had attained eminence in different departments of literature paid him the homage of inscribing to him their works. A rumour got afloat that he was heterodox, which induced him to write to Benedict XIV. repudiating the charge. His holiness assured him, however, that he had found nothing reprehensible in his writings. The health of Muratori, enfeebled by excessive labour, at length declined; and after languishing for some time, he died on the 23d of January 1750, at the age of seventy-seven. He was buried with much pomp in the church of Santa Maria di Pomposa, whence his remains were in the year 1774 transported to that of St Augustin.

Of the works of Muratori, sixty-four in number, a detailed list will be found in the *Biblioteca Modenese* of Tiraboschi (tom. iii., pp. 326–346). The principal are,—*Anecdota ex Ambrosianæ Bibliothecæ*, Milan, 1697, 1698; Padua, 1713, 2 vols. 4to; *Vita e Rime di Maggi*, Milan, 1700; *Della Perfetta Poesia Italiana*, Modena, 1706, 2 vols. 4to; *Anecdota Græca*, Padua, 1709, 4to; *De Ingeniorum Moderatione in Religionis negotio*, Paris, 1714, 4to; *Delle Antichità Estensi ed Italiane*, Modena, 1717, 2 vols. folio; *Rerum Italicarum Scriptores præcipui, ab anno 500 ad 1500*, Milan, 1723–1751, 29 vols. folio; *Delle forze dell' Intendimento Umano*, Venice, 1735 and 1745, 8vo; *De Paradiso Regnique Cœlestis gloria liber*, Verona, 1738, 4to; *Antiquitates Italicæ medii ævi*, Milan, 1738–1743, 6 vols. folio; *Novus Thesaurus Veterum Inscriptionum*, Milan, 1739–1742, 6 vols. folio; *De Superstitione vitanda adversus Votum Sanguinarium pro Immaculata Deiparæ conceptione*, Venice, 1740 and 1742, 4to; *Cristianesimo felice nelle missioni dei Paraguai*, Venice, 1743, 4to; *Annali d'Italia dall' era volgare sino all' anno 1749*, Venice, 1744–1749, 12 vols. 4to; *Liturgia Romana Vetus tria Sacramentaria complectens*, Venice, 1748, 2 vols. folio; *Della Pubblica Felicità oggetto de' buoni principi*, Lucca, 1749; Lives of Segneri, Ligonius, Orsi, Tassoni, and others; Dissertations, in various collections; *Lettere*, Venice, 1753, 2 vols., preceded by a Life of Muratori from the pen of Lazzari, professor of elocution in the Academy of Pesaro. The works of Muratori were published at Arezzo, 36 vols. 4to, 1769–80, and at Venice, 48 vols. 8vo, 1790–1810. (J. B—E.)

MURCIA, a province in the S.E. of Spain, between 37. 19. and 38. 39. N. Lat., and 0. 50. and 3. 5. W. Long.; and constituting the greater part of the ancient kingdom of Murcia, broken up in 1833. The kingdom of Murcia had a superficial extent of about 3000 square miles, and had the following boundaries:—N., La Mancha; E., Valencia; S., the Mediterranean; and W., Granada. The province has about 1200 square miles of surface, and is bounded N. by the province of Albacete, W. by that of Almeria, S. and E. by the Mediterranean; having a coast-line of between 70 and 80 miles. East of Cartagena the coast is low and sandy; W. of that port it consists, as far as Granada, of a line of precipitous cliffs, having only two other smaller ports, Aguilas and Almazarron. Of this coast the most remarkable feature is the Mar Menor, a kind of lagoon at the eastern extremity, 10 miles long and 3 broad, separated (except a small opening) from the sea by a narrow sandbank. The surface of the province is nearly equally divided between hill and plain. The most considerable mountains are those of the Espuña and those of the Carrascoy series,—the former bounding the province to the W., and having sometimes an altitude of 3000 feet; the latter, rising in the midst of the vast plain (El Campo) S.W. of the capital, extending eastwards and ending in Cape Roch. The Almagrera chain enters the province on the S. and W., and ends in Cape Palos. These mountains are of igneous formation, abound in copper, lead, and silver, and contain some singular caves, of which that of Barquillo and that of Don Juan near Cartagena are remarkable for their extent and the beauty and magnitude of their coloured crystals. The province is chiefly watered by the River Segura, and its affluents the Mundo, Mula, &c. The Segura has a tortuous course, W. to E., of about 170 miles, of which 92 are included in Murcia; and its waters are made available for irrigation by means of reservoirs, tanks, and canals,—Moorish devices, without which the whole province would be as sterile as an African desert. The *huertas*, or tracts watered in this way, are of great fertility, producing abundance of cereals, the palm, the orange, carob tree (St John's bread), silk, wine, &c. The principal roads of the province—those from Albacete to Cartagena, from Lorca to Andalucia, and from Murcia to Alicante—are bad, the last-mentioned often impassible during winter. Those in the N. are much worse, from the greater difficulty of the ground.

Wheat, barley, oats, hemp, and legumes are grown in the plains; also in the secanos, the barilla or soda plant, an exhausting crop. In the huertas of Calasparra, in the N., rice is cultivated for domestic consumption. In the huerta of Murcia, a fertile valley inclosed by hills and watered by the Segura, extending about 17 miles in length, by about 5 in breadth, are extensive plantations of mulberry for the silk-worm. Citrons, lemons, oranges, &c., are especially abundant in the valley of Ricote. Wine is grown to some extent, but under the discouragement of heavy duties. In the uncultivated hilly country the *esparto*, a rush used for mats and sandals, grows, especially in the plains of Mula, Albudate, Ricote, and Lorca, and in the marshes of Jaravia and Cope. Oil is grown, and is an increasing product, in the partidos of Murcia, Mula, Lorca, and Cartagena.

The chief mineral products are sulphur, alum, copper, lead, and silver. The mining industry of the province has recently received an impulse, many of the ancient mines having been re-opened, and new ones discovered. Lead and silver are found in the mountains on the coast, between the Bay of Porman and that of Villaricos. In the partido of Cartagena, the *escoriales* (slags) of the ancient mines have been worked with success. Sulphur is found in conjunction with other minerals; also pure in great quantities at the conflux of the Mundo with the Segura. At Calasparra and Maratalla are establishments for extracting it. White marbles and other ornamental stones are found; and there are considerable mines of alum and red clay at Mazarron.

The population is chiefly agricultural, and the products of the soil are manufactured elsewhere; even the silk grown in the huerta being mostly exported in a raw state. Besides that of silk, and silk fabrics to some extent, there are manufactures of salt, from salt springs and the salt

marshes on the coast; of numerous articles, especially cables from the esparto, of white paper in Caravaca, of brandy in Pliego and Calaspana. (See CARTAGENA, and LORCA.)

From the three ports of Cartagena, Aguilas, and Mazarron, are exported cereals, barilla, esparto (raw and manufactured), silk, fruits, and minerals. Grain and other articles are exported to Algiers. The silk of the province finds a market in South America, by way of Cadiz. By Cartagena are imported colonial products, sugar, cacao, &c. The imports of Aguilas and Mazarron are chiefly cereals from Andalucia. From La Mancha are imported wheat and saffron, and cattle from La Jaen. Owing to the proximity of Oran and Gibraltar, a good deal of smuggling is carried on. For the internal trade there is the annual fair of Murcia, the capital, 24th August to 8th September; of Lorca, 8th September; also of Caravaca, Cieza, &c.

Primary instruction is extremely scanty and deficient, and the crime and ignorance of the Murcians are proverbial in Spain. In 1844 a normal seminary was established, and an improvement is said to have already taken place. The seminary of San Fulgencio being in decay, there is a total want of the higher instruction.

The agricultural Murcians of the north differ considerably from the commercial people of the south; the former are grave, dull, apathetic, laborious, and tenacious of ancient manners. The *huertanos* of Murcia preserve much of the Moorish in manners and physiognomy, and a good deal of emigration to Algiers has taken place since the French occupation of that country. Pop. about 400,000.

MURCIA, a city of Spain, capital of the province of that name, is situated on the River Segura, in 38. N. Lat., and 1. 11. W. Long., nearly in the centre of the valley called the Huerta de Murcia. The Segura divides the city into unequal parts. The suburb of San Benito, on the right bank, is connected with the principal division of the city by a very fine stone bridge of two arches. It enjoys a delicious climate,—a kind of perpetual spring; an advantage which it owes mainly to its sheltered position. It is surrounded by a brick wall, erected during the civil war, and has three principal gates on the N., S., and E., besides various smaller entrances. The streets are mostly broad, straight, and well flagged; that of La Plateria is the principal street in the city, and a great resort of loungers, being covered with awnings of canvas in hot weather. The principal plaza is that of San Domingo, in which is a promenade planted with orange and other trees, and much frequented. The houses are mostly of two storeys, the lower being inhabited in summer. The finest building in the city is the cathedral (1388–1467): the fine Corinthian columns of its façade are the work of D. Jaime Brot, in 1737. The interior is of semi-Gothic architecture, but is not equal to the exterior. The bell-tower, begun 1521, and finished 1766, is of three stages, unequal in point of merit, and contains a peal of twenty bells. The episcopal palace of the see of Cartagena, erected 1748–52, is one of the finest edifices of its kind in Spain, and has a commanding situation. Near the palace are the colleges of San Fulgencio and San Isidoro, which have the appearance of a single edifice. The other remarkable buildings are—the hospital of San Juan de Dios; the silk and saltpetre manufactories, on the N.; and the Albordiga, a building for the deposit of grain. There are eleven parish churches, two hospitals, with a foundling hospital and a house of refuge. The seminary of San Fulgencio, founded in 1592, has since 1823 been in a state of decay. The institute of secondary instruction was founded first in 1837, the rents of various suppressed religious houses being appropriated; it has at present two professorships of Latin, two of mathematics, and chairs of philosophy, natural history, chemistry, and general literature. A normal school was founded in 1844 for the improvement of the education of the province, and there are numerous private schools in the city. In the suburb of San Benito, on the right bank of the Segura, is a Plaza de Toros rarely used.

The surrounding country, as far as the huerta extends, is very beautiful, and richly covered with the olive and mulberry. The olive and the vine are cultivated on the slopes of the surrounding sierras, but without much success. Silk is the most important product, amounting on an average to L.150,000 yearly; wheat, barley, &c., are largely grown, and all kinds of fruit. But few cattle are reared. There are manufactures of silk and silk cloth in the town; also of woollen cloths, of soap, earthenware, and some other articles, but to no great extent.

The province of Murcia was the first possession of the Carthaginians in Spain, and the city was, during the Moorish occupation, one of the seven capital cities of the seven military divisions of Spain, A.D. 787. It was taken by D. Alfonso, son of St Ferdinand, in 1240. Murcia was plundered by General Sebastiani in 1810, and in 1812 suffered from the attack of a detachment of Soult's army. On the 21st of March 1829 an earthquake caused a good deal of damage in the city, the cathedral being much injured. Pop. (1844) 55,053.

MURE, SIR WILLIAM, a Scottish poet, was the eldest son of Sir William Mure of Rowallan, and was born about 1594. Before his twentieth year he had written some English verses, and had attempted a version of the story of Æneas and Dido. In 1617 the visit of the King to Scotland called forth from Mure a poetical address, which is still preserved in the collection entitled *The Muse's Welcome.* For some time after the death of his father he passed his days in rural retirement, adorning the grounds and mansion of his family estate. The outbreak of the civil commotions of 1637 summoned him to action. Adopting the popular side, he served in the first army that was raised against the King, sat in the convention that ratified the Solemn League and Covenant with England in 1643, joined the parliamentary troops in the following year, and was wounded at Long Marston Moor. Sir William Mure died in 1657. Some of his poems, and an account of his life, are given in a book entitled *Ancient Ballads and Songs, chiefly from Tradition, Manuscripts, and scarce Works, with Biographical and Illustrative Notices, including Original Poetry,* by Thomas Lyle, London, 1827.

MURET (or MURETUS), MARC ANTOINE, a celebrated grammarian, was born at the town of Muret, near Limoges, in 1526. At an early age he cast off the uncongenial discipline that his teachers imposed upon him, and resolved to educate himself. Under the friendly eye of the elder Scaliger his progress in classical studies was so rapid, that at the age of eighteen he was invited to deliver lectures on Cicero and Terence at the college of Auch. After passing the next few years in teaching the ancient languages at Villeneuve-d'Agen, Poictiers, and Bordeaux, he was promoted to the chair of philosophy and civil law in the college of St Barbe at Paris. His lectures soon attracted notice by the lucid, elegant, and flowing style in which they set forth the most uninteresting legal details. Numbers, including the King and Queen, flocked to hear them. Yet envy at length marred his popularity by accusing him of the most unnatural sensuality. He was thrown into prison, and was on the eve of destroying himself, when the exertions of his friends secured his liberation. Retiring to Toulouse, he was pursued by the calumny, and barely escaped being burnt as a sodomist and heretic. His next place of refuge was Venice. There he published several of those clear and learned commentaries on the classics which constitute the corner-stone of his fame. But there also the relentless scandal found him out and drove him to Padua. By this time his character was gradually vindicating itself; his accomplishments were recommending him to the friendship of eminent literary men; and the malicious

whisperings of his former friends, Lambin and the younger Scaliger, were in vain attempting to re-kindle the flame of persecution against him. In 1559 he was invited to Rome to take up his abode at the court of Cardinal Ipolito d'Este, a munificent patron of letters. The rest of his life was passed in unclouded prosperity. He was caressed by popes and cardinals, crowded audiences applauded his lectures on philosophy and theology, and when he entered into holy orders in 1576 several rich benifices were provided for him. He died at Rome in June 1585. Regarding his rhetorical powers, his pupil Montaigne represents him as that "Marc Antoine Muret whom France and Italy recognised for the best orator of his time." A collection of his works, published by Ruhnken, in 4 vols. 8vo, Leyden, 1789, contains, among other productions, *Juvenilia et Poemata Varia; Variæ Lectiones; De Origine Juris; De Legibus et Senatusconsultis; Notæ in Justitiani Institutiones;* and *Orationes.* The verses of Muret are nothing higher than a collection of poetical expressions hiding prosaic and common-place ideas. His notes and commentaries, however, on ancient authors are still valuable.

MURET, a town of France, in the department of Upper Garonne, is situated at the confluence of the Bheze and the Garonne, 11 miles S.S.W. of Toulouse. It is well built, principally of brick; and has manufactures of woollen stuffs, leather, earthenware, and brandy; and a considerable trade in cattle. It is celebrated in history for the siege it sustained in 1213 from Peter II. of Aragon, and for the battle fought in the same year, beneath its walls, between that monarch and Simon de Montfort, in which the former was defeated and lost his life. Pop. 4213.

MURILLO, Bartolomé Éstevan, the greatest ecclesiastical painter of Spain, was the son of Gaspar Éstevan and Maria Perez, and was born at Seville in 1617. In accordance with a frequent Andalusian custom, he assumed the surname of his maternal grandmother, Elvira Murillo, in addition to that of his father. His parents having been struck with the precocious sketches with which the boy was accustomed to adorn whatever available surface came in his way, wisely resolved to place him under the care of their relative, Juan del Castillo, the painter. Juan taught him all the mechanical parts of his profession with extreme care, and Murillo proved himself an apt and docile pupil. The artistic appliances of his master's studio were by no means abundant, and were often of the simplest kind. A few casts, some stray fragments of sculpture, and a lay figure, formed the principal aids available in those days for the Sevillian student of art. A living model was a luxury generally beyond the means of the school; but on great occasions the indefatigable youths would strip in turn, and lend an arm or a leg to be studied by their fellows. Objects of still life, however, were much studied by Murillo, and he early learned to hit off, with genial humour, the ragged urchins of Seville pursuing their adventures in the market-place. Murillo in a few years painted as well as his master, and equally as stiff. His two pictures of the Virgin, executed during this period, show how thoroughly he had mastered the style of his instructor, with all its defects. Castillo, however, although not a first-rate artist, was a very kind man, and his removal to Cadiz in 1639–40 threw his favourite pupil entirely upon his own resources. The fine school of Zurbaran was too expensive for the poor lad: his parents were either dead or too poor to help him; and he was compelled to earn his bread by painting rough pictures for the *Feria* or public fair of Seville. The religious daubs exposed at that mart were generally of as low an order as the prices paid for them by their rude purchasers. A *pintura de la feria* (a picture of the fair) was a proverbial expression for an execrably bad one; yet the street painters who thronged the market-place with their "clumsy saints and unripe Madonnas," not unfrequently rose to be able and even famous artists. This rough-and-ready practice of the market-place doubtless increased Murillo's manual dexterity; but if we may judge from the picture of the "Virgin and the Child," still shown in the Murillo-room at Seville, as belonging to this period, he made but little improvement in colouring or in general strength of design. Struck by the favourable change which travel had wrought upon the style of his brother artist Pedro de Moya, Murillo in 1642 resolved to make a pilgrimage to Flanders or Italy in quest of further insight into the mysteries of his art. But how was he, already struggling for existence, and with a poor sister dependent on him, to raise the means necessary for such an expedition? The problem was a difficult one, but he gave it a brave solution. Having bought a large quantity of canvas, he cut it into squares of different sizes, which he converted into pictures of a kind likely to sell. The American traders at once bought up his pieces, and he now found himself sufficiently rich to carry out his much-cherished design. He placed his sister under the care of some friends, and without divulging his plans to any one, set out for Madrid. On reaching the capital, he waited on Velasquez, his fellow-townsman, the great court painter, then at the summit of his fortune; and communicating to him his simple story, asked for some introduction to friends at Rome. The great artist liked what he saw of the manly youth, and in the noblest manner offered him lodging in his own house, and proposed to procure him admission to the royal galleries of the capital. Murillo accepted the generous offer, and here enjoyed the masterpieces of Italy and Flanders without travelling beyond the walls of Madrid. The next two years were chiefly spent in copying from Ribera, Vandyck, and Velasquez; and in 1644 he so greatly astonished the latter with some of his efforts, that they were submitted to the inspection of the King and the court. His patron now earnestly entreated him to go to Rome, and offered him letters to smooth his way; but Murillo, from whatever cause, preferred returning to his sister and to his native Seville.

The friars of the convent of San Francisco in Seville had about this time piously determined to adorn the walls of their small cloister in a manner worthy of their patron saint. The idea was a good one, but the brotherhood had no money; and after endless begging, they still found themselves incapable of employing an artist of name to execute the task. Murillo was needy, and offered his services; and after duly balancing their own poverty against his obscurity, the good friars ruefully shook their heads, and bade him begin. Like the rest of their fellow-mortals, they were but short-sighted, and little dreamt of the fame which was in store for the little cloister of Saint Francis. Murillo covered its walls with eleven large pictures of remarkable power and beauty,—displaying by turns the rich, strong colouring of Ribera, the life-like accuracy and truthfulness of detail of Velasquez, and the heavenly sweetness of Vandyck. Among them were to be found representations of San Francisco, of San Diego, of Santa Clara, and of San Gil. These pictures were executed in his earliest style, commonly called his *frio*, or cold style. It was, according to Ford, based on Ribera and Caravaggio, and was dark, with a decided outline. This rich collection is no longer to be met with at Seville. Soult, that ruthless plunderer of churches and hospitals, carried off ten of them, and Mr Ford is now in possession of the eleventh. The fame of these striking productions soon got abroad, and *El Claustro Chico* swarmed daily with artists and critics. Murillo was no longer friendless and unknown. The rich and the noble of proud and opulent Seville overwhelmed him with their commissions and their praises. He found that, after all, the distance was not so great between the squalid Feria and the temple of Fame. But genius has always a curious art of discovering the shortest road to eminence.

In 1648 Murillo married a rich and noble lady, Doña

Beatriz de Cabrera y Sotomayor, of the neighbourhood of Seville, and his house soon became the favourite resort of artists and connoisseurs. About this time he painted the well-known "Flight into Egypt," and shortly afterwards changed his earliest style of painting for his *calido*, or warm style. His drawing was still well defined, but his outlines became softer, his figures rounder, and his colouring gained in warmth and transparency. His first picture of this style, according to Cean Bermudez, was a representation of "Our Lady of the Conception," and was painted in 1652 for the brotherhood of the True Cross, for which he received 2500 reals (L.26). In 1655 he executed his two famous paintings of San Leandro and San Isidoro, at the order of Don Juan Federigo, Archdeacon of Carmona, which are now to be seen in the cathedral of Seville. These are two noble portraits, finished with great care and admirable effect, but the critics complain of the figures being rather short. His next picture, "The Nativity of the Virgin," painted for the Chapter, is regarded as one of the most delightful specimens of his *calido* style. In the following year (1656) the same body gave him an order for a large picture of "San Antonio de Padua," for which he received 10,000 reals (L.104). This is one of his most celebrated performances, and still hangs in the baptistry of the cathedral. It was, however, "repaired" in 1833, which of course did *not* improve it. The grandeur of the design, however, and the singular richness of the colouring, may still be traced. The same year saw him engaged on four large pictures of a semicircular form, designed by his fast friend and patron, Don Justino Neve y Yevenes, to adorn the walls of the church of Santa Maria la Blanca. The first two were meant to illustrate the history of the festival of "Our Lady of the Snow." The one represents the wealthy but childless Roman senator and his lady asleep and dreaming; the other exhibits the devout pair relating their dream to Pope Liberius. Of these two noble paintings, the Dream is the finest, and in it is to be noticed for the first time the commencement of his third and last style, known as the *vaporoso*, or vapoury. Here the well-marked outlines and careful drawing of his former styles disappear; the outlines are lost in the misty blending of the light and shade, and the general finish betrays more haste than was usual with Murillo. Want of time may have had much to do with it, as in the case of our own Turner and Wilkie. After many changes of fortune, these two pictures now hang in the Academy of San Fernando at Madrid. The remaining pieces executed for this small church were, "A Virgin of the Conception," and a figure of "Faith." "That well-known French dealer," Soult, laid his hands on these also, and they have not been recovered.

In 1658 Murillo undertook and consummated a task which had hitherto baffled all the artists of Spain, and even royalty itself. This was the establishing of a public academy of art. By superior tact and good temper he overcame the vanity of Valdés Leal and the presumption of the younger Herrera, and secured their co-operation. The Academy of Seville was accordingly opened for the first time on the 1st of January 1660, and Murillo and Herrera the Second were chosen presidents. The former continued to direct it during the following year; but the calls of his studio induced him to leave it, now flourishing and prosperous, in other hands.

Passing over some half-length pictures of saints, and a charming dark-haired "Madonna," painted in 1668 for the chapter-room of the cathedral of his native city, we enter upon the most splendid period of Murillo's splendid career. In 1661 Don Miguel Mañara Vicentelo de Leca, who had recently turned to a life of sanctity from one of the wildest profligacy, resolved to raise money for the restoration of the dilapidated Hospital de la Caridad, of whose pious guild he was himself a member. Mañara commissioned his friend Murillo to paint eleven pictures for this edifice of San Jorge. Three of these pieces represented "The Annunciation of the Blessed Virgin," "The Infant Saviour," and "The Infant St John." The remaining eight also treat of scriptural scenes and subjects, and are considered Murillo's masterpieces. They consist of "Moses striking the Rock," the "Return of the Prodigal," "Abraham receiving the Three Angels," "The Charity of San Juan de Dios," the "Miracle of the Loaves and Fishes," "Our Lord healing the Paralytic," "St Peter released from Prison by the Angel," and "St Elizabeth of Hungary." These works occupied the artist four years, and in 1674 he received for his eight great pictures 78,115 reals, or about L.800. The "Moses," the "Loaves and Fishes," and the "San Juan," are still to be found at Seville; but the French carried off the rest. On these pictures Murillo evidently expended all his strength, and he has left in them an enduring monument of the grandeur of his genius. For compass and vigour the "Moses" stands first; but the "Prodigal's Return," and the "St Elizabeth," are said by Bermudez to have been the most perfect of all as works of art. They can never, however, display the same excellences elsewhere as when hanging in the light and position which the artist designed them to occupy. The front of this famous hospital was also indebted to the genius of Murillo. Five large designs in blue glazed tiles were executed from his drawings. He had scarcely completed the splendid undertakings for this edifice, when his favourite brown-frocked Franciscans again solicited the aid of his pencil. He accordingly executed some twenty paintings for the humble little church known as the Convent de los Capuchinos. Seventeen of those Capuchin pictures are still preserved at the Museum of Seville. Of these the "Charity of St Thomas of Villaneuva" is reckoned the best. Murillo himself was wont to call it "*su lienzo*" (his own picture). Another little piece of extraordinary merit, which once hung in this church, is the "Virgin of the Napkin," believed to have been painted on a *servilletta*, and presented to the cook of the Capuchin brotherhood as a memorial of the artist's pencil.

In 1670 Murillo is said to have declined an invitation to court, preferring to labour among the brown coats of Seville. Eight years afterwards, his friend the Canon Justino again employed him to paint three pieces for the Hospital de los Venerables. They were severally the "Mystery of the Immaculate Conception," "St Peter Weeping," and "The Blessed Virgin." The last mentioned is said by Mr Townsend, an eminent critic, to be the most charming of all the works of this artist. (*Journey through Spain in* 1786-7, vol. iii., p. 297.) As a mark of esteem, he next painted a full-length portrait of his patron the Canon Neve, in which all the artist's skill is visible. The sleek spaniel reposing at the feet of the priest has been known before now to call forth a snarl from a living dog as he approached it. His portraits generally, though few, are of great beauty. Towards the close of his life Murillo executed a series of pictures illustrative of the life of "the glorious doctor" for the Augustine convent at Seville. This brings us to the last work of this great artist. Mounting a scaffolding one day at Cadiz to execute the higher parts of a large picture of the "Espousals of St Catherine," on which he was engaged for the Capuchins of that town, he stumbled, and fell so violently, that he received a hurt from which he never recovered. The great picture was left unfinished, and the artist returned to his beloved Seville only to die. He died as he had lived, a humble, pious, brave man, on the 3d of April 1682. He left behind him two sons and a daughter, his wife having died before him. His body was laid in the church of Santa Cruz, and by his own desire was covered with a stone slab bearing his name, a skeleton, and the words "*Vive moriturus.*" Soult and his Vandals sacked this church, and nought is to be seen of it now but a heap of rubbish. Digging through this heap in 1823, the Sevillians found a quantity of bones in a vault, which

they piously closed up again. Let us hope that no foot stirs rudely that mound of ruins where rest the ashes of Murillo.

If Velasquez holds the first place as the Spanish court painter,—as the delineator of masculine and intellectual subjects,—Murillo has the undoubted pre-eminence as the religious artist,—as the painter of female and infantine grace. Of the old masters, and of what is called the antique, Murillo knew little. He painted only what he saw; and hence all his works are intensely Spanish. His representations of his favourite subject, "The Immaculate Conception," stand unrivalled for grace and feeling; and hence the epithet often applied to him of "*El Pintor de las Concepciones*." As a painter of landscapes he stands next to Velasquez among Spanish artists. Sir David Wilkie, in comparing these two great painters, remarks, "Velasquez, by his high technical excellence, is the delight of all artists; Murillo, adapting the higher subjects of art to the commonest understanding, seems of all painters the most universal favourite." (*Life of Wilkie*, vol. ii., p. 475.) (For further information respecting Murillo and his works, consult, especially, Stirling's *Annals of the Artists of Spain*, 3 vols., London, 1848; and the *Handbook for Spain*, by Richard Ford, London, 1855. For Murillo's position in the history of art, see FINE ARTS, and PAINTING.)

MUROM, a town of Russia, in the government of Vladimir, and 75 miles S.E. of the town of that name, stands on the left bank of the Oka. It has 18 churches, one of which is a cathedral. Leather and soap are the principal articles manufactured here; and in the neighbourhood there are rich iron mines. Some trade is carried on in corn. Pop. (1849) 9109.

MUROS, a town of Spain, in the province of Gallicia, pleasantly situated on a bay of the same name, 55 miles S.W. of Coruña. The houses are old, and many of them in ruins. There are two principal streets and three squares; and the town contains several churches, a court-house, custom-house, prison, and school. Fishing and the manufacture of linen are carried on here; and there is some trade. The harbour is defended by a fort, but it is suitable for small vessels only. Pop. 4792.

MURPHY, ARTHUR, a dramatist, was the son of a Dublin merchant, and was born near Elphin, in the county of Roscommon, in 1727. From 1740 to 1747 he was a student of St Omer's College. He then entered the counting-house of his uncle, a merchant at Cork. But four years afterwards he was in London prosecuting literature as a profession, and publishing *The Gray's Inn Journal*, a periodical in the style of *The Spectator*. The drama was also occupying his attention. He produced the farce of *The Apprentice*, and appeared as an actor in the character of "Othello." His dramas were more successful than his acting. After treading the stages of Covent Garden and Drury Lane for one season each, he abandoned the profession. His next undertaking was the editing of a political periodical called *The Test*. In this, too, he was unsuccessful. He next turned his attention to the study of law, and was called to the bar by the Society of Lincoln's Inn in 1757. But the smallness of his practice forced him to have recourse to his former vocation of writing for the stage. Among his many popular dramas, *The Upholsterer*, in 1758; *The Way to Keep Him*, in 1760; *All in the Wrong*, in 1761; *The Grecian Daughter*, in 1772; and *Know your own Mind*, in 1777, were very successful, and secured for their author both fame and wealth. He also published in 1792 an *Essay on the Life and Genius of Dr Johnson*, and in the following year a translation of Tacitus. Towards the close of his life the office of a commissioner of bankrupts, and a pension of L.200, were conferred upon him by government. He died in June 1805.

MURPHY, *James Cavanah*, an architect and antiquary, was born in Ireland, probably about the middle of the eighteenth century, and resided for some time in Dublin. In 1789 he repaired to Portugal for the express purpose of examining the curious and uncommon Gothic architecture of the church of Batalha. His attention was also directed to the manners, trades, arts, and antiquities of the Portuguese provinces through which he passed. After his return he published, in 1792–96, *Plans, Elevations, Sections, and Views of the Church of Batalha*; in 1795, *Travels in Portugal*; and in 1798, *A General View of the State of Portugal*. These works were favourably received by the public, and their author was thus encouraged to proceed in the same line of research. Landing in Spain in 1802, he devoted the next seven years to the study of the architecture, arts, customs, and history of that country. The results of this investigation were published under the titles of *The Arabian Antiquities of Spain*, 1815; and *The History of the Mahometan Empire in Spain*, 1816. During the publication of this latter work Murphy died.

MURPHY, *Robert*, a mathematician, was the son of a poor shoemaker, and was born at Mallow in Ireland in 1806. At the age of thirteen, while working as an apprentice in his father's shop, he became known to certain gentlemen in the neighbourhood as a self-taught mathematician of wonderful precocity. Through their exertions, after attending a classical school in his native town, he was admitted to Caius College, Cambridge, in 1825. His talents gained for him the degree of B.A., and the position of third wrangler in 1829. He was elected in the same year a fellow, and in 1831 the dean of his college. But the temptations of prosperity were too strong for him. A course of extravagant dissipation soon led him into debt; his fellowship was sequestered for the behoof of his creditors; and he was obliged to leave Cambridge in December 1832. After living for some time with his relations in Ireland, he repaired to London in 1836, a penniless literary adventurer. He had already contributed several mathematical papers to the *Cambridge Philosophical Transactions*, and had published a work on Electricity, 8vo, Cambridge, 1833. His pen was now employed in writing for the "Library of Useful Knowledge" a *Treatise on the Theory of Algebraical Equations*. This work was published at London in 1839. He was labouring diligently to throw off the load of debt that still pressed heavily upon him, when a disease of the lungs cut short his career in March 1843.

MURRAY, DR ALEXANDER, an eminent philologist, was the son of a shepherd, and was born at Dunkitterick, in the Stewartry of Kirkcudbright, in October 1775. His elementary education was almost entirely self-acquired. The few books that a peasant's cot possessed were conned over with eager avidity as he sat by the family hearth in the evening, or lay amid his flock on the hillside during the day. At length, in 1789, he was enabled to attend the school of Minnigaff. The next five years were spent by him in studying in the school during the summer, in teaching the children of neighbouring families during the winter, and in greedily devouring knowledge at every opportunity. Books of all kinds were bought or borrowed; grammars and dictionaries of several languages, old and obscure treatises, histories, and poems, were perused and re-perused; he acquired a knowledge of the French, Latin, Greek, and Hebrew languages, and of the Anglo-Saxon, Welsh, and Arabic alphabets; he also wrote and prepared for publication a volume of poems. In 1794 his fame as a self-taught scholar, which had for some time been spreading in the neighbourhood, reached the ears of the Rev. Dr Baird of Edinburgh. By that gentleman's assistance he was enabled forthwith to enter the metropolitan university. In the course of two years a bursary was conferred upon him, and he began to study for the church. Though compelled to earn a scanty livelihood by giving private lessons, he continued, during every spare hour, to cultivate his literary

Murray. tastes, and to gratify his ever-growing desire for general information. He contributed several miscellaneous articles to the *Scots Magazine* and the *Edinburgh Review*. He also acquired an intimacy with all the European languages, and with the Geez, Amharic, and Abyssinian dialects. His knowledge of the last of these tongues recommended him, in 1802, for the task of editing Bruce's *Travels*. The edition appeared three years afterwards, in 7 volumes 8vo, accompanied by a Life of the author, and by copious philological and antiquarian notes. Shortly after this, in 1806, Murray was ordained assistant and successor to the minister of Urr in the Stewartry of Kirkcudbright, and succeeded to the sole charge of this parish in 1808. Meanwhile his edition of Bruce's *Travels* had been extending the fame of his scholarship, and had been opening up a road to honour and preferment. Accordingly, in 1811 he was employed to translate a Geez letter that had been sent to the king from the governor of Tigré; and in 1812 he was elected to the chair of oriental languages in Edinburgh. The degree of D.D. was also conferred upon him. Murray had now attained his proper position in life. At the same time, the stores of learning which his daily and nightly studies had amassed were beginning to assume a tangible form in a *History of the European Languages*. He set himself to his academical duties with more than his wonted enthusiasm. But long before the end of his first session his toil-worn constitution broke down, and he died in April 1813, at the age of thirty-seven. His philological work was edited in the same year by Dr Scot of Corstorphine. Another work of Murray's, *The Outlines of Oriental Philology*, had appeared in 1812.

Murray, *John*, an eminent chemist, was born in Edinburgh in 1778, and became a pupil of the celebrated Dr Joseph Black. Murray commenced his career as an apothecary in his native city; but soon began to give chemical lectures, which were remarkable for clearness of diction and a happy mode of illustration; so that he was justly considered one of the ablest and most popular teachers of chemistry in the present century. His *System of Chemistry*, in 4 vols. 8vo, went through four large editions, and was regarded as one of the very best works on the subject of that period. The first volume contains a very admirable statement of the doctrines of heat in relation to chemistry, as promulgated by Black and later philosophers. His smaller work, entitled *Elements of Chemistry*, in 2 vols., was also very popular. Dr Murray afterwards gave annual courses of materia medica and pharmacy, which were numerously attended; and he published a good *System* of those branches of medicine, which went through two editions. The publication of Playfair's admirable *Illustrations of the Huttonian Theory of the Earth*, in 1802, quickly called forth Murray's *Comparative View of the Huttonian and Neptunian Theories*. He was a zealous defender of the latter; and although the igneous origin of mineral bodies is now generally received, Murray has given us by far the best and most ingenious defence of the Neptunian doctrines ever given to the world. Dr Murray was the author of several papers in the *Transactions* of the Edinburgh Royal Society; one of the most interesting of which is "The Analyses of several Mineral Waters," in which he showed how salts obtained by their evaporation may be different from those actually dissolved in the waters. Dr Murray was much respected and esteemed by those who best knew him. He died prematurely, of disease of the heart, on 22d June 1820. (T. S. T.)

Murray, *John*, an eminent publisher, was the son of John M'Murray, a bookseller in Fleet Street, London, and was born in November 1778. His education was received at the High School of Edinburgh and at several seminaries in England. In his fifteenth year he was left, by his father's death, to conduct the business, with the assistance of the shopman, Mr Highley. On his coming of age, he made his assistant a partner. The partnership, however, was dissolved in 1803; and Murray began a career of publication unrivalled in the history of literature. His acuteness in detecting the merits of an author, and his knack of discerning the taste and wants of the public, soon rendered him one of the most successful of publishers. In 1807 he suggested to Canning the project of establishing a Tory periodical that might prove a worthy rival to the *Edinburgh Review*. The plan received the approval and hearty co-operation of Walter Scott in 1808; and in 1809 Murray published the first number of the *Quarterly Review*. In 1810 he sought the acquaintance of Lord Byron, whose high poetical powers were not yet recognised, made him a liberal offer for the first two cantos of *Childe Harold*, and commenced a literary connection with him which increased the fame of both publisher and poet. To other eminent authors he was equally generous. They received princely sums for the copyrights of their works. If the sale surpassed expectation, the stipulated price was increased, and sometimes even doubled. Such generous and highly honourable conduct soon raised Murray to the position of a patron of literature. Authors began to frequent the shop in Albemarle Street, to which he had removed in 1812. In his little back parlour there might have been seen of an afternoon such men as Byron, Scott, Crabbe, Southey, Washington Irving, and Lockhart, enjoying the racy and humorous conversation of the publisher. Among the many undertakings which he continued to conduct was the *Family Library*, begun in 1829. He sometimes published with great success works, such as the *Sketch-Book*, which had proved failures in the hands of other publishers. He died in June 1843, leaving his trade to his son, the present Mr John Murray. Murray.

Murray, *Lindley*, the author of a well-known English Grammar, was born at Swatara in Pennsylvania in 1745. After receiving his education at Philadelphia and New York, he entered his father's counting-house; but afterwards studied law, and practised at the bar until the breaking out of the war of independence, when he became a merchant, and soon amassed a handsome fortune, which enabled him to retire. He spent the remaining years of his life in England; and wrote *The Power of Religion on the Mind* in 1787, and his *English Grammar* in 1795. Several other school-books, both English and French, followed. His last publications were *A Selection from Horne's Commentary on the Psalms*, 12mo, 1808; and *The Duty and Benefit of a Daily Perusal of the Scriptures*, 1817. He died in February 1826. Memoirs of Lindley Murray were published by Elizabeth Frank, 8vo, York, 1826.

Murray, *Sir Robert*, one of the founders of the Royal Society, was the son of Sir Robert Murray of Craigie, and was born about the beginning of the seventeenth century. After serving in the French army, and rising to the rank of colonel, he returned to Scotland during the civil broils, and became an ardent and trustworthy supporter of Charles I. The downfal of the royal cause compelled him to betake himself once more to France. He appears to have dwelt there, and to have held a commission in the French army until Charles II. placed himself at the head of the Scots in 1650. His loyalty was rewarded in the following year by his being promoted to the important offices of justice-clerk and a lord of session in Scotland. These appointments, rendered null and void by the complete overthrow of the King's cause at Worcester, were confirmed on the restoration in 1660. It was at this time that Sir Robert Murray began to take a prominent part in a small club that had been founded by Robert Boyle, Lord Brounker, and others, for the discussion of natural science, or, as it was then called, "the New Philosophy." He was present at the meeting of the 28th November 1660, when it was proposed

"that some course might be thought of to improve this meeting to a more regular way of debating things." He undertook to advocate this proposal to the court. His suit was successful; an encouraging answer was returned by the government; and on the 15th July 1662 the club was incorporated by charter under the designation of "The Royal Society." Sir Robert was its first president. During the rest of his life he continued to be one of its most active members, and delivered before it several learned papers. He died in June 1673. Sir Robert Murray is described by Burnet, in his *History of My Own Times*, as "the wisest and worthiest man of that age."

MURRAY, *William*, Earl of Mansfield, a celebrated English lawyer, was the fourth son of David, Earl of Stormont, and was born at Perth on 2d March 1705. He received his education in England, first at Westminster School, and subsequently at Christ Church College, Oxford, where he took the degree of Bachelor of Arts in 1727, and that of Master in 1730. Having completed his academical studies, he shortly after became a member of Lincoln's Inn. Being called to the bar, Murray early acquired reputation as a speaker, and obtained a good practice in his profession. As early as 1736 we find him professionally employed against the bill of pains and penalties, which afterwards passed into a law, against the city of Edinburgh on account of the riotous murder of Captain Porteous. In 1738 he married Elizabeth, daughter of the Earl of Winchelsea; and in 1742 he was appointed solicitor-general, and chosen representative of Boroughbridge, for which place he was afterwards returned in 1747, and again in 1754. In 1748 he acted as one of the managers for the impeachment of Lord Lovat by the Commons, and in his observations on the evidence, in reply to the prisoner, displayed singular candour and ability.

In 1754 Mr Murray was appointed attorney-general in the room of Sir Dudley Ryder; and in 1756 he succeeded the same person as chief justice of the King's Bench. He took his seat on the bench on the 11th of November, and was immediately afterwards raised to the peerage by the title of Baron Mansfield. Owing to various reforms which he introduced, the business of the court increased to an extent never before known, and continued to be despatched with exemplary regularity. It is stated by Sir James Burrow, in the preface to his Reports, that at the sitting for London and Middlesex there were as many as eight hundred causes set down in a year, "and all disposed of."

During the very unsettled state of the ministry in 1757 Lord Mansfield accepted the office of chancellor of the exchequer, and was the means of effecting a coalition of parties, out of which was formed a strong and successful administration. In the same year he was offered the great seal, on the retirement of Lord Hardwicke, but declined it. His political sympathies were not on the popular side, and at the commencement of the reign of George III. he was marked out as an object of party rancour, and continued for many years exposed to violent and unsparing invective, the most vigorous specimens of which have come down to us in the *Letters of Junius*. The affair of Mr Wilkes' outlawry served to rekindle the animosity with which he had been regarded by the popular party, and exposed him to renewed attacks. On the day when judgment was to be given on this case, not only the court, but the whole of Westminster Hall and Palace Yard, were crowded with anxious spectators. Lord Mansfield took notice of the popular excitement which had been directed against the judges of the court, particularly himself; and declared his contempt for all the threats which had been employed to deter the court from doing their duty. "I honour the King," said he, "and respect the people; but many things acquired by the favour of either are, in my account, objects not worth ambition. I wish popularity; but it is that popularity which follows, not that which is run after."

In the beginning of 1770 Lord Mansfield was once more offered the great seal, which he again declined; and a similar offer, renewed the following year, found him equally inflexible. About the same time he was attacked, in both Houses of Parliament, on account of his direction to the jury in the case of Woodfall the printer, who had been prosecuted for a libel. He maintained the dangerous principle that the question of law belonged exclusively to the court, and that the only point competent for the jury to try was merely the fact of publication, leaving it to the judges afterwards to decide whether the matter published did or did not amount to a libel. In 1776 his lordship was raised to the dignity of earl.

During the excitement and lawlessness of June 1780 Lord Mansfield was marked out as an object of popular vengeance, and his house in Bloomsbury Square, with every thing it contained, including his library and manuscripts, were wholly consumed. His lordship submitted to his loss with calmness and dignity, and declined a proposed indemnification by the House of Commons.

From this time it seemed as if popular hatred had spent its force; and during the remainder of his life all parties united in a common feeling of respect and reverence for his character and virtues. Notwithstanding his advanced age, he continued until 1787 to discharge his judicial functions with his wonted regularity; but from that time his infirmities increased so rapidly, that in June 1788 he came to the resolution of resigning his office, and withdrawing into the shade of retirement. His health continued to decline, but his mental faculties remained unimpaired almost to the last. He died on the 20th of March 1793, in the eighty-ninth year of his age, leaving his immense fortune to his nephew Lord Stormont, who also, in virtue of a new patent granted in 1792, succeeded to his title.

As a politician, Mansfield had too little courage to be the leader, and too much ability to be the dupe, of any party. He was not a forward nor a frequent speaker, but reserved himself for occasions worthy of himself, and never spoke except on subjects which he had carefully considered. In debate he was eloquent as well as judicious; displaying wisdom and good sense, set forth in the clearest method. He affected no sallies of imagination nor bursts of passion, and he never condescended to personal abuse or virulent altercation. His character as a judge has always stood high, although his legislation was more successful in commercial law than in that of real property; and the depth of his legal learning has been frequently questioned. He was tolerant in matters of religion; and in private life he was easy, friendly, and engaging; extremely sensible of worth in other men, and ready upon all occasions to countenance and patronize it. (See *Life of Lord Mansfield*, by Henry Roscoe, in Lardner's *Cabinet Cyclopædia*.)

MURRAY, the principal known river of Australia, rises in the Australian Alps, or Warragong Mountains, in S. Lat. 36. 20., E. Long. 148. 15. It flows in a very irregular course towards the N.W., forming the greater part of the boundary between New South Wales and Victoria. In E. Long. 142. it takes a general direction towards the W., in 140. it turns S.S.W., and finally falls into Lake Victoria, and through it into the ocean, in S. Lat. 36. 30., and E. Long. 139. This river and its tributaries water a most extensive tract of country, comprising the whole of Victoria and New South Wales, with the exception of a narrow strip that extends along the coast. The length of the main river is not more than 700 miles; and though several of its affluents much exceed it in the length of their course, yet they are all inferior to it in the volume and rapidity of their water. Not far from its source it has a breadth of 100 yards; and in 143. E. Long., where it receives the Murrumbidgee, it is three or four times as broad. From its junction with the Darling, in E. Long. 142., to its mouth, the breadth of the river is on an average from 100

to 150 yards; and where it enters Lake Victoria it is about 200 yards wide, and often as deep as 10 fathoms. Thus, like most of the rivers of Australia, the Murray, while broad, full, and rapid in the higher parts of its course, becomes gradually less as it approaches the sea, receiving no tributaries for a considerable distance above its mouth, and flowing through a marshy and alluvial soil. The plain through which the Murray flows is in general low and flat, slightly sloping towards the sea, and in about 144. E. Long. the course of the river winds through extensive tracts of reeds. Further down, the banks are lined for a very long distance with trees, which give to the river the appearance of an avenue; and it is remarkable that the same kind of wood is never found on opposite sides. Below its junction with the Darling, the Murray forces its way between precipitous cliffs of limestone rock, which rise in some places to the height of 200 feet; but these, as the river approaches the coast, give place to lower undulating hills inclosing between them large tracts of marshy land overgrown with reeds. The river is very much subject to floods. Its annual rise is about 16 or 20 feet; but the waters of the Murrumbidgee frequently cause it to rise 30 or 40 feet above its usual level. When the river is in flood, it is navigable as far up as Albury, about 90 miles from its source; and steamers and barges now ply regularly as far up as that place, when there is sufficient depth of water, which is about six months in the year. The entrance into Lake Victoria from the sea is difficult, if not dangerous, owing to the violent surf and to the constant changes in the position of the channel, which is also very shallow. In order to avoid the inconveniences of this navigation, a tramway has been constructed for a distance of 8 miles, between Goolwa, on the Murray, and Port Elliot, on the ocean. This is now working in connection with the river steamers.

The tributaries of the Murray form the greater part of the entire system of that river. The Murrumbidgee rises in the same mountains as the Murray, a short distance to the north of that river, and flows for the most part of its course in a direction nearly parallel. The country through which it flows resembles, in its low, flat character, that near the Murray; and it passes through many tracts of marshy and reedy ground in its course. As it proceeds westward it is gradually diminished in volume and rapidity, and finally discharges its waters into the Murray. The Lachlan River rises in the mountains to the west of Sydney, and flows first W. and then S.W., until it is lost in marshes which are drained by the Murrumbidgee. The Macquarie rises in the same chain of mountains farther to the N., and flows in a N.E. direction; but it soon becomes gradually less, till it is absorbed in an extensive morass. The longest of the affluents of the Murray is the Darling, a river which rises in the N.E. of New South Wales, and flows in an irregular course towards the S.W., till it falls into the Murray. In the upper part of its course it receives many tributaries, of which the principal are the Balonne, from the N., which falls into it by several branches, and the Macquarie from the S.E., through the marshes in which that river ends. It also receives the River Bogan, which runs parallel to the Macquarie; but in the lower part of its course it has no important tributaries. The water of the Darling is salt near its source, but below its junction with the Bogan it is fresh, and quite fit for drinking. The flats through which the Darling flows, near its union with the Murray, differ from those of the latter river in the beauty of their scenery, and in being covered, not with reeds, but with the most luxuriant vegetation. Its current here is generally sluggish, and its waters, which are muddy, do not in general contribute much to increase the volume of the Murray; but, like all the Australian rivers, it is subject to inundations, and is very variable in its condition, sometimes rising 3 or 4 feet in the course of twenty-four hours. Its banks, like those of the Murray, are thickly covered with timber. The navigation of the Darling is very uncertain; but it has been ascended as far as 30 miles above its confluence with the Murray. The basin of the Murray is bounded on the S. and E. by mountains, which skirt the coast, and which are known by various names at different parts. On the W. it is bounded by a range running N. and S., near the boundary between New South Wales and South Australia; and on the N. there is believed to be another range extending E. and W., and forming the watershed of the rivers of Australia. The general character of the basin of the Murray is flat. It is in some parts dry and destitute of water, and in others alluvial and marshy. The best part of this region is that at the N.E. corner, called Darling Downs, an extensive region of rich pasture grounds. This country seems to be very thinly peopled, and in some places, as far as the eye can reach, there is no trace to be seen of human habitations. This is almost the only portion of the interior of Australia that has been explored, and this has only been done in comparatively recent times. No attempt was made before 1813 to cross the mountains which form the eastern boundary of the Murray River system, and it was not till 1829 that its mouth in Lake Victoria was reached. In that year Captain Sturt followed the course of the Murrumbidgee from its source to the Murray, and that river down to the sea. The Lachlan and the Macquarie had been explored by Oxley in 1817 and 1818; and part of the upper course of the Darling was discovered by Sturt in 1828, who also penetrated, in 1844, for some distance up the Darling, and thence into the centre of Australia.

MURREE, in Hindustan, a sanatarium for British troops in the Punjab, situated on a hill between the rivers Indus and Jhelum, and established in the year 1851. The place is already attracting a considerable population. Barracks have been constructed, and houses are rising in every direction. Cherries, strawberries, raspberries, currants, apples, pears, and apricots are abundant. Elevation of the station above the sea, 7330 feet. Lat. 33. 54., Long. 73. 27.

MURVIEDRO (anc. *Saguntum*), a town of Spain, province of Valencia, is situated at the foot of a hill on the Palancia, 16 miles N. of Valencia. It is surrounded by Moorish walls, and there is a citadel on the summit of the hill. The town itself is irregularly built, with mean houses and narrow streets. It has two churches, several convents and hermitages, a town-house, custom-house, prison, hospital, schools, &c. Murviedro is more remarkable for its remains of antiquity than for any of its modern buildings; but most of these have been very much neglected, and many of the marble fragments have been built into modern edifices. The site of the ancient temple of Diana is now occupied by the convent of La Trinidad, which has several Roman inscriptions built into the wall. The plan of the ancient theatre may still be traced on the slope behind the town, and there are some remains of the circus in the neighbouring orchards. The inhabitants are chiefly employed in agriculture; but the town has several distilleries and flour and oil mills. The ancient town was a seaport, but the coast-line has now retired to the distance of 4 miles from the town. Corn, wine, fruits, and oil, from the surrounding country, are the principal exports. The fortifications are so strong that Murviedro is reckoned the key of Valencia. Pop. 5349.

MUSA, IBN NOSEYR, a famous Mohammedan conqueror, was the son of a liberated slave, and was born A.D. 640. At the court of Damascus he rose high in the favour of Abd-ul-aziz, the brother of the Caliph Abd-ul-malek. It is probable that he was early employed in high military offices; but not until his fifty-ninth year did his talents for war obtain full scope. He was then appointed governor of Eastern Africa, and was encharged with the subjugation of the wild tribes that bordered on that province. His armies, under

himself and his sons Abdullah and Merwan, were everywhere triumphant. They pursued the Berbers into their native deserts, and forced them to adopt the faith of Islam. Marching westward through Northern Africa, they did not halt in their victorious career until, in 709, they had stormed the cities of Tangiers and Ceuta, and had encamped by the shores of the Atlantic. At this juncture, when Musa was beginning to look around for new fields of conquest, his aid was solicited by the sons of Wittiza, the late King of Gothic Spain, who were endeavouring to wrest their father's crown from the brave usurper Roderick. The occasion was eagerly seized by the Mohammedan conqueror. An expedition was forthwith sent into Spain, and returned soon afterwards laden with booty. A still greater force, under Tarik Ibn Zeyad, landed at Gibraltar in April 711; and in September of the same year, Roderick was defeated and slain in a great battle on the banks of the Guadelete. No sooner had Musa heard of this victory, than, jealous lest he should be eclipsed by his own lieutenant, he commanded Tarik to prosecute his successes no further, and at the same time he set out in person for the scene of war. But long before his arrival, in 712, his orders had been disregarded, and Cordova, Malaga, Granada, Orihuela, and Toledo had been captured by the victorious troops. Chafing under this insult to his authority, he set himself with vigour to bring his reputation out of the shade into which it had been cast by the exploits of Tarik. Carmona, Seville, Beja, and Niebla fell before his attack. After an arduous siege he took Merida, and then marched towards Toledo to meet Tarik. No sooner had he met the disobedient lieutenant, than he struck him with his whip in the sight of the whole army, upbraided him for his neglect of orders, and threw him into prison. He was even meditating his death, when an order came from the caliph to set him at liberty and restore him to his command. Tarik was accordingly reinstated in the favour of his superior, and was placed at the head of a division. Then Musa prepared to subjugate the rest of the country. Entering Aragon, he marched northward, subduing Saragossa and its districts, and receiving the submission of the inhabitants. In a short time Spain was almost entirely under his power. His next enterprise was to cross the Pyrenees, and to make an inroad into France. But as he met with no encouraging success, he returned to Spain, and addressed himself to the invasion of Asturias and Galicia. An order from the caliph to repair to Damascus did not deter him from executing his project. He was at Lugo, in the midst of new conquests, when a second and more peremptory command reached him. With extreme reluctance he relinquished the design he had been entertaining of carrying his conquests westward through Gaul, Italy, and Germany, and of thus opening a direct communication between Syria and Spain. Consigning the government of Spain into the hands of his son Abd-ul-aziz, he embarked for Africa, on his way to the East, in 713. On his landing, he astonished the inhabitants of the districts through which he passed by the pomp of his march. Numerous waggons and camels, laden with costly spoils and treasures of gold, silver, and precious stones, went before him. Behind him marched in long array 30,000 captives, including 400 nobles in gorgeous attire. As he approached Damascus, he is said to have been met with the intelligence that the Caliph Alwalid was at the point of death, and that Suleyman, the heir to the crown, desired him to delay his entrance into the city, and the exhibition of the Spanish spoils, until the commencement of the new reign. This request Musa set aside, and marched straight into Damascus. Accordingly, on the death of Alwalid, the resentment of Suleyman fell heavily upon him. All those illustrious services by which he had added so many territories to the government of the caliph were forgotten. He was cast into prison, lacerated with scourges, and exposed to the sun till almost lifeless. A severe fine was then imposed upon him, which stripped him of his immense wealth, and left him to beg his bread from door to door. In the midst of his affliction, the head of his murdered son Abd-ul-aziz was shown to him by the tyrant. At length, overborne with misery and old age, Musa died at Wadal-Kora in 717. (See *History of the Mohammedan Dynasties in Spain*, London, 1840.)

MUSÆUS, an ancient Greek poet, flourished at Athens in the mystic period of Grecian history. Some legends represent him as the son of Orpheus. At any rate, he is generally supposed to have been the disciple and imitator of that famous poet. He presided over the Eleusinian mysteries, and in that capacity he composed and sung his hymns. A hill near the citadel of Athens, to which he was wont to resort for meditation and study, and on which he was afterwards buried, is said to have been called *Museium* after him. His works are only known in a few detached passages quoted by Plato, Pausanias, Clemens Alexandrinus, Philostratus, and Aristotle. They are said to have consisted of oracles, precepts addressed to his son Eumolpus, a hymn to Ceres, a theogony, a poem on the War of the Giants, a treatise entitled *Sphæra*, and a work on Mysteries.

MUSÆUS, a grammarian, supposed by the elder Scaliger to be the same as the preceding, is considered, from the internal evidence of his style, to have flourished in the later periods of the Roman empire. His only extant work, a poem on the famous love story of Hero and Leander, was first discovered in the thirteenth century; and ever since that time it has continued to be a great favourite with scholars. Among the many editions, those of Passow (Leipsic, 1810) and Schæfer (Leipsic, 1825) are the latest. It has been translated into English by Stapleton, into German by Stolberg and Passow, and into French by Marot. Marlowe's poem is rather a paraphrase than a translation of Musæus.

MUSCAT, or MASKAT, a city and seaport of Arabia, capital of Oman, is situated at the head of a small cove on the Indian Ocean, in N. Lat. 23. 38., E. Long. 58. 42. It is built along the shore in the form of a horse-shoe, and is surrounded by steep hills, through which it communicates with the interior by only one pass. These hills are occupied by a circle of forts, which defend the town, and, along with the domes and minarets of the mosques, present a very fine appearance when seen from the sea. The interior of the city, however, is very far from bearing out the impression which a distant view produces on the traveller; most of the houses being mere mat-built huts; and even the better class, of which there are a few, being seldom more than one storey in height. The streets are very narrow, and partly shaded from the sun by mats of palm-leaves laid across from roof to roof; and the numerous and generally crowded bazaars are extremely dirty. The principal buildings in Muscat are the residences of the imaum, of the governor, and of some of the other public officers. The heat in the town is extreme, in consequence of its being surrounded by bare rocks; the temperature is generally as high as 90° in the shade. The harbour is very good, being sheltered from every wind except the north; but with some winds it is not easy for vessels to enter. A little to the W. of Muscat is another bay, less sheltered, which opens to the N.E., and on which the town of Matarah stands. The climate here is more temperate; and here many of the rich merchants of Muscat fix their residence. Muscat derives importance from its natural strength and defences, from its excellent harbour, and from its commanding position at the mouth of the Persian Gulf. The surrounding country is dry and barren; and the inhabitants depend principally on trade for their means of subsistence. The manufactures are few, consisting chiefly of sugar and coarse cloth. An extensive trade is carried on through Muscat between Arabia, Persia, and India. Cloth and corn are

the principal articles of import, and the annual value of these is estimated at more than L.600,000. The exports consist of dates and madder, which are sent to India; sharks' fins to China; salt fish, horses, asses, hides, &c. Commercial transactions are here carried on principally by means of bullion and pearls. The harbour abounds in fish, and pearls may be obtained in the gulf not very far off; but the fishery has been for a considerable time neglected. The inhabitants of Muscat are a very mixed race, consisting of Arabs, Persians, Hindus, Syrians, Koords, Afghans, Belooches, &c.; and the prevailing language is a sort of corrupt Hindustanee, the use of the Arabic being confined to the native Arabs. The Sultan of Oman, whose capital is Muscat, is generally known by the ecclesiastical title of Imaum or Iman of Muscat; and his dependencies extend along the shores of Arabia and Africa as far south as Zanzibar. The present ruler ascended the throne, at the age of sixteen, in 1803; his father having been killed in 1802 by the pirates who then infested the Persian Gulf, and his uncle, who assumed the power as regent, having been murdered the year after. The beginning of his reign was disturbed by the pirates and by the Arab tribe of Beni-boo-Ali, who joined with them in attempting to introduce by force the doctrines of the Wahabee sect of Mohammedanism. The British government of Bombay, being desirous of suppressing the piracy that was carried on in the Gulf, made common cause with the Imaum against his enemies; and the result was, that the pirates were subdued in 1820, and the Arabs in 1822. Being thus in secure possession of his dominions at home, the Imaum turned his attention to his more distant possessions; but those who lived on the mainland refused to submit to his authority, and retired from the coast when he attempted to reduce them to subjection; so that all his dependencies, with the exception of the islands of Mombas and Zanzibar, are now merely nominally subject to his authority. No prince in the East is more highly esteemed than the Imaum of Muscat. The liberality of his government, and the protection and toleration which he affords to merchants of all nations and of all religions, have induced very many from different countries to settle in his capital. He has a considerable fleet, which is chiefly employed in commerce. He continues in alliance with the British government, and a British consul resides at Muscat. Under the sway of the Imaum the country is rapidly rising in wealth, commerce, and civilization. Pop. of Muscat, together with Matarah, variously estimated from 25,000 to 60,000.

MUSCULUS, Wolfgang, a German theologian, was born of poor parents at Dieuze in France in 1497. He entered the Benedictine abbey of Lutzelstein at the age of fifteen, and was soon afterwards ordained priest. Chancing, however, to meet with the writings of Luther, he became a Protestant, threw off the gown in 1527, and married. Danger and poverty now assailed him; and it was not until he had been compelled to skulk from place to place, and to earn a scanty pittance by the labour of his hands, that he was appointed minister of Augsburg in 1531. During the next seventeen years, the time not devoted to his pastoral duties was occupied in defending the doctrines of the Reformation against the Anabaptists and the Papists, and in studying Greek and the oriental languages. He left Augsburg in 1548, and wandered through Switzerland, with his wife and eight children, for some time afterwards. At length he was appointed to the chair of theology at Berne. He held this post till his death in 1563. The works of Musculus contain, among others, *Commentarii in Genesim*, fol., Basle, 1557; *Commentarii in Matthæum*, fol., Basle, 1541; and *Loci Communes*, Basle, 1554.

MUSES, The, were the inspirers of poets, and the patron goddesses of arts and sciences. Their number is given differently by different authors. According to Pausanias they are three—Melete, *Thought*; Mneme, *Memory*; and Aœde, *Song*. In Cicero there are four mentioned—Thelxinoë, *The Heart-delighting*; Arche, *Beginning*; Aœde; and Melete. Their genealogy is also disputed. They are variously represented by different writers as the daughters of Cœlum and Terra, of Pierus and Antiope, and of Jupiter and Minerva. But the prevailing notion is, that the Muses are nine in number, and that they were the offspring of Jupiter and Mnemosyne, Queen of Eleutheræ. They were born in Pieria, at the foot of Mount Olympus, and were called Clio, Euterpe, Thalia, Melpomene, Terpsichore, Erato, Polymnia, Urania, and Calliope. Their nurse was Eupheme; and they are said to have been educated by Harmonia in Attica. According to Hesiod, they usually dwelt on Mount Helicon. There they danced round the altar of Saturn, and bathed in the waters of Permessus, Hippocrene, and Olmeius. When the night came on, they set out on the discharge of their duties, robed in clouds, and chanting the praises of the gods as they floated through the air. Descending upon the earth, they visited those mortals who were the special objects of their care. They infused dignity and power into the words of rulers, and filled the souls of poets with light and harmony. By their presence every tormenting care was allayed. At times they dwelt in a magnificent palace on the summit of Olympus. There they stood in the presence of Jupiter, telling the secrets of the past, present, and future, or warbling festive songs at the banquets of the immortals.

The worship of the Muses began around their birthplace in Pieria. Thence it was transferred into Bœotia, and in course of time it became firmly established in that district. A temple was erected to "The Nine" at Thespiæ. The neighbouring Mount Helicon, with its wells of Aganippe and Hippocrene, was consecrated to them, and became the site of their sanctuaries and grottoes. From Bœotia the adoration of the Muses gradually spread through the rest of Greece. It was established in Parnassus by the erection of a temple, and by the consecration of the Castalian spring and of the entire mountain. A sanctuary was erected for its observance in the Academy at Athens. In course of time it was transferred to Italy. Poets and musicians were the principal votaries of the Muses, and on that account were sometimes called their sons. Thus ancient writers say that Hyacinthus sprung from Clio, Rhesus from Euterpe, the Corybantes from Thalia, and the Sirens from Melpomene. Yet it sometimes happened that those who had been the worshippers of the Muses became their rivals in the art of music. In such a rivalry the Sirens failed, and were punished with the loss of their wings. Thamyris hazarded a similar competition, and was smitten with blindness.

From being indiscriminately the patronesses of song, the Muses latterly came to be severally regarded as presiding over particular kinds of poetry and particular arts and sciences. (For an account of their distinctive offices, see the names of each.)

MUSEUM, a name originally applied to a part of the famous palace of Alexandria, on account of its being set apart for the worship of the Muses and the study of the sciences. Here were lodged and entertained the men of learning, who had each a handsome revenue. Its foundation is attributed to Ptolemy Philadelphus, B.C. 280, who here placed his library. The word *museum* is now applied to any place set apart as a repository for things which have an immediate relation to the arts. The most famous institutions in England bearing this name are those of Oxford, founded in 1679, and the British Museum, founded in 1753. (See London, and Libraries.) Galleries of paintings are likewise included under the term museum in Italy and France. Such are the Vatican, the Louvre, &c.

MUSIC.

Introduction.

WITHIN the limits necessarily prescribed to this article, it is impossible to do more than touch upon a few points belonging to the subject. A complete treatise upon the theory and practice of music, according to the received doctrines, would contain about six thousand articles, and would fill several volumes. In writing this article, we have frequently availed ourselves of materials offered by the best and latest musical authorities. When so many works have been published by skilful professional musicians upon their art, we have not the presumption to suppose that we can add much that is new; more especially as we have no new theory to propose, and to maintain with Quixotic zeal and recklessness. Whenever we differ from authorities generally followed, we express our dissent, and give our reasons for it. Our main purpose is to direct attention to some useful musical objects, hitherto in general too much overlooked; to point out some errors in the theory and practice of music; and to show the utter uselessness of pursuing the old routine of building up false theories of music, and spending years in the vain study of what is called thorough bass, and is even still considered, by too many persons, as comprehending the whole art and science of music. To attempt to make any one a composer of music by means only of dry treatises upon intervals and chords, is just as absurd as to attempt to make a poet by means of Bysshe's Art of Poetry, or other books of the kind. Genius and observation, and a careful study of the best models, are really the only things that can ever make a good poet, or a good painter, or a good composer of music. The aid of a skilful master will be of great importance, if he is not wrapped up in a theory. In the absence of a master, two or three of the best modern treatises, such as Reicha's and Cherubini's, may help the student to understand the construction of those models of composition which he ought to have constantly before him. We suppose the reader to understand musical notation, and to be able to sing, or to play upon some musical instrument. If this should be the organ, or piano-forte, so much the better for his more easy attainment of a knowledge of harmony; although he must always remember that both these instruments are *out of tune*, and do not produce perfect intervals or perfect harmony. If the student of musical composition would acquire a real dominion over the materials of his art, he must not trust entirely to his organ or piano-forte. He must learn to read, in silence, any piece of music in score (in partition), and to hear, "in his mind's ear," the effect of the whole; and he must learn to compose in silence, and without the aid of any instrument. All great composers have acquired these powers. This seems, to the vulgar musician, impossible. To mention only one instance of such powers among living artists; Cherubini composes all his music with the aid of no other instruments but pen, ink, and paper. We have seen him at work. An accomplished composer is able to form in his mind, with no aid from any instrument, the whole plan and details of a complicated piece of harmony, before he writes a note of it. In his "mind's eye" he *sees* the whole score; in his "mind's ear" he *hears* the effect which the piece would produce if performed. Until the student acquires this power of abstraction, he must consider himself as only on a par with those every-day musicians whom the "fatal facilities" of the organ or piano-forte raise into the ephemeral class of pseudo-composers.

Some persons consider music as a frivolous and useless art. They do not feel nor understand music, and they are not to be blamed for this when nature has denied them a musical ear, any more than a blind man is to be blamed for not admiring painting or sculpture, or a blind and deaf man for not admiring poetry. But really, when musical compositions are frivolous and useless, the fault is in the artist, not in the art. If men choose to write bad poetry, to paint bad pictures, to chisel bad sculptures, this can never prove that poetry, painting, and sculpture, are frivolous and useless arts. Every one of the fine arts may be rendered frivolous and useless by misapplication of its means; nay, some of them may be made highly dangerous and mischievous, as has often happened. No doubt all the fine arts may be considered in one point of view as *superfluous* things, not at all contributing to the *necessaries* of human existence. Food, clothing, fire, and shelter, are really all that man's mere animal existence requires to keep him alive. But if poetry and music, and painting and sculpture, cannot till the earth, nor build hovels, nor make clothing, nor kindle coal-fires, they can at least add ornaments to the structure of civilized society, and contribute to the innocent pleasures and happiness of man's transitory life. And it seems to be proved by experience, that the cultivation of these arts, how unimportant soever they may be to mere animal existence, has always tended to divert the attention of mankind from the sole indulgence of their animal appetites, and of their more dangerous passions. If so, it would not be wise to deprive man of such sources of innocent and pleasing occupation, or rather relaxation, and to reduce him to the merely animal state of the savage, who enjoys and admires nothing beyond his animal comforts, and his murderous triumphs over his rivals or his enemies.

Many persons are so constituted, or so trained, as to have no relish for poetry, or painting, or music. So much the worse for them, perhaps, since their want of feeling or imagination deprives them of sources of innocent pleasure open to others. If a mere mathematician should be dissatisfied with the works of a great poet, because these works *prove* nothing mathematically, a lover of poetry must not take offence at the mathematician. The lover of poetry, perhaps himself a poet, may be totally insensible to the beauties of the most profound mathematical reasonings, or the finest musical compositions. This often happens. But it rarely happens that the real lover of music is not also a lover of poetry and of painting. We have known men high in the literary and scientific world, upon whom the best music produced no other impression than that of an agreeable or a disagreeable noise. But this never made us respect them the less for their own *peculiar* powers of feeling and thinking. They were not so organized as to feel and think as we did. That was all. The wiser and more philosophical plan is, not to be angry with any of our fellow-creatures for not feeling and admiring as we do; but to regret that they cannot feel and admire with us, because such communion of feeling and admiration would serve to draw those persons closer to us in human fellowship. To call a man a blockhead, because he does not, or cannot, feel and think in every thing exactly like ourselves, is merely to be at once ill natured, uncharitable, and unphilosophical. It is, "*not to know ourselves.*" *Non omnia possumus omnes.* We find no fault with men who *cannot* perceive the beauties of music. We find fault with the perversions of an art which we ourselves feel to be a fine and expressive one, too often deformed and perverted.

Definition of music.

Most treatises on this subject begin with a definition of music. To persons who already understand music thoroughly, any attempt at such a definition is unnecessary. They have already formed their own ideas of music as an art. To persons ignorant of music, any such definition is quite unintelligible. The extent, the complexity, and the mutability of the art, render all such definitions imperfect and objectionable. The best way in this, as in all others of the fine arts, is to leave the student to form his own definition, after he has thoroughly studied the art. We follow this plan.

In some of the latest and best works on music, we find a definition of it attempted in this manner: "The art of expressing an agreeable play of feelings by means of sounds." But music often expresses the most painful and tragical feelings. Another is, "The art of expressing determinate feelings by means of regulated sounds." And then follows a long description of the nature of all the various branches of music; which is just tantamount to a confession that the definition is unintelligible and useless without the lengthy description.

Leibnitz had a strange metaphysical notion of music, which he thus expressed: "Musica est exercitium arithmeticæ occultum nescientis se numerare animi; multa enim facit in perceptionibus confusis seu insensibilibus, quæ distinctâ apperceptione notare nequit. Errant enim, qui nihil in anima fieri putant, cujus ipsa non sit conscia. Anima igitur etsi se numerare non sentiat, sentit tamen hujus numerationis insensibilis effectum, seu voluptatem in consonantiis, molestiam in dissonantiis inde resultantem. Ex multis enim congruentiis insensibilibus oritur voluptas," &c. Descartes entertained similar notions; and Euler, in his *Tentamen Novae Theoriae Musicae*, assures us that the ear is pleasingly or unpleasingly affected by musical intervals, according to its perception of the simplicity or of the complexity of their ratios of vibration. His measures of these ratios do not agree with practice. But the absurdity consists in supposing such an auricular arithmetic, by which the ear judges of the ratios of intervals. Does the milk-maid calculate the ratios of the intervals in her untutored song, and take pleasure in it, or the reverse, according to her perception of their simplicity or complexity? In Italy we may hear persons who cannot read music, singing very agreeably in two, or three, or four parts, in harmony. Do such persons know any thing of the harmonic ratios of the sounds they combine together in this way? They have no more idea that even an octave is in the ratio of 1 : 2, than they have of the distance between the earth and the moon. Similar false applications of mathematics have tended greatly to produce that mysterious obscurity which has hitherto been artificially thrown over the beautiful and inviting regions of musical melody and harmony. There, genius and perseverance have culled the sweetest flowers; while mathematical investigations have, as yet, only groped among the soil from which these blossoms sprang.

Theories of music.

The state of our knowledge of acoustics, one of the most subtile and difficult of sciences, is still too incomplete to permit of the formation of a perfect theory of music, even were music, as a fine art, entirely dependent upon the physico-mathematical science of acoustics, which it is not. Of late years, however, the beautiful experiments of Dr Chladni, M. Oërsted, Monsieur Savart, Professor Faraday, and Professor C. Wheatstone, have thrown much light upon some of the obscurer parts of acoustics.

In another work, we have expressed ourselves in the following terms regarding proposed theories of music. "The mischievous effects of false principles have been experienced in every branch of physical science. The blind rashness of premature generalization has operated with as great absurdity in music as in any other branch of human knowledge. While music was in its infancy, and while the observations and experiments which had been made respecting it were confined within limits by much too narrow to permit the formation of just and comprehensive general principles, musicians, both practical and speculative, misled by a false philosophy, and by erroneous ideas of simplicity, attempted to establish one single principle as the sole basis of musical harmony and composition. Confounding together the essentially distinct methods proper to physical and to mathematical science, they seized upon a particular phenomenon belonging to acoustics, and endeavoured to torture it into a principle which might apply to, and explain, the whole phenomena belonging to musical composition. From a particular fact, which had no necessary connection with musical composition, they attempted, with some ingenuity, and with much sophistry and ineffectual labour, to deduce the whole system of that art; while they were not aware either of the imperfection and incompleteness of the system which then existed, or of the improper method of induction which they had adopted. They employed the synthetical method of induction proper to mathematics, instead of the analytical method of induction, which is the true guide to physical investigation. In mathematics, we make discoveries by reasoning from definitions, axioms, and postulates; in other words, by reasoning from generals to particulars; but in physics, we extend our views and consolidate our knowledge by the opposite method of reasoning from particulars to generals. In physical science, when our observations and experiments have been sufficiently numerous and extensive, we may then, but not till then, establish general laws, or first principles, and reason from these synthetically; but if, on the contrary, the facts from which we generalize have been gathered from a narrow and unenlightened survey of the field of physical science, we shall almost inevitably draw false conclusions, and form principles which involve error and absurdity in relative proportion to the obscurity and contraction belonging to our investigation of particulars.

"It was long ago observed, that a musical string, or wire, capable of rendering a grave and powerful sound when thrown into a state of vibration, produced, in that state, not only a *principal* sound, corresponding to its length, tension, thickness, &c., but also two audible, concomitant, and accessory sounds, related to the *principal* sound by the intervals of a twelfth, or double (replicate) fifth, and seventeenth major, or second replicate major third. For example, the fourth string, or largest string of the violoncello, when strongly vibrating, may produce these accessory sounds, or *harmonics;* which, although feeble in comparison with the principal sound, may, however, be heard by a delicate and attentive musical ear.

"Upon this acoustical phenomenon, Rameau, a French musician, attempted to found his theory of harmony. We shall afterwards quote the opinions of some of the highest authorities in Europe upon this theory, and also upon that of Tartini, to which we now proceed.

"Tartini, in his *Trattato di Musica*, published at Padua in 1754, informs us, that if two sustained sounds (forming, for example, a third or a fifth) are produced at once from two violins, two trumpets, &c. the result will be the generation of a harmonic third sound, distinctly perceivable by the ear. This phenomenon was observed by Rameau in 1753. Tartini seems to have mistaken the pitch of the third sound, or grave harmonic, produced in this experiment, since M. Serre of Geneva, in his Principles of Harmony, tells us that the grave harmonic sounds produced by major and minor thirds are each an octave lower than those mentioned by Tartini. This phenomenon gave rise to Tartini's theory of harmony. We now make the quotations which we promised. The first is from the works of

the late Professor Robison, whose authority, on such a point, is of indubitable weight. He is writing of Rameau's theory. 'Rameau has made this,' the generation of acute harmonics, 'the foundation of his system of music, asserting that the pleasure of harmony results from the successful imitation of this harmony of nature. But a little logic should convince these theorists that they must be mistaken. A little mathematics, too, or mechanics, would have convinced them. His theory is a very *forced* accommodation of this principle to the practice of musicians and taste of the public.' Speaking further of Rameau's theory, he says, 'It is a mere whim, proceeding on a false assumption, namely, that a musical sound is essentially accompanied by its octave, twelfth, and seventeenth, *in alto*. This is not true, though such accompaniment be very frequent, &c. Are these acute harmonics musical sounds or not? He surely will not deny this. Therefore they too are essentially accompanied by *their* harmonics, and this absolutely and necessarily *ad infinitum*.' Of Tartini's theory he says, 'Tartini prized this observation,' the generation of grave harmonics, 'as a most important discovery, and considered it as affording a foundation for the whole science of music.' After some farther remarks, he adds, 'The system of harmonious composition which Tartini has, with wonderful labour and address, founded on it, has, therefore, no solidity.'

"Dr Chladni, in his celebrated work *Traité d'Acoustique*, expresses himself as follows regarding the theories which we have just mentioned: 'It is not conformable to nature to desire, like many authors, to derive all harmony from the vibrations of a string, and especially from the coexistence of several sounds with the fundamental sound. A string is *only one* species of sonorous body.

"'In many other sonorous bodies the general laws of vibrations, which were not known, are differently modified, consequently the laws of one sonorous body cannot be applied to that which ought to be common to all. A monochord cannot serve to establish the principles of harmony, but only to give an idea of the effect of ratios.'......'Many authors have regarded the co-existence of sounds comprised in the natural series of numbers (which, according to true principles, is nothing but a particular phenomenon) as an essential difference between a distinct sound and a noise. They have taken this quality for the basis of all harmony, believing that an interval is consonant, *because* the acute sound may be heard along with the fundamental sound. They do not know that, if more than one sound is heard at the same time, this is nothing more than a consequence of the existence of many species of vibrations; that in many sonorous bodies the series of possible sounds is very different from the natural series of numbers; and that we may produce each manner of vibrations, where there are nodes, without any mixture of other sounds, by touching the nodal points, or lines, which ought to be in motion in other manners of vibrating.

"'According to their principles, the perfect minor chord—if one does not make use of sophisms—would not be consonant; and, on the bell of the harmonica, the ninth (4 : 9) would be the first consonance, since it is the first sound which can mingle itself with the fundamental sound, &c. Daniel Bernouilli and Lagrange have sufficiently refuted these false principles.'

"With respect to Tartini's theory in particular, he says, 'Tartini pretended that this third sound was more acute by an octave than it really is. He regarded this phenomenon, combined with the pretended co-existence of the series of sounds 1, 2, 3, 4, 5, &c. in each fundamental sound, as the basis of harmony. Mr Mercadier de Belesta has very well refuted some false assertions of Tartini, in his *Système de Musique*, Paris, 1776.'

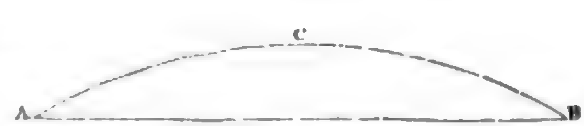
"Choron, in his work upon composition, says, 'It has been attempted to deduce the laws of succession from the multiple resonance, or from the sub-multiple resonance. Tartini had hardly discovered this last phenomenon, when he hastened, in order to satisfy the taste of his time, to rear up upon it a system, which he gave to the world in a very unintelligible work. J. J. Rousseau, who was almost equally a stranger to geometry and to the science of composition, produced, without having even comprehended it, a very imperfect analysis of it (Tartini's system) in his shapeless dictionary, and exalted it to the utmost of his power, for the pleasure of mortifying Rameau, with whom he had some quarrel.

"'With the phenomenon of the multiple resonance, of which he had considered no more than the three first terms, Rameau had propped up his system of the fundamental bass. Without entering more into detail, I shall remark, that this phenomenon has no connection with the laws of harmony. That if one absolutely would apply it to them, it would be necessary, *first*, in order to be consistent, to suppose, at least implicitly, that the sounds of the system are those of the series of aliquots: first absurdity. *Second*, That all the notes of the bass ought to be accompanied by all their aliquots, moving in a parallel manner with each other: second absurdity. Every other consequence is illegitimate, and tends, not to give a foundation in nature to the rules of harmony, but to reconcile, as one best can, the phenomena with the rules of harmony, which is a very indifferent matter.'"

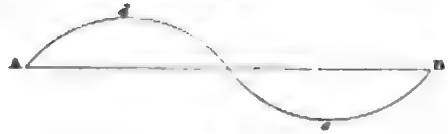
In 1753, M. Serre, a miniature painter at Geneva, published his *Essais sur les Principes de l'Harmonie*. He assumed three essential fundamentals in the scale; the tonic, the fifth, and the fourth. He described the nature and use of what he termed *diacommatic* intervals, or slides necessary to perfect intonation in various modulations; and he laid down as a principle, that it depended upon the nature of the intervals of a chord whether that chord should have *one* or *two*, or even *three* fundamentals. These opinions of M. Serre's have been of late years, and with some modifications, reproduced as new. In some works recently published, we have observed an analogy pointed out, as new, between the harmonics above mentioned and the curious phenomena of complementary colours. In Blackwood's Edinburgh Magazine for February 1823 (pp. 159–162), will be found a letter of ours in Italian, in which this analogy is particularly noticed, and a short description of some of the phenomena given. In the same letter there are some remarks upon the analogy between the harmonic series 1, 3, 5, 7, &c. and the progression of numbers 1, 3, 5, 7, ascribed by Newton to the squares of the diameters of the coloured circles produced by him on applying to the plane side of a plano-convex lens one of the convex sides of a double convex lens.

A strange error has long prevailed regarding the co-existent vibrations of a musical string. The *total* vibration which gives the gravest sound of the string, can by no means *co-exist* with the vibrations of the aliquot parts of the same string. The thing is physically impossible, as could be easily demonstrated. In fact, to assert that a vibrating string can move in a number of *different* and *opposite* directions at the same instant of time, is as absurd as to maintain that a man can run backwards and forwards, to the right and to the left, &c. all at the same moment. The following diagrams represent the three primary curves of the harmonic series 1, 2, 3.

1.



2.



3.

The co-existence of all these curves is a *physical impossibility.* For *how* can ACB *coincide* with AdeB, or with AfghB? It is needless to go farther. There may be many *co-existent* vibrations of traction and torsion in the string, but not any *co-existent* vibrations in directions quite opposite to each other.

The musical treatises of Choron, Catel, and Momigny, &c. among the French, and of Reicha and others among the Germans, are still too much tinctured with peculiar and arbitrary theories and systems, for which there are no sufficient grounds in either acoustics or æsthetics. By this last term the Germans have long chosen to designate, not very appropriately, the theory of taste in the fine arts. It is indeed impossible, by any purely mechanical and mathematical theories, or even by any metaphysical ones, to explain all the varieties of human sensations, affections, passions, that enter into our perceptions of beauty, sublimity, &c. in poetry, painting, or music. It cannot be too often repeated, that all the *rules* laid down by theorists for the construction of works belonging to the fine arts, are drawn from models of art previously in existence, and relate merely to the mechanical portions of these arts.

Had the rigid rules formed for (and from) the ancient Greek drama been always adhered to, we should never have possessed Shakspeare's plays. The magnificent musical works of Haydn, Mozart, and Beethoven, not to speak of many other great German and Italian composers, were not produced by blind adherence to old rules of art, but by an enlightened view of things, far beyond what the authors of these rules contemplated. Bühle has remarked, that the mechanical rules laid down in treatises on the fine arts may be compared to telescopes, which assist the vision of those persons who already see. A remarkable instance of this is found in the case of Beethoven, who happened to be placed under a master destitute of genius for melody; but a profound harmonist, and a learned writer of fugues and canons, &c. Under this man, Beethoven laboured most industriously, and went through the whole drudgery of thorough bass, and all the rigid ancient rules of composition; but evidently with frequent misgivings as to the general truth and application of what was taught to him. But the result was, that these lessons and *rules* served him as a "telescope," to enable him to perceive a wide field of composition far beyond them all. In short, he was a man of first-rate musical genius, and therefore by nature a great melodist; and, fortunately for the world, his injudicious training *could* not extinguish his passionate feeling for melody, and his charming expression of it in his best works. In some of his works, especially among his last, we find unpleasing traces of the predominance of his early training over his native genius. But his latest works were composed when he had been for many years perfectly deaf.

The sense of hearing. Notwithstanding the laborious investigations of many eminent anatomists and physiologists, from Comparetti downwards to Magendie, the uses and functions of all the various parts that compose the human ear are by no means well understood.

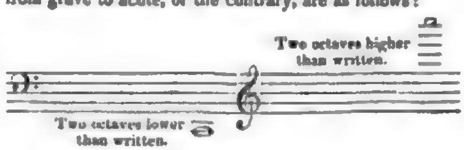
The perceptive powers of the ear differ considerably among mankind, especially as regards the perception of the various qualities and relations of musical sounds. In like manner, we find that the perceptions of form, proportion, colour, &c. are by no means always the same in every human eye. Perfection of the eye is requisite to the painter; perfection of the ear to the musician. Sometimes persons are found who cannot distinguish colours, or shades of colour, from each other. Perhaps more frequently instances are met with of persons whose perceptions of the differences between musical sounds are very imperfect. We have been informed that Mr Pond, the late astronomer royal, though a real lover of music, and capable of hearing distinctly sounds of a grave pitch, or of a middle pitch, was incapable of hearing very acute sounds, whether musical or not, which were perfectly audible to other persons; for example, the loud chirping of a number of crickets in a room, and the very piercing sound produced by turning round the ground-glass stopper of a bottle containing calomel. The stopper was turned round close to Mr Pond's ear without producing any sensation. All this clearly proved that Mr Pond's ear, however perfect in other respects, was incapable of conveying any perception of very acute sounds.

All vibrations sufficiently rapid and powerful to act upon the auditive organs produce the sensation of sound. To enable us to hear slow vibrations as well as more rapid ones, it would be necessary, according to Riccati, that the intensity of each simple vibration should be in proportion to its duration. For this reason, says Chladni, and on account of the different organization of each individual, and each kind of animal, there exist no absolute limits to the perceptibility of sounds.

The ear does not distinguish the very small differences of the exact ratios between sounds. Were it not for this illusion, music would have no existence. But this is not to make us seek the less for true intonation, wherever it can be obtained. Few persons are aware how great is the difference between the true intonations of a fine voice, or a violin, &c. and the false intonations of such instruments of fixed sounds as the organ, piano-forte, &c. Many singers, trained to the intonation of a piano-forte, have their ear and voice so misled that they can never afterwards learn to sing in tune. The famous Madame Mara condemned the use of the piano-forte in learning to sing. She said every singer ought to learn to play on the violin, in order to know what true intonation is.

The different quality (*timbre*) of a musical sound and its articulations, says Chladni, are among the most remarkable objects of audition. They do not appear to depend on the manner of vibration, nor (or very little) upon the form of the sonorous body; but rather on the matter of the sonorous body, and that of the body by which it is rubbed or struck, as well as on the matter which propagates the sound. We have not the least idea of the nature of these different characters of sound, nor of their propagation.

The limits usually assigned to musical sounds, reckoning from grave to acute, or the contrary, are as follows:



The lowest of these sounds will be such as is produced by an open organ-pipe of 32 feet in length, and the num-

ber of vibrations of the reed will be 32 in a second of time. The next octave above will be produced by an open organ-pipe of 16 feet, and the number of vibrations in a second will be 64; the next octave above that, pipe 8 feet, and 128 vibrations; and so on. The highest sound above noted will have 16,384 vibrations in a second. This last sound is not to be taken absolutely as indicating the extreme limit of acute sounds that may be used in music, and may be appreciated by the human ear; for it has been calculated that a sound produced by 24,000 vibrations in a second is appreciable. We shall give, in a wood cut, p. 618, a copy of a very useful table of the compass of voices and instruments, published by Monsieur Choron, in his large and expensive work upon composition. As all the plates of that work were destroyed some years ago, copies are now extremely rare and valuable.

Production of series of musical sounds.

If we take a vibrating musical string or wire, perfectly uniform in thickness, and homogeneous throughout, and divide it into its aliquot parts, its half, its third, its fourth, its fifth, and so on, we shall obtain, by this division of the *monochord*, as it is called, a great many of the sounds belonging to our musical system. A number of these sounds can be obtained from it by lightly touching it at these divisions, as happens when we produce harmonics on the open string of a violin, &c.; and all these sounds are *true*, or nearly true, if the string is perfect; otherwise they are not. This frequent imperfection in the uniformity and homogeneity of strings is one great obstacle to perfect intonation. Again, if we take an organ-pipe, or a French horn, &c., and blow into it in such a manner as to produce its natural series of sounds, we shall have, beginning with the lowest, a series corresponding (in ratio of vibrations of the column of air contained in it) to the arithmetical series 1, 2, 3, 4, 5, 6, 7, 8, &c. thus:

These sounds also are *true* harmonics, supposing the sonorous tube properly constructed, and the force of the blast suitably regulated. If we push this harmonic generation of sounds still farther, we may obtain a number of other sounds, some of which, though apparently *false* as regards our artificial temperament on instruments of fixed sounds (such as the organ, piano-forte, &c.), are yet *true*, or nearly so, as regards the intervals which occur in *true intonation*.

There is no room here to enter into a discussion of this curious and intricate subject. We shall content ourselves with giving a table of the harmonics obtainable from an open cylindrical glass tube furnished with a suitable mouth-piece, and fitted to an organ-bellows. This table shows that the gravest sounds obtainable from the tube are removed from each other by wide intervals. Thus the two first sounds, C_1 and C_2 are separated by the interval of an octave. G_2 is a fifth above C_2, and C_3 is a fourth above G_2, and so on. This is the series followed by the natural sounds of such instruments as the horn, trumpet, serpent, &c.; but it is extremely difficult, or nearly impossible, to produce on these instruments the sound corresponding to C_1. Even C_2 is very difficult to produce; and the first sound that usually occurs corresponds with G_2. As the sounds become more acute, that is, as the column of air divides itself into a greater number of parts, they approximate each other more and more. By and by, chromatic intervals occur, represented by flats and sharps; and, at last, intervals so small that they cannot be represented by any of the common signs of musical notation. But these smaller intervals are necessary to perfect musical intonation, and are employed by the best singers and performers on instruments of the violin kind. In France, a number of experiments were tried with Viotti's performance, and it was ascertained that he employed a vast number of very minute intervals, in order to play perfectly in tune in all keys.

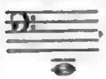
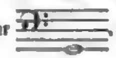
$1 = C_1$	$13 = G^{\sharp}_4$	$25 = A^{\flat}_5$ —
$2 = C_2$	$14 = B^{\flat}_4$	$26 = G^{\sharp}_5$
$3 = G_2$	$15 = B_4$	$27 = A_5$ +
$4 = C_3$	$16 = C_5$	$28 = B^{\flat}_5$
$5 = E_3$	$17 = C^{\sharp}_5$	$29 = C^{\flat}_5$ —
$6 = G_3$	$18 = D_5$	$30 = B_5$
$7 = B^{\flat}_3$	$19 = E^{\flat}_5$	$31 = C_6$ —
$8 = C_4$	$20 = E_5$	$32 = C_6$
$9 = D_4$	$21 = F_5$	$33 = D^{\flat}_6$ —
$10 = E_4$	$22 = G^{\flat}_5$	$34 = C^{\sharp}_6$
$11 = G^{\flat}_4$	$23 = G_5$ —	$35 = D_6$ —
$12 = G_4$	$24 = G_5$	$36 = D_6$

In treating of the musical sounds produced by sonorous bodies, such as vibrating strings, or wires, or springs, or columns of air in tubes, &c., it is rarely kept in view that in these, as in all mechanical phenomena, allowance must be made for the mechanical conditions which may render the actual phenomena not exactly correspondent to the mathematically calculated results. From want of attention to this, many false theories of musical intonation have been adopted. It is quite true, mathematically speaking, that if all the hypothetical conditions of a sonorous body were, as they are assumed to be, in the course of a mathematical reasoning regarding them, the physico-mathematical result deduced by such reasoning, supposing this reasoning accurate, must be perfectly correct. But, in general, such reasoning and deduction are carried on with abstraction made of some of the inevitable physical circumstances which attend the real phenomena. In this way, pure mathematical reasoning is often, in some degree, at variance with mechanical phenomena. A badly formed string, or wire, &c. will not conform to the mathematical calculations as to the sounds that it must produce when divided in such and such ways. Neither will its real vibrations agree with those mathematically calculated. In like manner, the friction, and inequalities and imperfections, of any piece of machinery, will, in the real operations of the latter, produce results in some respects contradictory to the abstract mathematical theory of what the operations of the mechanism ought to be.

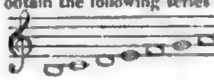
Musical intervals.

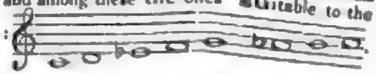
A musical interval consists in the difference between two given sounds, in respect to their relative acuteness and gravity. Thus it is evident that the *unison* is not an *interval*, although it is often improperly so called. Aristotle, in the tenth section of his thirty-ninth problem, very correctly designates the unison as being "only the same sound multiplied." But the slightest departure from *unison*, by one of the sounds becoming a little more acute, or the other a little more grave, forms an *interval*, though it may be so *very small* as not to belong to those intervals generally recognised in melody and harmony. The measure of the relative lengths, or vibrations, of two musical strings producing an interval, will be the difference of their respective logarithms, as has been remarked by Dr Smith in his "Harmonics," and by various other subsequent writers. Among these, the late Professor Robison, of Edinburgh

University, pointed out some useful applications of the logarithmic subdivision of the circumference of a pasteboard circle, fitted with a moveable concentric circle, &c. as described in his article TEMPERAMENT, in the present work. He adds: "Or a straight line may be so divided, and repeated thrice; then a sliding ruler, divided in the same manner, and applied to it, will answer the same purpose." We may remark, that these suggestions of Professor Robison have been employed in the construction of similar instruments, without any acknowledgment; and also, that Professor Robison's experiment, by applying a stop-cock to an organ-pipe, and producing various sounds from the regular and rapid opening and shutting of the stop-cock, bears great analogy to the syren instrument recently constructed by M. Cagniard de la Tour. Professor Robison, speaking of his stop-cock apparatus, says, "The intelligent reader will see here an opening made to great additions to practical music, and the means of producing musical sounds, of which we have at present scarcely any conception," &c. We have already mentioned, very briefly, how intervals are produced by the subdivisions of a sonorous string or wire, &c. or of the column of air in a wind-instrument, or in the glass tube before described.

If we suppose such a tube to produce, as its gravest sound, , its primary harmonics will be , viz. octave, replicate of fifth, and replicate of third. Carrying the series farther, we shall have one similar to that already given in the table of harmonics. Supposing two other such tubes, the one having for its gravest sound , and the other , the harmonics resulting from these respectively will be , and , and so on, as in the case of the first.

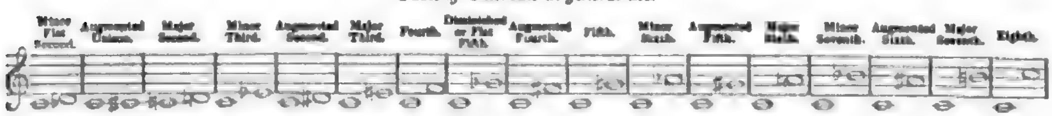
By bringing closer together these dispersed primary harmonics, by means of their octaves above or below, we shall obtain the following series of sounds:

 or 

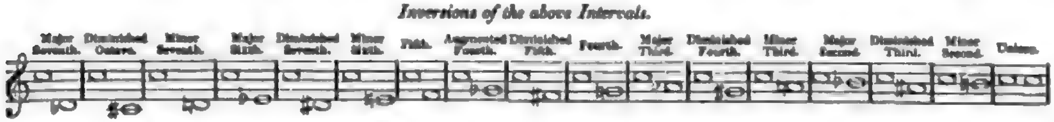
and so on. If to the last of these series we add  at the top, we shall have the major diatonic scale of C. By carrying farther the series of harmonic products of these three tubes, we shall obtain a number of other intervals (see the table), and among these the ones suitable to the scale of C minor: 

The subject of intervals has been involved in frightful confusion by the number and complexity of names introduced, and the contradictory statements of various writers upon music. We have no space to devote to the clearing up of this chaos; but we may remark, in general, that in this matter, as well as in many others connected with music, there is great need of a reformation in terminology. To glance at only three or four of the misnomers in daily use, without meddling with the more abstruse terms: the fifth diatonic sound of an ascending scale is called the *dominant* of the scale, which signifies the *ruling* or *governing* sound; while, in fact, the tonic, or key-note, and no other, is the chief and ruling sound of the scale, the sound from which, as a common centre, all the others of the scale may diverge, or to which they may converge, like the radii of a circle. This use of the term *dominant* seems to have arisen from the *predominance* of the fifth of the key in ancient church-chants. The term *subdominant* is improper, too, as applied to the diatonic fourth of a scale. The terms *double octave, double third, double fourth*, &c. are wrong as applied to intervals, because they *imply* that these intervals are *doubled* in the unison, while it is meant to express only the acuter or graver replicates of these intervals in the octave. The same with regard to *triple octave*, &c. When we read of *diminished* or *augmented unisons, false fifths, superfluous fifths, seconds*, &c. &c. we must regret the obscurity of such terms; but meantime we shall use the common terms as we find them, because to introduce new ones abruptly would only add to the confusion already existing.

Table of Intervals in general use.



Inversions of the above Intervals.



Inversion of an interval takes place when the graver sound is carried an octave higher, or the acuter an octave lower. The effect of inversion of intervals may be represented by the following two rows of figures, where it will be seen that 1 or unison, becomes 8 or octave; 2, or second, becomes 7 or seventh, and so on.

1	2	3	4	5	6	7	8
8	7	6	5	4	3	2	1

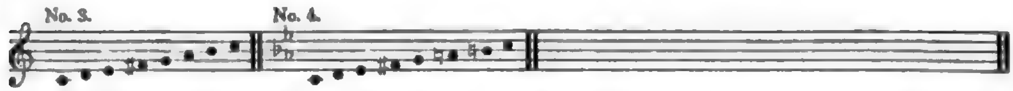
By looking at the above table of intervals, and their inversions, we perceive that *minor* intervals inverted become *major*, and *major, minor; diminished* intervals become *augmented*, and *augmented, diminished*. We have placed D♭ before C♯, and E♭ before D♯, and so on; because, contrary to the common opinion, the D♭ in the above series is a graver sound than the C♯, and the E♭ than the D♯, and so of the others. This is not easily understood by a mere player on the organ or piano-forte, but can be exemplified by any accomplished singer or violinist.

In writing for voices, especially in the strict or serious

style, many of these intervals are not used. The following are generally prohibited in that style: Augmented second, diminished fourth, augmented fourth, diminished fifth, augmented fifth, major sixth, diminished seventh, minor seventh, major seventh, augmented third.

Musical scales, modes, keys.

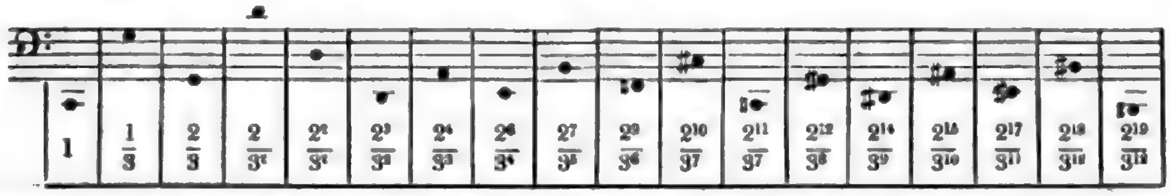
Scale is the more comprehensive of these terms, since all appreciable musical sounds between the extremes of grave and acute form the general scale or system of sounds employed in melody and harmony. A *mode* is a certain arrangement of tones and semitones, &c. between a given sound and its octave above or below. *Key* properly signifies a character employed at the beginning of the staff, to fix the names of the notes; but it has long been used as nearly synonymous with scale or mode, since these terms are often employed the one for the other. What is called the *key-note*, or *tonic*, is the principal sound of a mode, or that from which we begin to reckon its degrees upwards or downwards. Suppose we take the note C as *tonic*, or *key-note*. The arrangement of notes No. 1 will form the *mode* or *key* of C major, and the arrangement of No. 2 the *mode* or *key* of C minor.



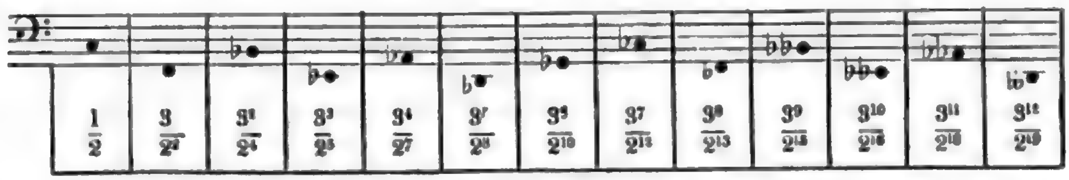
Both these are called *Diatonic* scales, although they are not strictly such, since they contain other intervals besides tones. The chromatic scales formed from these consist of a semitonic (or so-called semitonic) series between the key-note and its octave above or below, ascending or descending. These two modes, major and minor, and their respective chromatic scales, may be considered as the types or representatives of all other major and minor modes and chromatic scales. No. 3 and No. 4 are two forms of the major and minor mode not generally adverted to, but which are very effective when skilfully used, as, for example, by Haydn in the andantino in C minor of his symphony in E flat. As an octave series or scale may be formed anywhere within the limits of appreciable musical sounds, we thus obtain a variety of scales, diatonic and chromatic, all of which, however, are to be considered as only so many fragmentary formulæ, comprehended within, and belonging to the *whole series* of the general system. Thus we shall have the modes or scales of C flat, C sharp, major and minor; D major and minor, D flat and D sharp, major and minor, and so on with E, F, G, A, B, and their chromatic alterations, flat or sharp. The term *key* is usually applied to these. Thus we speak of the *key* of C major, of C minor, of C sharp major or minor, and so on. As concert-pitch is not one and the same in all countries, keys of the same name do not everywhere correspond exactly. The production of what is called the sharp series of keys arises from a regular succession of perfect fifths taken in ascending, or fourths in descending, beginning with C for the major ones, or A for the minor ones. Thus the first step of a 5th ascending from C brings us to G as a new key-note. G major, with one ♯ at the clef. The first step of a 5th ascending from A brings us to E as a new key-note E minor, with one ♯ at the clef. A 5th, again, ascending from G brings us to D major with two sharps at the clef; and a 5th ascending from E brings us to B minor, also with two sharps at the clef; and so on progressively with the major keys of A, E, B, with 3, 4, 5 sharps at the clef, till at last, at the twelfth 5th from C, we reach B sharp, which, when brought down by octaves towards the original C, will be found not to correspond with that C in unison or octave, but to be too sharp. The same thing will occur after a similar series of twelve perfect 5ths from A, as tonic of A minor, up to G double sharp, which last will not be in unison or octave with the original A, but will be too sharp in the same proportion as the other extreme of the series of twelve ascending 5ths from C to B sharp. We may mention here, that composers seldom go beyond the keys of F♯ or C♯ major or minor, in their notation of a piece of music, on account of the multiplicity of sharps and double sharps in the subsequent keys of G♯, D♯, A♯, E♯, B♯, and the difficulty of reading these, and of playing in tune in such keys upon musical instruments even of the most perfect kind.

What is called the flat series of keys, arises from a succession of perfect 5ths, the converse of the former. That is to say, when, beginning with C, or with A, for the major or for the minor series, each key-note, in regular succession, is a 5th in descending below, or a 4th in ascending above the key-note immediately preceding. Thus, from C to F in descending, F major with one flat at the clef; from this F to B♭ in descending, B♭ major with two flats at the clef; and so on with E♭, A♭, D♭, major, and with 3, 4, 5 flats, &c. at the clef. Then, again, the minor flat series, beginning from A as tonic of minor, D minor with one flat at the clef; from D tonic to G tonic of G minor, with two flats at the clef: and so on with C minor, F minor, B flat minor, &c. with 3, 4, 5 flats, &c. at the clef. We may here remark, that what is commonly called the relative minor key of a major key, has its tonic at the interval of a minor third below the tonic of that major key, and bears at the clef the same number of sharps or of flats. Thus the relative minor of C is A, without any sharps or flats at the clef; the relative minor of G is E, with one sharp at the clef; and so on with D major and B minor, A major and F sharp minor, &c. with 2, 3 sharps, &c. The same kind of relation occurs in the flat series of relative major and minor keys. Thus C major, A minor; F major, D minor; each of the latter two with one flat at the clef; B flat major, G minor, each with two flats at the clef; and so on with the rest, 3 flats, 4 flats, &c. The remoter flat keys beyond D flat are rarely used, for reasons similar to those assigned for the infrequent use of sharp keys beyond C sharp. To render more intelligible what has been said regarding the production of the sharp and the flat series of keys, we subjoin the following explanations. Suppose a musical string to render a sound equal to the lowest C of the violoncello, and to be numerically represented by 1. If this string be divided into three equal parts, any one of these parts will (tension and other circumstances remaining the same) render a sound equal to the first octave of the 5th above that C, and will be expressed by $\frac{1}{3}$. Two of these parts taken together will render the 5th above that C, and such 5th will be expressed by $\frac{2}{3}$, and will be equivalent to the lowest G of

the violoncello. Taking, again, the length of the string represented by $\frac{2}{3}$, and dividing it into three equal parts, two of these parts will render a sound equivalent to D of second open string of violoncello, and this D will be expressed by $\frac{2^2}{3^2}$. By proceeding in the same manner, we shall obtain the series represented in the following diagram. With regard to the numerical expressions placed under the 5ths, it will be remarked, that at each successive 5th, the exponent of the number 3 increases by one, while that of the number 2 sometimes increases by one, sometimes by two, according as the new term is in the 5th above, or in the 4th below, the preceding one.



We shall find that the B♯, the twelfth 5th of this series, will not be in unison with C$\frac{1}{2}$, the octave above the original C1, but will be more acute than that C$\frac{1}{2}$. If we suppose the whole string C1 divided into a number of parts equal to 2 × 531541, the B♯ in question will have 524,288 of these, while the C$\frac{1}{2}$ will have 531,541; and therefore the B♯ will be the acuter sound of the two. In reversing the process above described, that is to say, in reckoning a series of 5ths from acute to grave, the numerical expression of the 5th will be $\frac{3}{2}$. If, then, we set out from the C represented by $\frac{1}{2}$, and carry on, from acute to grave, a series of operations similar to the former, we shall obtain the following expressions for the flat series of keys by descending 5ths.



The D♭♭, the twelfth 5th from C$\frac{1}{2}$, will be found to be a graver sound than C1, the octave below that C$\frac{1}{2}$; for, supposing the whole string = C1 divided into 524,288 equal parts, the D♭♭ would require 531,541 of these parts, which exceeds the whole length of the string, and would therefore produce a graver sound than C1. The following diagram of the scales by 5ths ascending (sharp series), and by 5ths descending (flat series), will show the relative differences in pitch between the sounds of the one series and of the other.

Scale of Ascending Fifths.

C	G	D	A	E	B	F♯	C♯	G♯	D♯	A♯	E♯	B♯
$\frac{2^0}{3^0}$	$\frac{2^1}{3^1}$	$\frac{2^3}{3^2}$	$\frac{2^4}{3^3}$	$\frac{2^6}{3^4}$	$\frac{2^7}{3^5}$	$\frac{2^9}{3^6}$	$\frac{2^{11}}{3^7}$	$\frac{2^{12}}{3^8}$	$\frac{2^{14}}{3^9}$	$\frac{2^{15}}{3^{10}}$	$\frac{2^{17}}{3^{11}}$	$\frac{2^{18}}{3^{12}}$

Scale of Descending Fifths.

D♭♭	A♭♭	E♭♭	B♭♭	F♭	C♭	G♭	D♭	A♭	E♭	B♭	F	C
$\frac{3^{12}}{2^{19}}$	$\frac{3^{11}}{2^{18}}$	$\frac{3^{10}}{2^{16}}$	$\frac{3^9}{2^{15}}$	$\frac{3^8}{2^{13}}$	$\frac{3^7}{2^{12}}$	$\frac{3^6}{2^{10}}$	$\frac{3^5}{2^8}$	$\frac{3^4}{2^7}$	$\frac{3^3}{2^5}$	$\frac{3^2}{2^4}$	$\frac{3^1}{2^2}$	$\frac{3^0}{2^1}$

If we compare with each other the corresponding terms of these two scales or series, we perceive that the sounds of the sharp series are more acute than those which correspond with them in the flat series, because the strings which produce the latter surpass the others in length by the difference between 524,288 and 531,541, = 7253. A slight consideration of these processes, and their results, will show the necessity of what is called *temperament* upon such an instrument as the organ, the piano-forte, &c. By it the fifths are rendered a little false, in order to obtain all the octaves true.

What are called the ancient ecclesiastical scales or modes, being, in reality, nothing but certain conventional scales or modifications of the common major and minor scales, and differing from these in nothing but the disposition of their semitones, it is not necessary here to notice them very particularly. The four most ancient of these were the Dorian, the Phrygian, the Lydian, and the Myxo-Lydian. The first of these was equivalent to the series *d, e, f, g, a, b, c, d*; the second to *e, f, g, a, b, c, d, e*; the third to *f, g, a, b, c, d, e, f*; and the fourth to *g, a, b, c, d, e, f, g*. The dif-

ferent positions of the semitones is indicated by the curved line ⌒. The reader will find a full explanation of all the ecclesiastical modes, authentic and plagal, in the first part of the first volume of Padre Martini's *Saggio di Contrappunto*. A good many years ago, a Frenchman, Blainville, pretended to have discovered a new scale or mode, which was really nothing more than the Phrygian mode above indicated. Reicha, in his volume of thirty-six fugues, proposed what he considered as a *new system* of scales, harmonies, and cadences, which he considered as *relative* to the usual major and minor scales, &c. These relative scales, however, were merely the Dorian and others above mentioned, with the addition of the series *a, b, c, d, e, f, g, a.* The relative cadences were those that might be used between the assumed dominant and tonic of such scales, there being no chromatic alteration made in the sounds of the scale. For example:

Reicha says, enthusiastically, "according to this system, we should have two primitive scales, a major and a minor, and five relative ones; and, by transposition, twelve primitive minor scales, and sixty relative scales; in all eighty-four scales, and as many cadences. What resources unknown till now!" We cannot join Reicha in this burst of enthusiasm. The formulæ of these scales and cadences are to be found in a great many old church chants, and even national melodies. We must not mistake these fragmentary formulæ for entire and peculiar scales, independent of the general system of musical sounds. Reicha adds, "It remains for philosophers and men of genius at a future period to deduce all the consequences from this important system, as well as from the compound measures, and their use. But the subtilty of a conventional taste, the ignorance and the prejudices so fatal to the progress of the arts, and which are peculiar to narrow minds, will be long opposed to such deduction." We should rejoice if Reicha's anticipated deductions could be verified in our day; but, with all respect for that excellent musician, we rather think that he has too often suffered his reason to be led astray by the incomprehensible idealism and metaphysics, so general in Germany upon almost all subjects of art, science, and literature.

Some peculiarities that have been observed in certain national tunes, such as the omission, in some instances, of the fourth and seventh of the key, have been referred to scales of a particular kind, while it seems more reasonable to refer them merely to the imperfections of some of the musical instruments employed; for instance, the ancient flageolet, and the chalumeau, &c. Scales, seemingly anomalous, may arise from such causes, or from caprice, or conventional usage; but all such scales are only fragments of that general system of sounds which comprehends all manner of appreciable intervals, many of which last are much smaller than is commonly believed. It has been denied that the ancient Scotish music contained any semitones; but that this is an error, is proved by the Skene manuscript in the Advocates' Library, Edinburgh. In the ten Indian scales given by Sir William Jones, we find two that want the fourth and seventh of the key note, and one that wants the third and seventh. The former are the scales called *Máravi* and *Gaudi*, equivalent to *c, d, e, g, a*, and *g, a, b, d, e*; the latter is the one called *Saindhavi*, equivalent to *a, b, d, e, f.* The *Asávéri*, *Bahairava*, and *Malava*, correspond exactly with the Dorian, the Lydian, and the Myxo-Lydian modes above mentioned. The *Friraga* is the same as the *Malava*, the *Todi* is the same as our scale of C major, and the *Varati* and *Bengali* correspond with our scale of A minor with minor seventh. As to the Hindu, Persian, and Chinese scales, and the use of quarter tones, or other minute intervals, we refer the reader to what we published on that subject in No. iv. of the New Edinburgh Review, April 1822, pp. 521–528. We have examined a number of Chinese wind and stringed instruments brought home in June 1837, and have found semitones in all of them. Professional musicians who followed Napoleon into Egypt, remarked the frequent and dexterous use of very small intervals by some singers in that country. Dr Burney, in the second volume of his history, p. 424, mentions that the Arabian scale of music is divided into quarter tones, and that each of the twenty-four of these, into which the octave is divided, has a particular denomination.

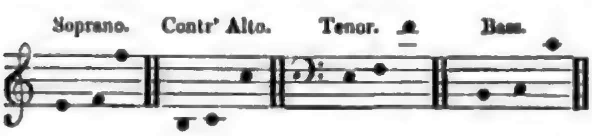
Musical Instruments.

At the head of these must be placed the human voice. The nearer any artificial instrument approaches to it in quality and power of expression, the more excellent it is. Much controversy has arisen regarding the mechanism of the vocal organs which effect the modulations or inflexions of the human voice in singing. Some physiologists have considered this mechanism as similar to that of a reed instrument; others as similar to that of a stringed instrument. It is indeed neither, according to our artificial instruments, but a mechanism of wonderful delicacy and complexity, infinitely surpassing all artificial instruments in variety of *timbre*, in delicacy of intonation, and in power of melodic expression. Some of the most curious inquiries into this subject were made by the late Dr Francesco Bennati, an Italian physician and surgeon, and an accomplished amateur singer, who died a very few years ago in the prime of his life. He says that *phonation* has hitherto been confounded with *modulation*; the sounds of the voice in speaking, &c. with those of the voice in singing. We would observe, that the ancient Greeks, in their writings on music, made a marked distinction in this. Dr Bennati says that the muscles of the larynx are by no means, as hitherto asserted, the only ones employed in the production of the sounds of the human voice in singing; and that from leaving out of view a number of elements which belong to the real mechanism in such production, the theories of the whole matter that have been proposed and received are erroneous. Among these omissions of real elements, he instances the muscles of the *os hyoïdes*, of the *tongue*, of the *upper anterior* and *posterior part of the vocal tube*, besides other anatomical parts that contribute to modify the voice. We cannot here enter into the curious details given by Dr Bennati; but may add, that he rejects the received terms of *note di testa* and *note di petto*, as conveying false ideas; and proposes to substitute for them the terms *supra-laryngean* and *laryngean* notes or sounds. His proofs of all that he asserts are drawn from his own frequent observation of the actual functions of the whole mechanism of the voice in the cases of a number of the most celebrated male and female singers, his contemporaries. Stretched strings of gut or silk, either plain or spirally covered with wire, are the sonorous bodies employed to produce musical sounds on instruments of the violin kind, or of the guitar kind, or on the harp. Stretched wires of brass or steel, &c. plain, or spirally covered with wire, produce the sounds of the pianoforte, &c. Other instruments are constructed of glass bells or rods, &c. made to sound by friction or percussion; others, again, of metal springs, made to sound by a revolving toothed barrel, as in the Geneva musical boxes; or by a current of air directed against them, as in the German toy called the mouth harmonica, or in the Æolophon, or the Accordion and Symphonion. Several other instruments of a similar kind were invented before these. It

may be mentioned, that Professor Robison of Edinburgh University gave the hint for constructing instruments of this last kind.

In the year 1785, the Abbate Gattoni constructed at Como a most singular Æolian harp. He stretched fifteen iron wires, of different thicknesses, from the top of a tower fifty-two *braccia* in height (about ninety feet), to his dwelling-house, about 150 paces distant. This giant-harp, by its mysterious sounds while the air was calm, indicated changes of the weather. This was ascribed to electric influence. The same phenomena occurred in a similar harp constructed by Captain Haas of Basle. The effect of the vibrations of the wires in each of these giant-harps, prior to changes of weather, or during storms, is said to have been quite indescribable. The sounds swelling and dying, and combining in the wildest harmonies, were sometimes heard for miles around. Wind instruments are tubes of wood or metal, in which the vibrating body is the column of air contained in them. They are sounded either by a peculiar mouth-piece, like that of the old flute or the flageolet; or by blowing into an aperture on one side of the tube, as in the fife, german flute, &c.; or by means of a reed, as in the oboe, clarinet, bassoon, &c.; or, as in the case of the horn, the trumpet, &c. by means of a cup-shaped mouth-piece, to which the lips are applied in a particular manner, and the sounds produced by compressions and dilatations of the lips, and the regulated force of the breath, and, in some circumstances, by introducing the hand within the bell-shaped end of the instrument. Other instruments are merely pulsatile, such as triangles, cymbals, bells, gongs, drums, &c., and have their sounds fixed. The harsh and unmusical tone of the gong seems to be owing to its peculiar shape, as well as to the numerous abrupt inequalities in its thickness and density.

With reference to Choron's table of compass of voices and instruments, we have to remark in general, that the best sounds of voices and instruments are their medium sounds, and that this ought to be carefully attended to by the composer. The frequent neglect of this in modern compositions produces a detestable chaos of screaming, squeaking, and grumbling. We add the following supplementary and explanatory information, which is of importance to the student. The medium compass of voices is as follows:



These restrictions are, of course, not intended to apply to solo singers, who have voices of great compass, but to Parts[1] written in songs, duetts, trios, &c. for voices of ordinary compass. It should be kept in view, that in writing for voices of the *same* compass and quality, we can hardly go beyond a trio or a quartett without producing a poor effect. Duetts, or at most trios, of this kind, are therefore best when circumstances require such combinations. But, for *variety* of effects, and freedom of harmonic combinations, three, four, or more voices of different compass and quality ought almost always to be preferred in vocal trios, quartetts, &c. For *duetts* of this contrasted kind, see the operas of Cimarosa, Mozart, Cherubini, Himmel, &c. To write effective Parts in harmony for voices, requires great skill and judgment. In a vocal quartett, for example, if we throw any of the voices out of their best medium compass, and do not carry them all on in correspondence with that compass, we shall produce poor and ineffective harmonies; for instance, if we place the tenor Part too low and too near the bass, while the treble and contr' alto remain in their best medium compass. Again, we may render the principal Part in a soprano a secondary Part (to the ear), by bringing it and the contr' alto too close to the tenor and bass; and may thus render the tenor, or even the bass, the most prominent Part, when we intended the contrary. In vocal Parts for many voices, such as choruses, &c. great simplicity of structure and of *performance* is required to produce any good effect. In 1819 we witnessed the famous Crescentini's training of a chorus at Bologna. His ear caught in an instant the slightest defect of intonation in any of the voices; the slightest excess of disproportionate *piano or forte;* the slightest attempt at any embellishment, even an *appoggiatura.* He stopped the whole performers immediately, pointed out the fault, and made them repeat the music over and over again till he was satisfied. This was the true way to train a perfect choral band; it would be well if his example were followed in all such cases.

Violin. Its powers and compass as a solo instrument are very great, although too often misused. In orchestra music it is seldom carried above F in alt.

Viola. In writing for an orchestra, the viola is rarely used above G, two octaves and a fifth above its lowest sound C. Not unfrequently, in modern music, it crosses the second violin, and rises above it for a short time in the harmony of a quartett, even where it is not performing a solo Part. But this generally occurs for the sake of preserving a melodious progression of the Parts, or of producing some particular effect from the *interweaving* of the different *timbres* of the stringed instruments.

Double basses. We must keep in view, that the German double basses have generally four strings, and that some are tuned E, A, D, G, upwards, while others have D for their lowest note. In Italy and France the double basses have only three strings, and are tuned A, D, G. In writing for the double bass, rapid passages ought to be avoided, because they produce no effect, but only a confused noise. In music for a full orchestra, the double basses are reinforced by the tenor violins and violoncellos, or by the bassoons; or by the trombones, serpent, &c; sometimes by the horns and trumpets, by the lower notes of the clarinet or of the oboe, even by the flute in its upper octaves, or by the octave flute, though the latter combinations are often abused by some living composers. Sometimes, in a florid passage for the double bass, a good effect is produced by reinforcing it by the second violins.

Violoncello. In orchestra music, the violoncello generally goes (an octave above) with the double bass Part: but beautiful effects are often produced by giving the violoncello a principal melody, accompanied by other instruments. When the treble clef is used in passages for the violoncello, care must be taken to write them according to the real pitch of the sounds, and not an octave higher, as is too often done.

Flutes. In writing for the German flute, all rapid passages in keys having more than one or two sharps or flats should be avoided, as they are very difficult of execution. We have corrected Choron's table, by extending the compass of the flute to C downwards, as most flutes now have the C finger-key. Its compass upwards is to B flat on the fifth ledger line in alt. In modern orchestra music, the octave flute, or *piccolo,* is too much employed. Its shrill and piercing sounds ought to be reserved for particular effects. In military music there are other kinds of flutes used,

[1] In this article, we use the word Part, beginning with a capital, to signify that portion of a musical composition assigned to a particular voice or instrument.

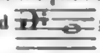
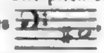
Music.

the *piccolo* in E flat, and the *piccolo* in F; the former being a semitone higher, and the latter a minor third higher, than the octave flute. There are also what are called third and fourth flutes, the former being a minor third, and the latter a fourth, higher than the common German flute in D. Parts for these flutes are written in D.

Flageolets. There are five sorts of flageolets, in C, D, E flat, F, and G, for the sake of facilitating their performance in different keys. Double and even triple flageolets have been contrived in London by Mr Bainbridge. On the former, two parts can be played at once; on the latter, three.

Oboe. The oboe requires attention in writing for it. The easiest scales for it are C major, F major, G major, and D major. In some modern oboes, there are, in the upper part of the instrument, finger-keys for F and A flat; and, in the middle part, for F sharp, E flat, and C. Some have a finger-key for the lowest C sharp. Some players have two or three upper and middle pieces, to serve for altering the pitch of the instrument to different keys, on the same principle as flutes and clarinets, &c. are made of different lengths to avoid difficulties of fingering. In orchestra music the oboe is not used beyond E flat in alt.

English horn. The English horn, or *vox humana*, is an instrument of the oboe kind, having the same relation to the oboe that the viola has to the violin. It has the same number of sounds as the oboe, only the scale is a fifth lower; so that pieces of music in F are written in C for the English horn, pieces in E flat are written for it in B flat, and so on.

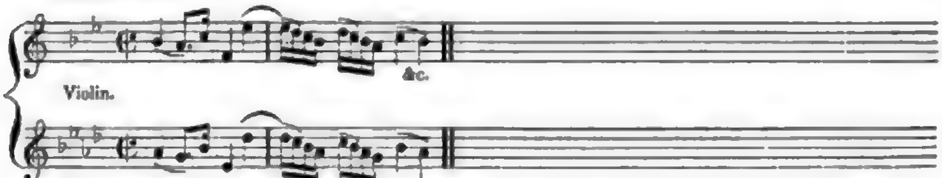
Clarinet. The clarinet, or clarionet as it is often called, is an instrument of great power and compass. We have corrected Choron's table, by extending its compass upwards to C above fifth ledger line in alt. The sweetest sounds of the clarinet are comprised between  and  The sounds between B on third line of treble clef and C♮ on second ledger line above are the most penetrating and brilliant. The sounds above that C♮ are very difficult to produce without harshness of tone. It requires great skill to play in tune on this instrument, particularly in the lower part of its compass. On this account, as well as to avoid difficult fingering, clarinets of different sizes are used to suit different keys. The most common used in orchestras are those in C, in B♭, and in A. Besides these, there are used, in military bands, clarinets in D, E♭, F, and G. These changes alter the pitch of the instrument, but the fingering remains as before. Thus the pitch of a B♭ clarinet becomes in its lowest sound ; that is, a tone lower than the C clarinet. The pitch of the A clarinet in its lowest sound becomes , and so on.

Music.

It is the custom to consider the principal key of every clarinet, whatever that may be, as if it were C. The composer must attend to this in writing for the clarinet. The B♭ clarinet serves to lessen the number of flats at the clef, and the A clarinet to lessen the number of sharps, and so of the others. When the piece of music is in E♭, the B♭ clarinet plays in F. The A clarinet plays in C when the piece is in A. If the piece is in A♭ the B flat clarinet plays in B♭, and so on. An example or two will make this rather puzzling matter more clear.

Clarinet in B♭. Clarinet in A.

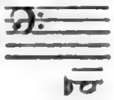
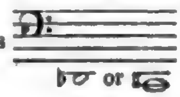
Clarinet in B♮.



A few years ago, a German instrument-maker invented a bass clarinet and a double-bass clarinet. The former is an octave lower than the C clarinet, and reaches B♭, the lowest note of the bassoon. The double bass clarinet has a compass of two octaves and a half upwards from the lowest F in bass clef. It therefore extends to a fourth below the bassoon. The union of these with common clarinets permits the formation of a clarinet quartett, and, of course, new orchestral effects.

Basset-horn. The basset-horn is an instrument of the clarinet kind, although differing in form from a clarinet. Choron has omitted it in his table. As it is sounded and fingered like a clarinet, any clarinet-player can play upon it also. It holds a middle place between the clarinet and the bassoon. Some authors give it a compass of four octaves from  to ; others a compass from  to . As it is an instrument difficult to manage, it is generally confined to the keys of C, F, B♭, and G. Mu-

sic for the basset-horn is written in the treble clef, and a fourth or a fifth higher than the real sounds; except in the case of arpeggios, &c. in its lower octave, which are expressed in the bass clef. For instance, if the music is in G or in F, the part for the basset-horn will be written in C. For examples of its use, see Mozart's *Requiem*, his *Figaro*, his *Clemenza di Tito*, and his *Die Enführung aus dem Serail*. It is too much neglected in orchestra music.

Bassoon. The bassoon is an instrument of the oboe kind, though it differs from the oboe in shape and construction. It holds the same place among the oboe class of instruments as the violoncello does among the violin class. Some writers state its compass to be from  to , or even to  among solo-players. Music for the bassoon is written in the bass clef for the lower sounds, and in the tenor clef for the higher ones. The easiest keys for it are C, F, B♭, and G. In general it wants the sound , and the sounds  are very bad, and must be avoided.

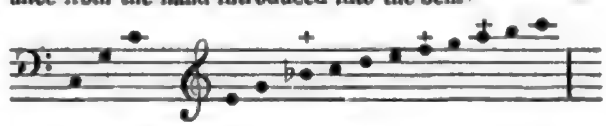
Of late years, some bassoon-players and instrument-makers have facilitated the execution of certain passages on that instrument by a new disposition of the finger-holes and the finger-keys. In orchestra music, bassoons are important instruments. They serve as a bass to the flutes, oboes, clarinets, and horns; they may fill up and enrich the harmony of the middle parts; they may go along with (in the octave or the unison, as may suit) and reinforce the double bass, the violoncello, the viola, the violin, the clarinet, the oboe, the flute, the horn; or they may perform solo passages of their own with great effect. Composers seldom put the bassoons to their proper and effective use, but too often make them a mere reinforcement to the other bass instruments.

Bass-bassoon. The bass-bassoon (fagottone or contra fagotto) is an octave lower than the common bassoon. It is not mentioned by Choron in his table. The first bass-bassoon seen in England was made by Handel's orders, for the use of Lampe, an excellent bassoon-player, and author of the music of the Dragon of Wantley. Being an unwieldy instrument, sixteen feet long, it was necessary to fix it in a frame like a telescope.

Serpent. The serpent is chiefly used in military music, but has of late been introduced into orchestra music to reinforce the basses. Mersenne says that a serpent played by a boy was sufficient to sustain the voices of twenty stout monks. Of late years some improvements have been made on it by the addition of keys, though it is still an imperfect instrument. Writers differ in the compass assigned to it. Some give it a compass from the lowest B flat of the piano-forte, up to G on the second line of the treble clef, with all the semitones. Others state its compass to be from lowest C of violoncello, up to C in third space of the treble clef. One eminent writer says that its compass is four complete octaves; that is, from C an octave below the lowest C of violoncello, up to C in the third space of the treble clef. He says the lower notes, in this last compass, are very difficult to produce, and their intervals not easily appreciable. Reicha assigns to it a compass of three octaves, viz. from lowest C of violoncello, up to C in third space of treble clef. The safest compass for ordinary players is the two first of these octaves only, leaving out the highest of the three. It is a singular fact, that there exists at this day, even among many professional musicians, a great deal of misconception regarding the real compass of a number of musical instruments of the wind kind. We have often been surprised to find that a performer upon a horn, for instance, did not know its real pitch or compass, and that he even supposed these to be just what appeared from the notation in the treble clef. Now, a C horn, for example, is a tube of eight feet or so in length; and, when played upon, becomes a tube stopped at *one end* by the lips, and therefore may render, as its lowest possible sound, one equivalent to that produced by an organ-pipe of sixteen feet open at both ends; that is to say, = C an octave below the lowest C of the violoncello. The serpent, if a tube of the same length, will, when played on with all the finger-holes stopped, be in a condition to render (but, like the horn, with great difficulty) the same low C as the horn.

Ophicleide. The name of this powerful brass instrument (from the Greek ὄφις and κλεὶς) signifies a keyed serpent. The ophicleide was invented a few years ago in Germany. It was at first used in military music only, but of late years has been introduced into orchestras. It is too noisy an instrument for any place but a large locality. There are several kinds of ophicleides, as of trombones, and music for the former is written in the same manner as for the latter. Examples of the judicious use of the ophicleide may be seen in the *Gloria* and subsequent movements, and *Marche Réligieuse* of Cherubini's third solemn mass performed at the consecration of Charles X.

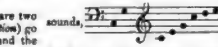
Horn (Ital. *Corno.*) Whatever may be the key of the piece of music in which horns are employed, their Parts are always written in the key of C. The following is the harmonic progression of sounds producible by the horn, without any assistance from the hand introduced into the bell.

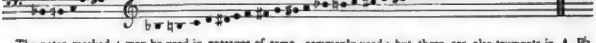


The sounds marked + are, successively, = to B flat, harmonic; G flat, ditto; and G sharp, ditto. See preceding section, *Musical Sounds and Intervals*. We may here remark, once for all, that the sounds called false and bad on the horn, trumpet, &c. such as the pseudo fourth and sixth and flat seventh of the scale, are *true* as *chromatic* harmonics, but do not correspond with the sounds found in the same nominal places in the *diatonic* scale. In treating of harmony, it will be seen that these same chromatic harmonics—called false sounds from their not belonging to the diatonic series—are frequently employed in modern harmony and melody. The dominant seventh continually occurs, and less frequently the diminished fifth and the augmented fifth, which are the other two harmonics in question. It must be observed, that if a horn in C, of eight feet tube, performs the above notes, the real sound of each is an octave lower than the notation indicates. Of late years it has been attempted to remedy the imperfections of the horn, and to render it capable of playing in a variety of different keys without difficulty. This was so far done in Italy in 1822, by means of eight finger-keys, and a sliding tube to regulate the pitch; but this improvement has not been generally adopted. Some German instrument-makers have also contrived stops, to be pressed down by the fingers, which are said to answer much better than keys. They have also applied these stops to trumpets and trombones. This has also been done in England. We shall consider only the common horns, as they are still used in some orchestras. The method generally adopted to alter the pitch of a horn, is to shorten or lengthen its tube by means of moveable bent tubes called *crooks*. In some few cases, horns of different sizes are used instead. Thus there are horns in C, in D, in E flat,

in E, in F, in G, in A flat, in A, in B flat, and even in C above. There are two B flat horns, the one an octave lower than the other. The lowest B flat horn goes a tone lower than the lowest C of the C horn. In writing for the horn, it is necessary to mark, at the beginning of its Part, for what key it is intended, as in the following examples. The Italian word *corni* (horns) is generally used in partitions.

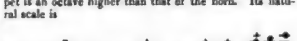
Music.

In general, in writing for an orchestra, there are two horn Parts, the first of which does not (by *notation*) go lower tnan the lowest C in the treble notation, and the second one not higher than E in the fourth space of treble clef. The compass is generally limited to the following sounds,  But in solo Parts for the horn, the compass is as follows, a number of the semitones being produced by a dexterous use of the hand within the bell of the instrument.

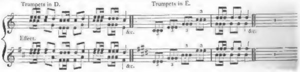


The notes marked + may be used in passages of some quickness, but should never be sustained. The sounds of the middle part of this compass, or at least from G on second line of treble clef to G above the fifth line, are the best. In modern orchestra music, the proper use of the horns is too often lost sight of. They are either too much employed, or used in passages quite unsuitable to their character and powers. Their best effect lies in sustained sounds, not in rapid passages. They should be used to enrich the harmony in proper places, or to sustain a principal melody, or to produce contrast by their solos judiciously introduced. By using at once three or four horns tuned to different keys, a number of rich and beautiful harmonic effects have been produced by modern composers. As the sounds of the middle compass of the horn are the best, judicious composers for that reason often make use of horns in a key different from that of the piece of music in which these take part. Sometimes, but rarely, we find horn Parts written in the bass clef, as more truly representing the compass of the instrument; but it is better to avoid difficulty in reading such notation, by conforming to the usual practice of writing horn Parts in the treble clef. Skilful horn players expend but little breath on their instrument, and thus produce its finest tone. Others not only exhaust themselves by strong blowing, but produce a harsh tone, and fill the tube with water from their condensed breath. This water contributes to spoil the quality of the tone, and to break it into gurgling sounds.

Trumpet. Trumpets in the keys of C, D, and E♭ are those most commonly used; but there are also trumpets in A, B♭, E, F, and G. It must be observed, that in some of these, F and G, for example, the gravest sounds are very difficult to produce. Some very skilful performers execute all sorts of passages on the trumpet; but, in writing for an orchestra, we ought not to go beyond rapid passages of double or triple tongueing upon a reiterated sound, or certain arpeggio passages. The trumpet may be either played softly, like the horn, or loudly with tongued passages, as in military music. To perfect the trumpet, finger-keys have been applied to it by some makers, and a sliding tube by others. Whatever the key of the music, the trumpet Part is written in C. The pitch of the trumpet is an octave higher than that of the horn. Its natural scale is



The notes marked +, like those of the horn, do not correspond with the diatonic series, and should not be used in sostenuto passages. The best notes are from  up to , and those higher had better be avoided.

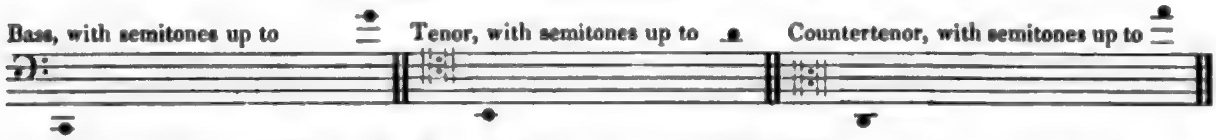


Trumpets, as well as horns, may be muted by introducing a pasteboard tube into the bell of the instrument. The sound then becomes extremely feeble, and the pitch is lowered a semitone. By using two trumpets in different keys (as in the case of horns), a number of harmonic combinations in minor keys may be introduced which could not otherwise be effected; also by combining together two or more horns in one key, with two or more trumpets in another. The penetrating and warlike sound of the trumpet renders it very effective in pieces of military music, and in music expressive of heroic or exulting feelings.

Trombone.

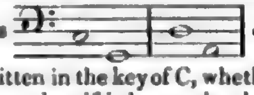
The trombone is a most powerful and effective instrument, but very difficult to manage correctly. In Italy the bass-trombone only is used; but in France, Germany, and England, there are three kinds of trombones, the bass, the tenor, and the counter-tenor. There is also a *double-bass trombone*, which goes a fifth lower than the common bass-trombone, but is not much used. The treble trombone is very rarely used; and it is better to add to the three former another counter-tenor trombone when four trombones are to be employed, than to add a treble one. In the performance of solemn, religious, or warlike music, the combination of three or four trombones produces a great effect; for instance, in the statue scene in Mozart's *Don Giovanni*, where the supernatural voice is accompanied by three trombones, two bassoons, two clarinets, and two oboes. The effect of the chant so accompanied is terrific. Mozart borrowed the idea from that passage in Gluck's *Alceste*, where the voice of the oracle of Apollo is heard in the temple.

Scales of Bass, Tenor, and Countertenor Trombones.



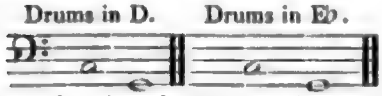
Parts for trombones are written in the above clefs; and, as in the case of bassoon Parts, the key is marked at the beginning, or accidental sharps or flats introduced when required. It is to be noticed, that there are trombones in different keys, for different purposes: in F, C, G. Sustained sounds are most suitable to the trombone, especially in orchestral combinations. A very few players are so skilful as to be able to execute very difficult solos on the trombone; such as Schmidt, who performed on it in London in 1829. The trombone can be *muted*, like the horn or the trumpet, and then its effect in funereal music becomes very striking. Chromatic passages ought, in general, to be avoided on this instrument.

Kettle-drums.

Kettle-drums, called *Timpani* in Italian, are tuned to various keys, as occasion requires. They are generally in pairs; one of them sounding the key-note of the music, and the other the 4th below, as  &c.

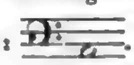
The Part for them is always written in the key of C, whether the key of the music be C or not; but if it be another key, this is marked at the beginning, as

Drums in D. Drums in E♭.

 &c. It has been proposed to introduce into orchestras three drums tuned to different sounds; and perhaps there might often be advantage in this. We have seen a vocal and orchestral composition for forty voices and forty-two instruments, in which eight kettle-drums were employed. They were to be played by four persons, and were tuned thus: from G upwards, A flat; A, B flat; C, D flat; D, E flat.

The *roll* of these drums, when executed *piano*, has a sombre and mysterious effect. It is usually marked *tr*—— or *ss* over the notes. Clarinets, horns, trumpets, and drums, may be changed for others in the course of a piece of music, provided a sufficient number of bars of rest are given.

Bass-drum.

Tamburone in Italian, or vulgarly *cassa grande*. This is a very large drum, of the usual cylindrical shape, and is used chiefly in military bands, but occasionally in great orchestras. In Haydn's symphony, called the *Surprise*, it is used with startling effect. Its Part is written in the bass-clef thus: .

Gong.

The gong is occasionally used in theatrical music, to add to the effect of scenes where terror and confusion predominate.

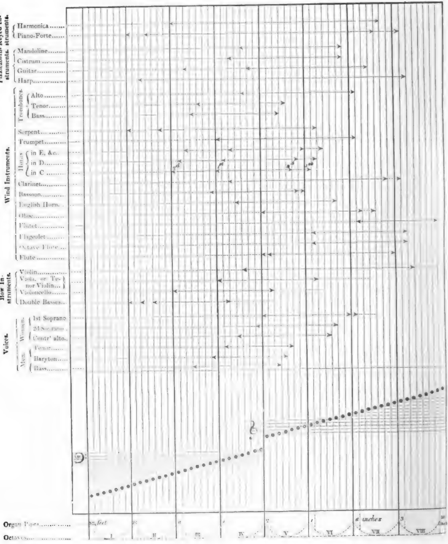
Chinese pavilion, &c.

The Chinese pavilion, the triangle, the common drum, and cymbals, are almost entirely confined to military music, though they are sometimes used in theatrical orchestras. In Mozart's *Die Entführung aus dem Serail*, the orchestra Parts of the duett "*Vivat Bacchus*" contain bass-drum (*tamburo grande*), *triangle*, and cymbals (*piatti*). Parts for the triangle, Chinese pavilion, and cymbals, are written in the treble-clef upon C the third space.

To point out all the difficulties of the wind-instruments above mentioned, and all the particular passages that should be avoided in writing for them, would occupy a volume. We shall merely notice, that in the flute, oboe, clarinet, and bassoon, the finger-keys of these instruments often render the performance of certain *legato* passages impracticable, and that therefore the composer ought to make himself acquainted with all these niceties. If he do not, his music, however excellent in other respects, can never produce the effects that he intended. We have dwelt more at length upon these matters regarding voices and instruments, because they are really of great importance to the musician and the composer, and because they have been hitherto too much neglected in our British treatises upon music. What we have stated in our general view of voices and instruments will preclude the necessity of entering into details regarding most instruments under their alphabetic heads in other articles of this Encyclopædia.

The guitar, the harmonica, the harp, the organ, and the piano-forte, are mentioned in Choron's table; but we have no particular remarks to make upon them in this place. We shall have something to say of the organ and the piano-forte in speaking of accompaniment, in the course of the present article.

Table of the Compasses of Voices and Instruments.



Melody may be considered in relation to a single voice or instrument, or as accompanied by one or more voices or instruments. In the latter case it is called the principal melody. There are many simple and expressive melodies, of such a kind that they will hardly bear any accompaniment without injury to their effect. Too often such melodies are spoiled by the addition of crowded and elaborate accompaniments, having nothing in common with the melody in style or character. This is one of the great mistakes of the modern schools of music, though we have no doubt that a better taste will prevail when more study is bestowed upon melody as the most important part of musical composition. We cannot too often repeat, that harmony ought always to be considered as subordinate to melody, although we are aware that certain great and peculiar effects may be produced by harmony, independent of melody in the true sense of the latter term; for instance, such effects are heard in certain forms of solemn ecclesiastical harmony that contain hardly a vestige of melody. The effects of mere harmony are often very striking when produced by a certain combination of voices, or of instruments, or of both, and in a building sufficiently spacious and suitably constructed, or even in the open air when heard at a certain distance, and especially if they pass over an expanse of still water. In ancient ecclesiastical music, the length of the sounds and the simplicity of the harmony were well calculated to produce a great effect in large cathedral churches. In such places, rapid changes of sounds, and chromatic harmonies, never produce any thing but confusion; and this ought to be kept in view by the young composer. He must calculate the effect that his music will produce in a cathedral or in a theatre, a concert-room or a private room. No one who has not observed the difference of effect produced by the same music in places of different size and construction, can understand how important it is to attend to all this. But we must not encroach here upon another section of this article.

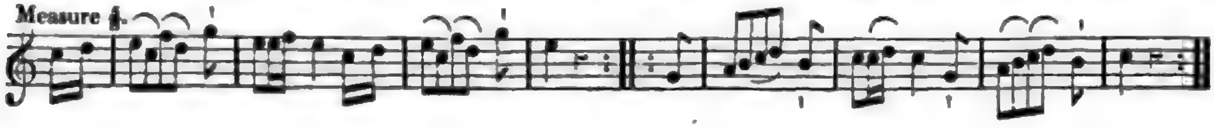
The study of melody is by far too much neglected. Harmony has generally in these days usurped its place; and we find ten good harmonists according to rule, for one good melodist. The reason is, that a man without real musical genius may become a very good scholastic harmonist, while a great melodist must be a man of great genius. Handel was in his day *one* of the most remarkable musicians for *general* excellence in both melody and harmony; but he was a man of the highest musical genius, and his profound skill in all the harmony of his time could never altogether check the flow from the spring of melody which existed in his mind. In his oratorios and his operas that spring is never failing. It is a pity that Handel's operas are now so little known. They contain much beautiful melody, although that is often disfigured (as in his oratorios) by conventional passages of a formal kind, which must, like all other such passages, become quite antiquated after a short time, having no foundation in any thing but temporary fashion of style.

In the proper order of musical study, melody ought to precede harmony. It is from reversing this order that so many dry unimaginative harmonists have been produced;—men actually rendered incapable of composing good melodies, or of appreciating their beauties when heard. The student ought to have daily before him specimens of the most beautiful and expressive melodies in all styles, and of all nations. It is much to be regretted that there has not been published any judicious and comprehensive collection of such melodies. It would be invaluable to the student.

One of the earliest writers who treated of melody was Salinas, a Spaniard, and blind, but an eminent musician, and professor of music in the university of Salamanca. His work, which is now very rare, was published in Latin in 1577, at Salamanca. The fifth, sixth, and seventh sections of it are devoted to the consideration of the nature of musical, oratorical, and poetical rhythm. There is a great deal of curious and instructive matter in these sections, and he illustrates his text by numerous fragments of melody, some of which are very interesting, being old Moorish, Spanish, or Italian melodies. We have given some of these as curiosities in Plate III. Salinas says (page 235), "In the three following books (sections) we have to treat of the rythmical part of music, a part of it not less useful, and even more delightful, than the harmonical part."

Another of the earliest writers on melody was G. B. Doni, the Florentine musical amateur and antiquary. Among his published works (3 vols. folio, 1763) we find many sensible remarks upon melody, and some curious notices of the distinguishing characteristics of national melodies (see, in particular, his *Trattato della Musica Scenica*, vol. ii. of his works). Speaking of the remarkable difference in the pronunciation of Latin by the French, Spaniards, and English, as compared with its pronunciation by the Italians and Greeks, he says, "This difference arises from the diversity of the accents, and the elevations and depressions of sound."..."We may say that common speech is a kind of outlined melody; and the mode of speaking in the recitation of poems, a kind of shaded melody, half finished; while true melody, called by the Greeks [illegible] μέλος, is perfect and finished, and, as it were, completely coloured." (P. 18 of *Trattato*.) With regard to setting of words to music, he says, "One of the most important remarks, and one perhaps not attended to by any person at present, is, that the music should not imitate the words, but the whole sentiment of the poetry; for in this consists true musical expression." He adds, that "Mimics and buffoons adopt the other mode; and, by exaggerated looks, and gestures, and noises, attempt to enforce the words they utter, or to represent the passions they are supposed to feel. (P. 29.) "Melopoeia is the art of composing beautiful melodies, without any reference to counterpoint, which belongs to another part of music." (P. 35.) As to modulation, he says, "The moderns are too scrupulous in wishing to keep always in the same key; a custom perhaps derived from the ecclesiastical chants, but quite unsuitable to varied and scenic melody." (P. 33.) Chapter xvii. of Doni's *Trattato* contains a number of ideas which Reicha has borrowed and developed in his Treatise on Melody. Doni proposes the use of *quinary*, and even *septenary* measures, such as $\frac{5}{2}$, $\frac{5}{4}$, &c., or $\frac{7}{2}$, $\frac{7}{4}$, &c. Reicha has also proposed the adoption of the quinary measure, and gives a specimen of its use in a national dance-tune of the district of Kochersberg, on the Lower Rhine, in the old province of Alsace. Reicha says, from information sent to him, "The manners and customs of the inhabitants of Kochersberg distinguish them completely from the other people of Alsace. Their dances have a particular and remarkable character, and nothing in common with those of their neighbours. The tunes of these dances have a very decided measure of five times. Tradition, in the country, carries back this music to the remotest antiquity."

Measure $\frac{5}{4}$.



William Shield, a clever English composer, introduced a movement in this quinary measure into one of his instrumental trios. Two or three other Englishmen, and several Germans, have attempted the same measure; but it has not been generally adopted, though there is no *reason* but *custom* and *habit* why it should be rejected. Doni says (p. 74 of *Trattato*), "If the septenary measure could be conveniently adopted, it would produce a more remarkable effect upon the ear than any other, and it would suit lachrymose and compassionable subjects. But we let this alone, because it will be no small matter if we bring the quinary measure into use."

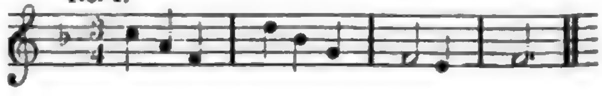
The following passage from Doni relative to national melodies is interesting, as having been written more than two centuries ago: "Although Italian music seems the most excellent and varied of all, still let us remember that *non omnis fert omnia tellus;* but that one nation abounds in one thing, another in another thing, according to the different genius of each. Therefore the judicious composer may draw from French airs (which have great variety and lightness in lively subjects), good passages and spirited and pleasing melodies. From the old Spanish airs he may derive many hints regarding melody and rhythm, for grave and majestic subjects; for example, from the Pavana; and from modern airs, and those borrowed from the Moors, he may also draw beautiful and lively melodies, but more soft and effeminate. Portuguese melodies may afford him very tender and affecting passages; and, for mournful and lugubrious subjects, he may enrich his imagination with Sicilian melodies, although they have little variety; and if he will go farther, he will find in English" (Scottish? Irish? Welsh?) "and German airs something to imitate in certain bold and military conceptions; there being perceptible in these airs, especially the German, a certain manly and military character," &c. (P. 131, *Trattato*.) The Spanish ex-jesuit Eximeno, in his work *Dell' Origine, &c. della Musica*, published in 1774, says, "In Italy national airs are not common, for most of the people have so fine an ear that it is enough for them to hear the opera airs, in order to amuse themselves afterwards by singing them in the streets." However, he adds, "The country people and villagers have their songs and tunes in a simple style, but in good taste. The romanella, which they sing accompanied by the colascione, is full of good taste, and still more so the tamburo of the Trasteverini. The taste for songs reigns chiefly in Venice; and although they are usually composed by professional musicians, the people learn them easily."

In Plate III. we give the tamburo, No. 1, and a beautiful Venetian air from Eximeno, No. 2. The tunes to the Spanish romances Eximeno thinks "monotonous and tiresome," and believes them to be remnants of Moorish melody, or else ancient sprouts of the Canto Fermo. "The most tasteful popular songs of Spain are the Seguidillas, of which there is an endless variety." (See Plate III., No. 4.) We have given a few other specimens of curious melody which have not before been published in Britain. Among these are (Plate IV.), No. 15, a German melody of the year 1425; No. 17, Egyptian air, performed "with all their might" by the musicians of Grand Cairo, when the principal inhabitants, headed by all the sheiks of the town, went to meet Bonaparte on his return from the Syrian expedition. It was dictated by the chief of these musicians to one of Napoleon's. The performer accompanied it on the instrument called in Arabic *al oud.* Hence the English name of *lute*, Spanish *laudo*, Italian *liuto*, French *luth*. No. 18 is a song and chorus of cannibals. This curiosity was written down by a Russian voyager (Councillor Tilesius) in 1804, and published in the Leipsic *Musical Gazette*, No. 17, in 1805. Tilesius passed a night in listening to this music among these savages, in one of the islands of St Christina. He says, "there was something frightful in this melody, which almost drove one to desperation, and seemed to make one hear his own funeral dirge." He mentions, as a curious circumstance, that the voices of these savages passed, by sliding through very small intervals, from the E to the G of this chorus, or the converse. The savages, several hundreds, men and youths, sung it in unisons, or octaves, and danced at the same time. They marked the measure by clapping their hands, and also by beating drums. Tilesius explains the meaning of this chorus. "The warriors have returned from battle. It is night. One of them perceives a distant fire on the enemy's island. He asks, 'Where is the fire?' The chorus answers, 'Upon Tanhuatah Montanioh, among our enemies! they are roasting our dead and the captives!' This renders them frantic; they call for fire immediately, and feel a pleasure in being able to use it in reprisal against the dead, and prisoners taken from the enemy, but not without compassion in thinking of the wives, the children, the relatives, who will weep at that moment. Finally, they reckon the days from the first to the tenth, indicating the time fixed for feasting upon the victims, and for solemnizing the victory." An English writer of the last century, when speaking of Scottish music in one of his essays on various subjects, says, "Who was it that threw out those dreadful wild expressions of distraction and melancholy in *Lady Culross's Dream?* an old composition, now, I am afraid, lost; perhaps because it was almost *too terrible for the ear.* I'll venture to swear that David Rizzio was as innocent as any lamb of all such frantic horrors." The examination of the melodies Nos. 1 to 18 inclusive will suggest matter for reflection. We would point out especially the elegance of No. 2, the expressive character of No. 4, the beauty and absolutely *modern modulations* of No. 14 (of fifteenth century), the curious rhythm and changes of measure in No. 15, the wild and singular cast of the Egyptian air, No. 17, and the hideously lugubrious character of the cannibal chorus, No. 18. Burckhardt, Bowdich, and some others, have published curious specimens of African melodies. We can only refer to these, and to a great variety of national melodies, Russian, Danish, Swedish, Norwegian, Polish, Bohemian, Hungarian, Greek, Spanish, Italian, Sicilian, Welsh, Irish, Scottish, &c. &c. that have appeared from time to time in collections, or detached. Among foreign national airs, we may mention some rescued from obscurity among the mountains of Auvergne, by that admirable English amateur and accomplished composer, the Honourable George Onslow. He has introduced some of these interesting national tunes of Auvergne into his violin quartetts, &c.

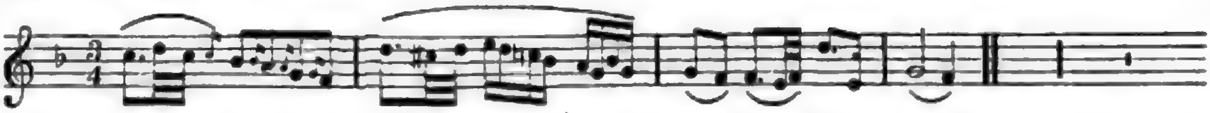
Rhythm and structure of melody.

Reicha, in his *Traité de Melodie*, is the latest writer upon this subject. Several valuable works upon it by Italian and German writers had preceded Reicha's treatise. Among these writers may be mentioned Pisa, Sacchi, Nichellman, Riepel, Koch, &c. A translation of Reicha's Treatise on Melody, with some judicious notes and modifications, would be a useful offering to British students of music. Before we proceed farther, we must advert to what we consider as an error in treatises on melody or harmony. We allude to what are called *passing* notes, or *unreal* notes, and which are said not to form any *real* part of the melody or the harmony. It appears to us very plain that this is a mere fallacy, and that *every sound* that is *actually heard* in a melody or a harmony is just as *real* a sound as any other can be. For example, we take the following melody:

No. 1.

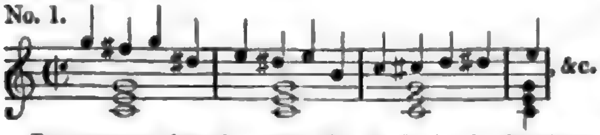


 And then this one, No. 2.



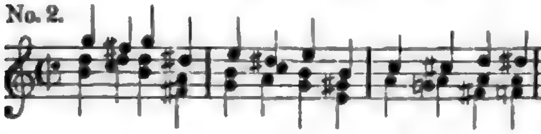
We shall be told that this No. 2 is only No. 1 varied, or embellished by notes of grace, *passing* notes, *unreal* notes, that do not belong to the melody. But No. 2 is a melody *per se* as much as No. 1; and supposing No. 1 had never existed, No. 2 would still be a real melody, and all its sounds *real* sounds. It would startle us were a poet to say, "Such and such words in my poem are not to be taken as *real* words, but merely as *passing* shadows of words that do not belong to the language, or melody, or harmony, or meaning of my verses." There can be no doubt that if we pre-establish a certain chord, we may say that any sound that does not form one of the sounds of that chord is not a sound belonging to it. This is easily exemplified.

No. 1.



But suppose that the notes F♮, D♮, B, C♮, in the above passage were to occur as *real* notes in a melody—and might they not do so?—what then becomes of their *unreality?* For instance,

No. 2.

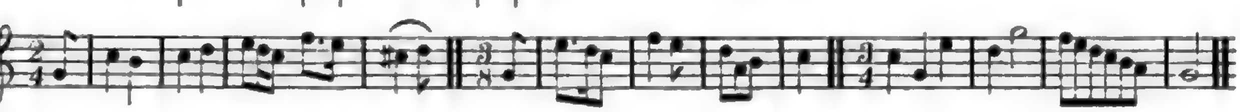


To avoid all uncertainty of *meaning* as to *intonation*, we shall take these passages as if performed on the organ or the piano-forte. All that we could rationally say in such cases would be, that the ear *may* be pleased by the one harmony as well as by the other, according to circumstances; but that the melody in both cases is a *real* melody, and cannot be explained *harmonically* in either case by the *generally received system* of the fundamental bass.

Musical rhythm, in its general sense, applies to the symmetrical arrangement of the sounds of a melody.

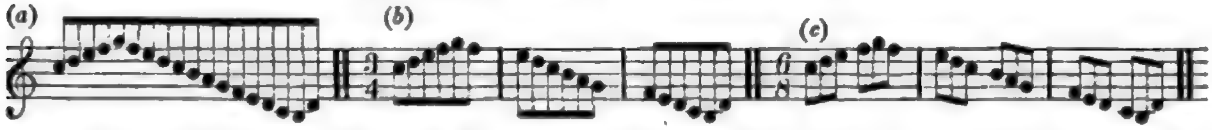
Measure is the manner in which these sounds are divided into portions of equal duration, and this division is represented in musical notation by means of bars; the notes, pauses, &c. contained between two bars constituting a measure.

Times, as they are called, are the subdivisions of a measure into its simpler aliquot parts, binary or ternary, or quaternary or senary, &c. It might be better to use the terms *accented* or *unaccented aliquots*, rather than *strong* or *weak times*. But musical nomenclature requires a thorough reformation. It is the perception of a decided rhythm in the sounds of a measure that has given rise to these terms *strong* and *weak times*. Certain modifications of two, or three, or more aliquot parts of a measure, in regard to accentuation, how faint soever this may be, or the regulated succession of sounds of unequal duration, will impress the ear with a particular rhythm, binary or ternary, or quaternary or senary, &c. &c.



Were all the sounds of the following passage (*a*) performed with perfect equality of intensity and duration, no strong nor weak times would be perceived; and yet it is divisible into exact measures of different kinds, producing different rhythmical effects, as at (*b*), (*c*).

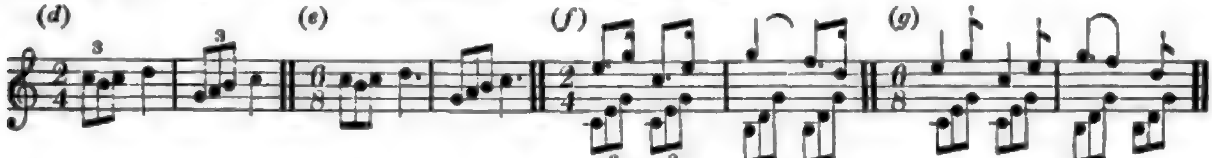
(*a*) (*b*) (*c*)



Sometimes, to produce a particular effect, the accent or emphasis is thrown upon the weak times of the measure.

It is plain enough that the simplest elementary forms of musical measure are the binary and the ternary, and that the compound forms arise from a duplication, or quadruplication, &c. of the binary, or a duplication, triplication, &c. of the ternary, or by certain combinations of the binary with the ternary. In the latter case, we have quinary and septenary measures. The last of these is not in use, but the former is occasionally employed. It may be remarked, that although these quinary and septenary measures are generally avoided by composers, yet *periods* of melody containing five or seven *measures* are of frequent occurrence. In binary and quaternary measures we often meet with triplets which really belong to a measure ternary or senary, &c.

(*d*) (*e*) (*f*) (*g*)



Thus (*d*) produces on the ear the same effect as (*e*), and (*f*) the same effect as (*g*); so that there would really be no impropriety in writing (*e*) for (*d*), or (*g*) for (*f*). Haydn's beautiful canzonet, *O Tuneful Voice*, and the larghetto movement of Beethoven's charming *Adelaida*, are examples of the use of compound ternary measures; while the sign C at the clef, and other circumstances of notation, lead one by the eye to infer that the measures are compound binary ones. But the effect upon the ear, from the predominance of continuous triplets in the ac-

companiment, is that of compound ternary measure. A curious instance of the intermixture of different measures in melody and harmony occurs in the dance-scene near the end of the first act of Mozart's *Don Juan*, where there are three different orchestras, each playing a different tune, one in $\frac{3}{4}$, the other in $\frac{3}{8}$, and the third in $\frac{2}{4}$. Intermixtures of different measures were not uncommon in the works of composers of the fifteenth and sixteenth centuries, but generally produced nothing better than confusion.

The only modern music that is not divided into measures is simple recitative. It has often been desired by composers of music, that the inflexions, the varying sounds of declaimed language, could be reduced to a musical notation more delicate and accurate than the one in common use. To enable us to express such inflexions, a notation for *very minute* intervals, as well as for peculiar accents, would need to be contrived. The attempts to express such declamation are represented by recitatives and *arie parlanti*. Some of these are remarkably expressive, from their near imitation of the inflexions of the voice in declamatory and impassioned language; among others, those of Gluck and Piccini. Beethoven, among the very few remarks that he has left to us upon recitative, says, "Recitative ought to be declaimed as if it were spoken. It is a discourse sometimes accelerated, sometimes retarded, according to what is required by the impassioned expression of the words. The comma, the semicolon, the colon, the period, the sign of interrogation, and of exclamation, each require a different accent." "To compose a recitative well, it is useful, previously, to declaim the poetry to one's self, as an intelligent actor would do. Any composer who has not ability to do this, ought not to be ashamed to have recourse to some one who can aid him." The best composers of recitatives have carefully studied the declamation of the great actors of their day. The danger lies in imitating false inflexions of the voice, intended to express natural feelings or passions.

We shall now give a brief statement of some of the chief points in Reicha's Treatise on Melody, referring the reader to that work for all developments and minutiæ. The treatise consists of a hundred and twenty-three quarto pages of letter-press, and seventy-five plates. "Melody is nothing but a succession of sounds; but if these sounds were placed at random, they would form no sense, that is to say, no melody. It is the same as in regard to words not connected by syntax, nor directed by the understanding. The circumstances that connect sounds together so far as to form a musical sense, are, 1. the key; 2. the measure; 3. the different durations of the sounds; 4. the slurs which connect these more closely; 5. the rhythm; 6. the perfect equality of the *timbre*; 7. the period in which the sense is more developed; all this being guided by feeling and taste. Ideas and periods are separated from each other by points of repose, which are cadences of different kinds. In order to see how all these objects form melodic ideas, and contribute to connect them together, it will not be superfluous to analyse here the following period:

PERIOD.

First Melodic Phrase, composed of three designs. Second Melodic Phrase, composed of three designs.

(First Member. First Rhythm.) (Second Member. Second Rhythm.)

Allegretto. ¼ cadence. ½ cad. ¼ cad. ¼ cad. ¼ cad. Perfect cad.

The following are Reicha's explanations of technical terms, which he uses in his treatise on melody.

"1. *A quarter cadence*, or a point of repose weaker than a half cadence, and which serves to separate one melodic design from another.

"2. *A half cadence*, which separates one member and one rhythm from another, and which ought consequently to be stronger than the preceding cadence.

"3. *A three-quarter cadence*, which is stronger than the half cadence, and weaker than the full cadence, but which terminates a period as well as the latter, the difference between them existing only in the key in which we end. Thus, the first period of an air of two strains which ends on the dominant, would be only a three-quarter cadence, because another period is required in order to return to the tonic.

"4. *Perfect cadence*, which terminates the period in a positive and indubitable manner; but which does not hinder other periods from being added, if this be thought proper.

"5. *Interrupted cadences*, where, instead of the final sound, we fall upon another, or else leap suddenly from the final sound to another sound.

"6. *Melodic design*, a short musical idea separated from another by a quarter cadence. Two or three of these designs may form a member, which last ought to form a half cadence.

"7. A member of a period is composed of one or of several designs, and ought to make up a rhythm, and form a half cadence.

"8. *A period* may be composed of different designs and of different members. Its cadence is final, or else a three-quarter cadence, which may be called a perfect cadence relative to the key.

"9. *Rhythm* is the extent or the symmetrical and comparative number of the melodic members. It may have all the cadences except the quarter cadence.......Measure divides into equal parts a series of simple times, as, for example, crotchets in common time; and rhythm divides into equal parts, and consequently in a symmetrical manner, a series of measures. Hence we may say with propriety, that measures are simple times of rhythm, as the crotchets and rests are the simple times of a measure.

"10. *The complement* is a little melodic design that fills up the pauses which occur between the members.

"11. *The supposition* is a measure which, in the theory of rhythm, counts as two; 1. as final measure of the first rhythm; and, 2. as initial measure of the following rhythm.

"12. *The echo* is the repetition of a part of a melodic design, executed by other instruments, and which is not reckoned in the rhythm.

"13. *The coda* is the confirmation of the end of a piece of music. It is also sometimes employed at the end of a period, either at the beginning or in the middle of the melody; but in this case it is short. When it terminates a piece, it ought to increase the animation of the music. It is for this reason that interrupted cadences and the supposition are employed in it, and that it is often executed with an accelerated movement. As to the length of the coda, it depends upon the duration of the piece. When the coda finishes a grand piece, it may be compared to the peroration of an oratorical discourse."

We pass over Reicha's explanations of "Le Retard de

Music.

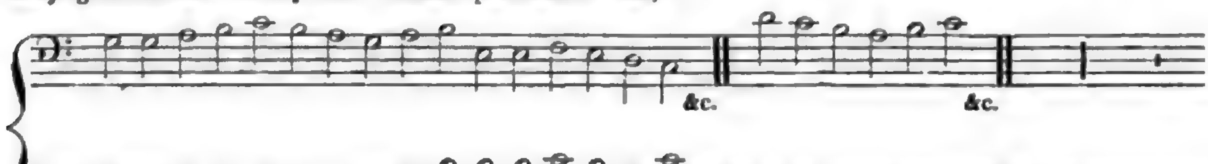
la Cadence," and of "Le Conduit," as these relate merely to arbitrary embellishments introduced just before a final cadence, or between one period and another.

To please a vitiated public taste, most modern performers make an overwhelming use of such *embellishments*, as they are called. Among singers, for instance, none would be listened to who did not prepare to conclude every melody, no matter how simple and unsuited to such trappings, with a flourishing cadenza and a long *shake*. Pietro Verri very properly abominates all such formal shakes and cadences, and desires all rational melodies to be finished off by a simple appoggiatura. G. M. Raymond, writing in 1811 of singers of that time, says: "L'un chante avec les épaules, les bras, les coudes, le corps tout entier; l'autre pousse des cris et pratique des élans qui prouvent suffisamment ses bonnes intentions; celui-ci se livre à des mouvemens convulsifs qui peignent l'excès du sentiment; celui-là à des efforts semblables à ceux qui accompagnent les nausées, et qui ne remplacent pas mal les mouvemens de l'âme et les accens du cœur," &c. All this applies too nearly to many of the singers of 1837.

Among most writers upon music, we find great confusion regarding *feet, cæsures, phrases, clauses, sections, times, rhythms*. We think that, in general, Reicha has been more successful in clearing up and simplifying these matters. His $\frac{1}{4}$, $\frac{1}{2}$, and $\frac{3}{4}$ cadences come in place of the confusion of cæsures, phrases, clauses, &c. He shows, by numerous examples, the nature of these melodic cadences, and of the final cadence or period; and also of melodic designs, members of periods, periods, rhythms, &c. A discrepancy occurs in what he says (above cited) regarding $\frac{1}{4}$ and $\frac{1}{2}$ cadences in melodic *designs* and *members;* and we have to object to what he says about *the supposition* (article 11, *supra*), as being a measure that counts as two in the theory of rhythm. In a matter of this kind there are really no *suppositions* made by the ear. It hears neither more nor less than what it hears. As to the echo (article 12) "not being reckoned in the rhythm," we conceive that it ought to be just as much so as any other passage in the melody. Reicha refers to Haydn and Mozart as models of skill in the development of a melodic subject, and we cordially agree with him. He says that a treatise upon melodic modulation is wanted; also one upon the accompaniment of melody. We refer to Plate V., No. 19, for an example of the mixture of different rhythms in a melody of Paésiello. There is an almost inexhaustible store of melodies, in all their forms, in the works of ancient and modern composers. The student who examines these works will find, that the modern melodists have, in general, little to boast of in originality. To give an instance, one of the most popular vocal compositions in England, *Oh, Happy Fair*, is framed in its commencement, in melody and harmony, upon a church chant of C. P. E. Bach.

Harmony.

Harmony has been defined by an eminent French philosopher of our day, "a succession of chords, subjected to certain laws, according to which several different melodies, governed by a common rhythm, and heard together, produce an agreeable effect to the ear." This definition is, like many other technical ones, unintelligible to every person who has not studied harmony. But we shall make only one objection to it, which is, that very frequently harmony contains little or no melody, properly so called. It must be kept in view that harmony has its own peculiar means of producing effects, independent of melody, or, at least, of any prominent melody. It is more vague in its effects than melody; and, being more complicated, is less generally relished and understood than the latter. A chorus of Handel, or a symphony of Beethoven, requires a trained ear to relish and understand it fully. The progress of both melody and harmony was slow in improvement, as the history of music shows. As the materials of each were increased, like the enrichment of a language, melody and harmony assumed new forms, and became more copious and expressive. To assign limits to what may be called *improvements* in melody or harmony is impossible, since the plastic nature of the human ear is such as to be capable of being trained to relish almost any peculiarities in music, as in the sounds and inflexions of language. When we find that, in ancient times, a rude, unmelodious, ecclesiastical chant, and its accompaniment by another voice in consecutive octaves, fifths, and fourths, were considered as the perfection of melody and harmony, it is hard to say what the human ear may or may not be trained to relish. Gerbert, in his work *De Cantu et Musica Sacra*, gives several specimens of this strange harmony of the fourteenth century. See vol. i. pp. 376, 392, 435, 6, 7, 8, and 456, 7.



But something still more curious than this is given by Franchino Gafforio in the fourteenth chapter of the third book of his work *Practica Musica*, published at Milan in 1496. Under the head "De Contrapuncto Falso," he says that it was anciently the custom to sing a counterpoint composed of dissonances; that is to say, of second major and minor, perfect and major fourth, seventh, and ninth; and that such counterpoint was used in the fourth century in solemn vigils, and in certain masses for the dead. He gives the following example of this horrible counterpoint, as having been sung in the cathedral of Milan, from an ancient mass for the dead. He confesses it to be hideously bad. We avoid the alto clef, for the reader's sake; so the example should be performed an octave lower than it is here written.

Doubtless the human ear was *then* not a different organ from what it is *now*, and yet we should consider such harmony as intolerable. But to many persons the noisy confusion of certain modern compositions for orchestras *and* voices is delightful; voices yelling and growling, and, in the orchestra, all sorts of heterogeneous instruments mingled together to make a chaos of deafening noises. When we find, in a celebrated German orchestra, musical effects attempted to be produced by cracking of whips, firing of pistols, jingling of post-horse bells, ringing of bells of all sorts and sizes, thrumming on the Russian balalaika, beat-

ing of drums, and so on, and all this received with rapture by a civilized European audience, we may well be justified in saying that it is hard to tell *what* the human ear may or may not be trained to relish in music, or rather in noise. Such music reminds us of the pewter dish, the tongs, the bellows, and the salt-box, used as solo or concerto instruments, according to No. 90 of the Babbler; or of the hog-concert, produced by order of Louis XI. Bayle gives the passage on this subject from Bouchet, *Annales d'Aquitaine*. A great number of hogs of different ages were confined in a tent covered with velvet. In front of the tent there was an apparatus with keys like an organ. These keys communicated with the hogs in the tent, and were armed with needles, so that when the performer touched the keys, the hogs were pricked by the needles, which "les faisoit crier en tel ordre et consonance, que le Roy, et ceulx qui estoient avec luy, y prindrent plaisir."

The opinions of theorists on the subject of chords alone, without reference to their successions and modulations, are very much at variance. Some reckon only one single fundamental chord, formed from the first harmonics of a vibrating string, and which chord, they say, contains all the other chords. Other theorists assume two fundamental chords, others seven, others twelve, others thirteen, others seventy, and so on. Another theorist reckons so many as 3600, and among these, 700 dissonant fundamental chords. Besides all this perplexity and contradiction, these theorists give no satisfactory explanation of a multitude of phenomena belonging to modulation and harmonic combination. We would advise the student to pay very little attention to theories, but a great deal to the works of the best composers. Our space permits us to make only a few occasional remarks upon some received opinions regarding harmony, which seem to us to be erroneous.

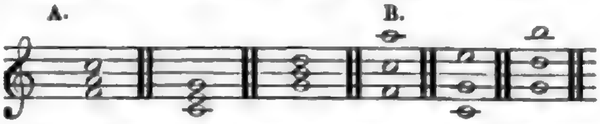
Hitherto, what is called thorough bass has been confounded with figured bass; and both, as if one and the same thing, have been ascribed to L. Viadana as their inventor, in the beginning of the seventeenth century. But it appears that Viadana was not the inventor of figured bass, and that his thorough bass (*basso continuo*) has nothing whatever to do with figured bass, or with the doctrine of the progressions of chords. This appears clearly from his Italian work published at Venice in 1608, in five volumes 4to. It contained what he called "a hundred ecclesiastical concertos for one, two, three, and four voices, with the continuous bass (*basso continuo*) to be played on the organ." He says he invented these pieces in 1597, at Rome, and that his chief reason for composing them was, that there were no pieces of the kind constructed for one, two, or three voices, with organ bass. In these concertos, the organ bass had no pauses, and was therefore called *basso continuo*, that is, *continuous* or *thorough bass;* but it was not figured. The organist played this bass, *and* the voice part, or parts, as they lay before him. G. Sabbatini, a contemporary of Viadana, was the inventor of the *figured bass*, as appears from his work published at Venice in 1628, in which all the basses are figured, and in which he claims this invention. But this invention, which might serve well enough in these days for *slow* and *simple* music, accompanied on the organ according to *certain fixed rules*, has been, unfortunately, brought down to our day, when it is worse than useless, although the teaching and practice of it are still persevered in, to the great disadvantage and perplexity of musical students. Besides, different composers and different nations have different ways of figuring their basses, which adds to the confusion and difficulty. This clumsy contrivance should be entirely abandoned by all modern composers, who ought to write down in the common notation, fully and exactly, the accompaniment as they wish it to be performed.

A chord, as it is called, consists of two, or three, or four, or more sounds, heard at the same time. A primary *consonant* chord consists of intervals such as those given in the following examples, No. 1. A, B, and No. 8, *a*, *b*. Examples of primary *dissonant* chords are given at No. 4, *a*, *c*. Other dissonant chords will be afterwards noticed. The tonic or key-note of every scale may be considered as the central point to which, in the course of a melody, or a harmony, the other sounds of the scale converge, or from which they diverge; in the former case producing tonic cadences or reposes, and in the latter, imperfect cadences and inconclusive passages. We have already seen that the sounds of a scale, whether major or minor, may be derived from the harmonic products of three sonorous bodies, representing the tonic, the dominant, and the subdominant. In the scale of C major, for example, the simplest harmony belonging to the tonic, the dominant, and the subdominant, considered as bass sounds, will appear in the three following chords, either as they stand at A, or with a changed position, or inversion, of the two upper sounds in each, as at B.

No. 1.

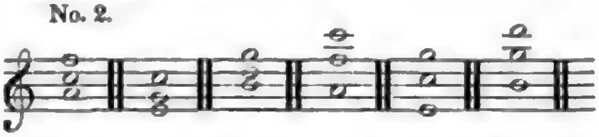
Subdominant Common Chord. Tonic Ditto. Dominant Ditto. Changed Position.

A. B.



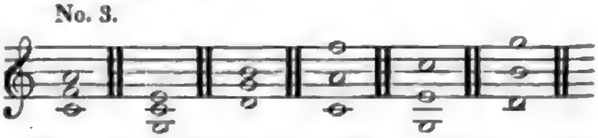
These chords, as they stand, cannot form a harmonic succession, on account of the consecutive fifths between them. In harmony, as in melody, the intervals are reckoned from the lower sound upwards. Each of these chords is called a major common chord, and consists of lowest or fundamental sound with its major third and perfect fifth. The change of position at B makes no difference in the name of the chord, but only in its effect. The closest possible position of the intervals, as at A, is called *close harmony*. Their altered position at B is called *extended* or *dispersed harmony*. By making the thirds of these chords the bass sounds, we obtain the following inversions, called chords of the sixth. The lowest sound of a chord is the bass for the time being.

No. 2.



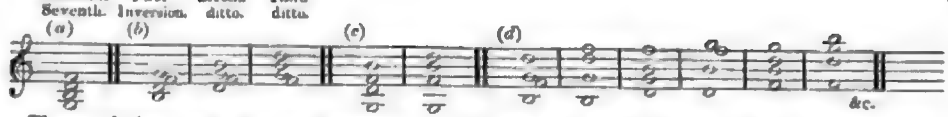
Diatonic or chromatic successions of chords of the sixth, with or without the third, are very frequent in harmony. If in each of the preceding common chords we make the fifth the bass, we shall have the following inversions, called chords of the sixth and fourth.

No. 3.



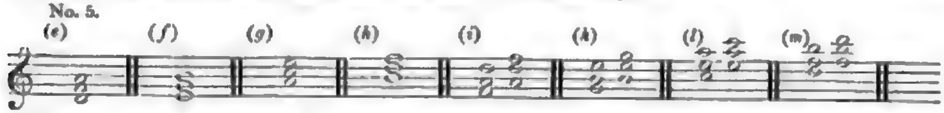
Most writers on harmony consider the interval of the fourth as a dissonance, while in truth it is a consonance, as is clearly shown by its forming one of the intervals in the perfect common chord, which contains no dissonance of any kind. Besides these three principal chords of the major scale, with their inversions, and which are all *consonant*, there is an important *dissonant* chord formed by adding the minor seventh to the fifth and third of the dominant. This is named the *dominant* seventh. We subjoin it (*a*), and its three inversions (*b*).

No. 4.



The sounds above the bass, in each of these chords, may be placed in various positions, some of which are shown at (c) and (d). The first inversion of the chord of the dominant seventh is called the chord of the sixth, fifth, and third; the second inversion, sixth, fourth, and third; and the third inversion, sixth, fourth, and second. In particular circumstances, the second, third, sixth, and seventh sounds of the major scale may each, as a bass, bear a common chord with a minor third. See No. 5 (e), (f), (g), (h), and the inversions i, k, l, m. But harmony of this kind is generally confined to ancient music, or imitations of the ancient style.

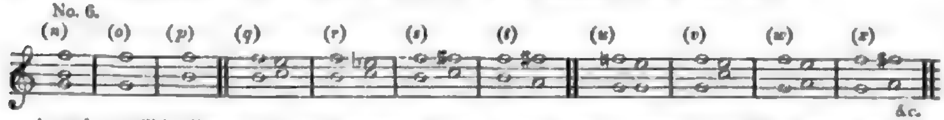
No. 5.



The chord at h, with imperfect fifth, is rarely used in what are called *fundamental progressions*.

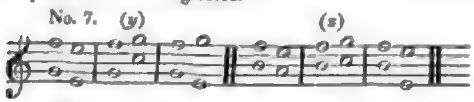
The chord of the dominant seventh contains two primary dissonances which are the least harsh of any in use, and are therefore the most frequently employed; the interval between the bass sound and its seventh, and the interval between the third of the chord and the seventh; see n, o, p. This last is an imperfect fifth, and requires a particular *resolution* (as it is called) in the next succeeding chord, unless some chromatic alteration intervene to change the simple progression; see q, r, s, t. For the most common resolutions of the seventh, see u, v, w.

No. 6.



A good ear will be displeased by such passages as those at y and z, where the resolutions of the seventh and of the imperfect fifth are neglected.

No. 7.



Such passages are bad, whatever number of Parts there may be besides to fill up the harmony; but they are intolerable when there are only two Parts.

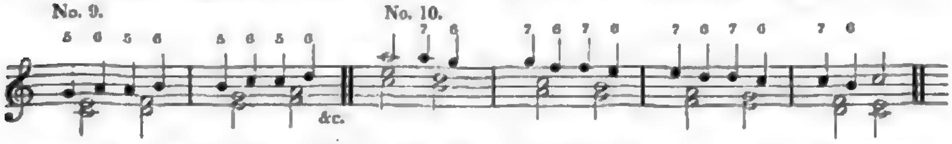
The three principal common chords of the minor scale are the following, at a, b, and c.

No. 8.

These subordinate ones at d, e, f, and g, may be occasionally used. The same remark applies to them as to the common chords on the second, third, sixth, and seventh sounds of the major scale. Of course, all the common chords in the minor scale may be inverted in the same manner as those in the major scale, thereby producing so many chords of sixth and third, and of sixth and fourth. The positions of their intervals above the bass may also be varied in the same manner as formerly shown.

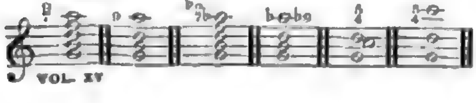
Sometimes, and especially in ancient harmony, we find a chord of the seventh occurring on every sound of the scale, in what are called *sequences* or *chains* of sevenths, in which the progressions of the bass sounds are by ascending fourths or descending fifths. These dry and formal passages, and their inversions, are now rare. There are some other kinds of sequences still in use; such as the fifth and sixth on each bass sound of a diatonic ascending series, or the seventh and sixth on each bass sound of a descending diatonic series.

No. 9. No. 10.



Besides these dissonant chords, there are many other dissonant ones, such as the chord of ninth and seventh, or ninth only; the chord of fourth and fifth; and so on.

No. 11.

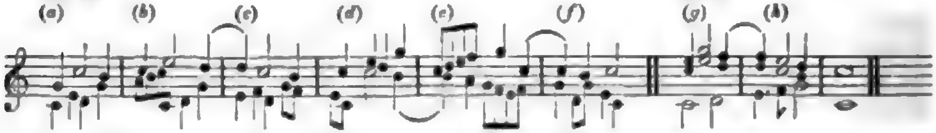


It is evident that every common chord, or either of its inversions, consists of three distinct sounds only; so that in composing for four voices, for example, a gap would occur in the harmony whenever a common chord, or one of its inversions, had to be employed, unless one of these three sounds should be doubled in the unison or octave. This doubling accordingly takes place when there are more than three Parts in the harmony. Which of these sounds

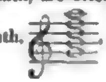
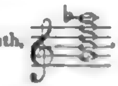
it is best to double, depends entirely upon the nature of the melodic and harmonic succession of sounds in this or that particular passage, and cannot be rightly learned but by a careful study of the best compositions in four, five, six, and more Parts. The chord of the seventh, again, or any of its inversions, consists of four distinct sounds, and therefore requires no doubling of any of its sounds in writing for four Parts. In other cases where the Parts are more than four, the doubling of any of the sounds (except the third, or the seventh of the primary chord) must be regulated by the circumstances of the case. The third and the seventh of the dominant chord of seventh do not bear to be doubled, because the progression of each of these sounds follows a certain course in *resolution* by the third rising a semitone and the seventh falling a semitone, or a tone, into the next succeeding chord, unless in the case of some chromatic alteration which interferes with the simpler progressions of these two sounds. In writing for three or for two Parts, it becomes necessary to omit one or two of the sounds belonging to the chord of seventh, or any of its inversions. Whether the third or the fifth of the primary chord should be retained along with the seventh, depends upon the effect intended to be produced. In the former case the effect will be more piquant, in the latter more soft and undecided. Again, in writing for two Parts, suppose a duett for two voices, it is necessary to use only two of the sounds of a common chord, or two of the sounds of a chord of seventh. In the former case none of the sounds ought to be doubled, except at the beginning, or at a close, or in preparing a cadence, when the unison or octave of the lowest sound of the primary chord, or of its fifth, may be used. In the other case (chord of seventh) there is a choice among the intervals of primary sound and seventh, third and seventh, or fifth and seventh, or the inversions of these. The effect intended must guide the choice. In these cases none of the sounds should be doubled in unison or octave.

What are called the *preparation*, the *percussion*, and the *resolution* of dissonances, may be made sufficiently clear by the following examples of Padre Martini.

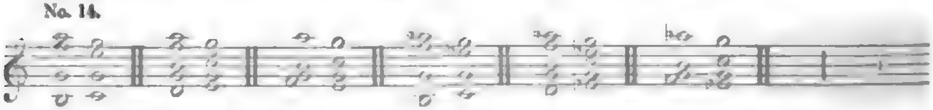
No. 12. No. 13.



At No. 12, (*a*), the seventh is *prepared* by the previous consonance of sixth, and is *resolved* upon the consonance of third. At (*b*) the ninth is prepared by the previous consonance of tenth, and is resolved upon the consonance of fifth. At (*c*) the sevenths are both prepared by previous fifths, and resolved by the consonances of fifth in the first case, and third in the second case. At (*d*) the second is prepared by third, and at (*e*) by sixth, in the preceding chord.

At No. 13, (*g*), the ninth and eleventh are *prepared* by previous tenth and twelfth, and are *resolved* into eighth and tenth. At (*h*) the ninth and seventh are prepared by previous tenth and eighth, and are resolved into eighth and sixth. As to what is called the *percussion*, or *striking* of the dissonance, it means simply the actual occurrence of the latter. The dissonance of the dominant seventh has no need of preparation; and the diminished seventh, the ninth, and the diminished ninth, are often struck unprepared. The chord of the ninth, , and of the diminished ninth, , are susceptible of three inversions. These, with their resolutions, are as follows:

No. 14.



In the chord of the ninth, and in its inversions, the sound forming the fifth in the direct chord is generally omitted. The ninth itself is not inverted, and care must be taken to keep the ninth in its proper interval above the lowest sound of the direct chord, so as to form a ninth or higher octave of ninth above that sound. The following infractions of this rule produce in general a bad effect, especially when prolonged.

No. 15.

The ninth may be used in the following manner, without any preparation:

No. 16.

In Haydn's beautiful canzonet, *Fidelity*, there are examples of the use of the major seventh, the ninth, and the diminished ninth, all without preparation. In the same canzonet we find the augmented octave and augmented fifth employed very elegantly. His tenth canzonet shows a very effective use of the diminished seventh, at the word "grief;" and also, at the same passage, the skilful introduction of an interrupted cadence. In the second section of the first movement of Mozart's third quintett in G minor there are many diminished ninths, and ninths and sevenths, introduced very boldly without any preparation. In Italy, about 1580, Monteverde began to introduce *unprepared* sevenths and ninths; but it would appear, from the following very curious passage, that Jean Mouton, a Frenchman, had used these *unprepared* dissonances long before. J. Mouton was born in 1461.

Examples of Unprepared Sevenths and Ninths, and of both combined, about the end of the Fifteenth or beginning of the Sixteenth Century.

No. 17. Jean Mouton.

It is worth while to remark, that, in dissonant chords, the dissonance often leaves its place and passes to some other sound of the chord, without being resolved in the way it would have been had it continued to keep its place. For example:

No. 18.

Passages of this kind often puzzle the student, as seeming to contradict the rules given for the resolution of dissonances.

In a series of chords, the progression from one to another may take place by similar motion, oblique motion, or contrary motion. The latter is the most frequent and the most useful, as it gives greater variety to the harmony, and enables us to avoid displeasing consecutions of octaves and fifths.

In similar motion, the Parts move together by conjunct or disjunct degrees, ascending or descending.

In oblique motion, one of the Parts remains on the same degree, while the other moves upwards or downwards.

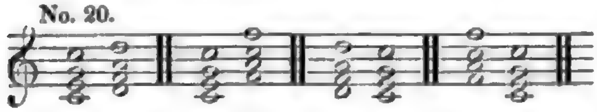
In contrary motion, the Parts move in opposite directions; the one ascending, the other descending.

No. 19.

Chords in succession.

An examination of all the possible successions of chords, consonant and dissonant, direct or inverted, diatonic or chromatic, is beyond our limits and our purpose. These successions must be learned from an extensive perusal of the best compositions. We must confine ourselves to a few examples and a few general remarks. First, with regard to common chords in succession, two or more of them are not allowed to succeed each other diatonically, or by leaps in similar progression, or what is called similar *motion* ascending or descending.

No. 20.

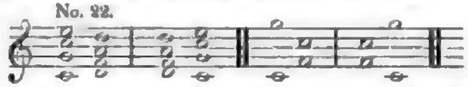


The bad effect of such progressions is much more striking in compositions for voices, or for different instruments, than it is upon such an instrument as the piano-forte, on which the progressions of the different parts are not so distinctly perceived by the ear, owing to the quality of tone or *timbre* of each sound being of the same kind. It ought to be remarked, that this last circumstance is too much neglected in writing for the organ or the piano-forte, and that in consequence many particular passages of harmony written for one of these instruments produce little or no effect, or even a bad effect, while the same passages, if performed by different voices or different instruments, would be good and effective. In the above successions of common chords (No. 20) there are consecutive fifths and octaves, both of which, and especially the former, are prohibited in all cases where *the ear perceives them* and is displeased by them. There is no other rational rule against their use. With regard to consecutive unisons or octaves, daily experience proves that they are not in themselves displeasing when they are employed in the reinforcing of some particular melody or passage of melody. Were this not so, there would be no such thing in choruses or in orchestras as ten, or twenty, or more voices or instruments, performing the same melody in unison or in octaves. Haydn said that one of the most overpowering effects he ever experienced from music, was when he heard the singing of the subjoined melody in unison by a vast number of trained children in St Paul's Cathedral at London.

No. 21.

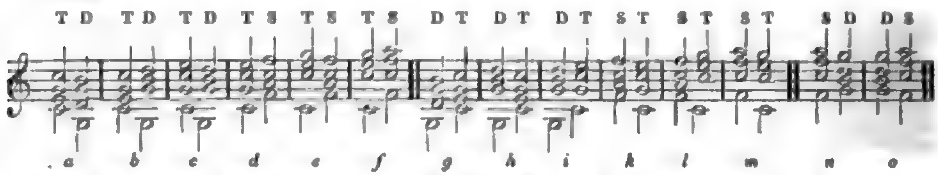
In a composition for two, or three, or four voices or instruments, where the intention is to interest by means of harmony, the *casual* occurrence of consecutive octaves is felt unpleasingly from the poorness of their effect, from the deficiency of that richness of harmonic combination generally expected in such compositions; but still only a *musical* and *trained* ear would perceive this poverty of effect, and be displeased by it. The fewer the number of Parts, down to the duett, the more perceptible would this poverty be. The bad effect of consecutive fifths also rests upon the ground of poverty and want of variety. Some modern theorists assert that the *reason* why two or more consecutive fifths produce a bad effect, is, that the ear supplies the major third of the lower sound of each fifth, and thereby perceives a succession of major common chords forming so many disjoined tonic chords, which give an impression of a series of different keys unrelated to each other. This hypothesis is erroneous, because the ear does really supply no such thirds, nor any other sounds. The ear, in harmony as well as in melody, supplies nothing beyond what it actually hears. It has to do with nothing but its own actual sensations. The *imagination* may supply or suggest what it pleases; but that is quite a different matter. Cherubini says of consecutive fifths, that "a succession of them forms a discordance, because the upper part moves in one key, while the lower part moves in another. For example, if to the scale of C major we add an upper Part moving in perfect fifths with the former, it will result from this, that one Part will be in C, while the other will be in G. It is from this double concurrence of key that the discordance arises, and consequently the prohibition to employ several fifths in succession." The best way to avoid the effect of consecutive fifths and octaves, is to employ contrary motion of the Parts. The second examples (No. 22) should never be used in music for two Parts only, or between two extreme Parts of a harmony, though they may be used in two middle Parts between the bass and the highest Part where the harmony is full.

No. 22.



We have seen that the three principal common chords of a scale are those of the tonic, the dominant, and the subdominant; and that the principal dissonant chord is the chord of the dominant seventh. We shall first examine these common chords in their simple diatonic successions, direct and inverted; and afterwards as undergoing certain chromatic changes, and other modifications. The letter T will stand for tonic chord, D for dominant chord, and S for subdominant chord.

No. 23.



At *a* and *b* and *c* we have three progressions from T to D producing three imperfect cadences (see preceding section, *Melody*) of harmony and melody together. At *d*, *e*, and *f*, we have three other progressions from T to S, producing also imperfect cadences, but not so decidedly imperfect as those at *a*, *b*, and *c*. Indeed these last might, not improperly, be called *reversed* cadences. At *g*, *h*, *i*, we have three progressions the reverse of *a*, *b*, and *c*, and forming tonic cadences more or less complete. At *g*, the cadence is complete, from the third of dominant rising semitonically, in the upper Part, to the tonic itself. The cadence at *h* is less complete, from the fifth of dominant descending to tonic by a whole tone in the upper part; and at *i* the cadence is still less conclusive by the fifth of dominant rising by a whole tone to the third of dominant. At *g* and *h*, if the dissonance of seventh were added to the dominant, the determination of the complete cadence from D to T would be more striking.

No. 24.

A perfect cadence from the chord of the dominant seventh may be *interrupted* in various ways. The following are examples.

No. 25.

The successions at *k* and *m*, No. 23, may be considered as imperfect cadences, although in some cases, in ecclesiastical harmony, the cadence from the chord of the S to the chord of the T is used as a final cadence. The succession at *l* is an imperfect cadence, the most imperfect that occurs in the scale, if we except *n* and *o*.

The succession at *n* from S to D is used in ancient and modern music; but the contrary succession at *o*, from D to S, is very rarely attempted, on account of its harshness and striking discontinuity. No satisfactory reason has been assigned (theoretically) for the avoidance of such successions; nor why the progressions of common chords (properly managed) between the tonic and its second, ascending or descending by conjoint degrees, or between the dominant and the sixth of the scale, ascending or descending by conjoint degrees, should be frequently used with no displeasing effect. And, again, what *fundamental bass* can be assigned, according to received theories, to such successions as chords of sixth and third ascending or descending by conjunct degrees? Not to speak of many

more successions in harmony and in melody, quite inexplicable by the system of fundamental basses, commonly received as the true one. It may be remarked, that singers, in attempting to sing the ascending major scale, always find great difficulty at first in executing, in tune, the series of sounds from the fourth upwards to the seventh.

No. 26.

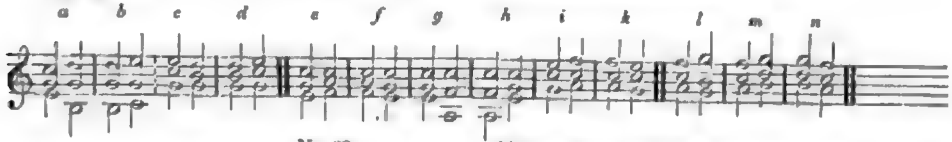
This is a practical fact, not explained by any theory. If you give the learner (with a good ear) three of the ancient conjunct Greek tetrachords to sing in ascending, there is no difficulty in the intonation.

No. 27.

The ancient Greeks seem to have known more about fragmentary scales than our modern theorists do.

The partial inversions of the preceding successions of common chords are as follows:

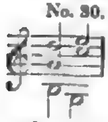
No. 28.



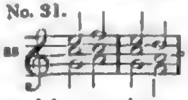
No. 29.

At *b* the progression *might* be ; but such a passage is harsh in its effect, from the more natural progression of the third of the dominant being by a semitone ascending, instead of by a leap. Another harsh progression

No. 30.

 *might* be (according to some composers) introduced at *b*. But such progressions ought in general to be avoided, though they sometimes occur in the free style of modern music; not, however, in the works of the best masters. It may be here remarked, that although the perfect fourth is a consonance, as we have said before, still, when it occurs between the bass and an upper Part, it requires a certain management. This is the reason why it has been erroneously called a *dissonance*. It would require a great many examples to show in what manner the perfect fourth should be treated when it occurs between the bass and an upper Part. We shall merely remark,

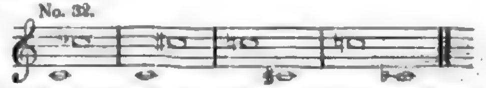
No. 31.

that, except in such successions as  &c. the fourth must, in general, descend by a semitone, or a tone, to the third of the same bass sound; or, if the bass moves upwards or downwards to the following chord by a tone or a semitone, the sound forming the original fourth must either be continued in that following chord, or must descend a semitone or a whole tone. Such are the technicalities regarding the treatment of the fourth in harmony. The quantity of printed disputation regarding the nature, &c. of the fourth is most unreasonable.

A great deal of the variety and *colouring*, as it is called, of the free style of modern music depends upon the use of chromatic changes of the intervals of the simple common chords, and their inversions. To make the nature of this more clear, we shall again have recourse, in the first place, to the same successions of common chords that we have already given, and show how their forms and effects can be altered by means of these chromatic changes. Of course, it is not upon every occasion that these chromatic changes are to be used. Some clever composers of the more modern schools indulge in these chromatic alterations to such excess that many of their compositions are little better than continuous lamentation, or caterwauling. By such abuses, the manly simplicity, energy, and dignity of certain styles of music are entirely destroyed. The whole practical principle of these chromatic changes is the division of a tone into two smaller intervals, ascending or descending. We do not say "into two *semitones*," because that is not really the case in correct intonation of such passages. In a succession of chords such as we have given, one at least of the Parts may rise or fall by a tone to one of the Parts of the next succeeding chord. It is therefore obvious that an ascending or descending tone *may* be divided into two smaller intervals; and this is done by the chromatic alteration,—sharp in ascending, and flat in descending, as shown in Plate VI., Nos. 20 to 27 inclusive. We give these merely to show how the thing may be done. *When* such chromatic alterations may be introduced with good effect, is to be studied in the compositions of Hadyn, Mozart, Clementi, Beethoven, and some others. All our examples of mere chords are to be considered by the student as no more than some of the dry and detached bones of a skeleton of harmony. He will find them all knitted together in their proper places, and clothed in living beauty of form and substance in the works of the best composers. It is *there* that he must seek for their use, and not in theories.

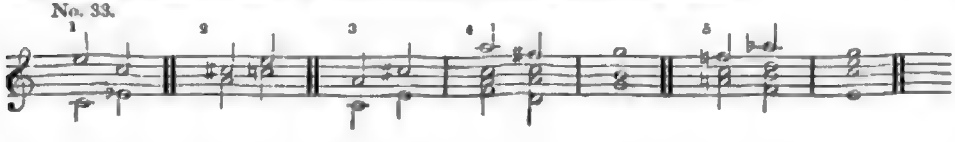
False relations must be avoided in melody as well as in harmony. When a sound passes to its diminished or augmented octave, above or below, there is a false relation in melody; as, False relations.

No. 32.



In harmony, such octaves struck together, and *prolonged for some time*, would be intolerable. Such passages as the following contain false relations.

No. 33.



Music.

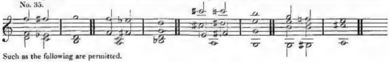
In these passages, the chromatic alteration is not made in the same Part; hence arise the false relations, and their harsh effect. These examples, when corrected, will stand as follows:—

Music.

No. 34.

Such passages as the following, where dissonances occur along with the chromatic alteration, are not objectionable.

No. 35.

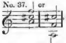


Such as the following are permitted.

No. 36.

Dr Burney, in criticising some of Purcell's harmonic combinations, blames him severely for using the $\natural 6$ and $\sharp 3$

No. 37.



and says that this chord is "*detestable*," and is "jargon at all times and in all places." It so happens that this same *detestable* chord is very frequently used in modern music; and, if Dr Burney had looked into the works of Emanuel Bach and Haydn, of which he speaks with unmingled commendation, he would there have found many instances of the elegant and effective use of the chord of $\flat 6$ and $\sharp 3$; also in Mozart's works, both vocal and instrumental. Another chord that Dr Burney finds great fault with in Purcell, is the chord of

No. 38.

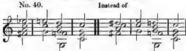
9 $\sharp 7$ $\sharp 3$

; but this chord is found in the works of the best modern composers. Among chromatic chords we shall notice only two more, of considerable importance, which frequently occur in harmony. They are the chord of the diminished seventh, and the chord of the augmented sixth.

No. 39.

These chords occur more frequently in minor scales than in major ones; and when they do appear in the latter, the notation is generally wrong. For example,

No. 40.



The effect of the diminished seventh is mournful and pathetic. Among other instances, see "He was despised," in Handel's *Messiah*, at the words "a man of sorrows." Sometimes we meet with a series of three or four chords of diminished seventh, or their inversions, in which all the Parts ascend or descend together by semitones. With regard to the chord of the augmented sixth, it is called the Italian sixth when it consists of $\sharp 6$ 3

No. 41.

, the German sixth when it consists of $\sharp 6$ 5 3

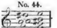
No. 42.

and the French sixth when it consists of $\sharp 6$ 4 3

No. 43.

Of these, the Italian sixth is the most simple and elegant, and the German sixth the most powerful in its effect. The French sixth is harsh and poor. In writing for four Parts, the third of the Italian sixth is doubled:

No. 44.



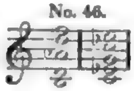
The third and fifth of the German sixth are usually prolonged in the form of $\flat 6$ 4 upon the next bass sound; but there are some exceptions to this practice. These augmented sixths are rarely inverted; but some instances are to be found in good composition. In the chord of the diminished seventh, it depends upon the position of the upper Parts, whether or not we may double its third. When in this position

No. 45.

we can-

not; but we may in the following position, where the diminished seventh occurs in a middle Part, and below the

No. 46.

third  We have a few remarks to make

upon what are called enharmonic changes of modulation, made by means of the chord of the diminished seventh, or of the chord of the German augmented sixth, or inversions of these. What is termed *enharmonic*, is really neither more nor less, in practice, than a change of signs in notation; which change, being merely addressed to the eye in all such pretended enharmonic transitions, leaves the sounds exactly as they were before upon all our imperfectly-tuned instruments, such as the organ and piano-forte. For example, we strike the following chord on a

No. 47.

piano-forte . If we choose to alter the signs

No. 48. No. 49.

of this chord, and to write , or , or

No. 50.

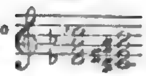
, all this makes no change whatever in the

sounds heard on the piano-forte. The very same sounds are produced, because the very same finger-keys are struck.

No. 51.

In the case of the German augmented sixth 

No. 52.

we might change the notation into ; but

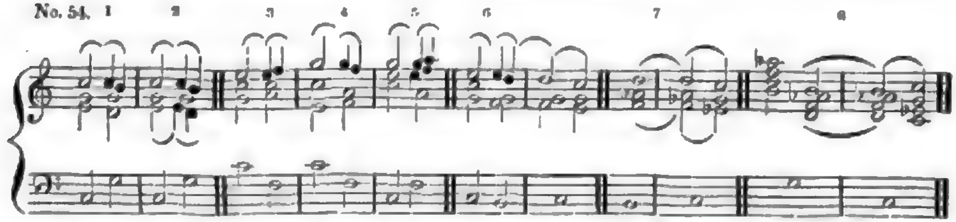
the sounds would remain the same on the piano-forte; so that the real differences between the sounds represented by these different modes of notation, cannot be made by such an instrument as the piano-forte, and therefore all pretended enharmonic changes and modulations upon it are mere delusions and non-existences. Again, to take a very plain case: Suppose that we were playing on the piano-forte a passage written in E♭, and that we chose to change the notation suddenly to D♯, where would be the enharmonic *modulation* in such a case?

No. 53.

There is not the slightest difference of effect. A *real* enharmonic change in such a passage, if effected by voices or instruments in perfect intonation, would produce a very perceptible difference of pitch, and no agreeable result.

In passing from one chord to another, one or more of the parts of the first chord will (in compact harmony) ascend or descend by a tone, or a smaller interval, to one or more of the parts of the next chord that follows. The *prolongation* of one or more of these ascending or descending parts of the first chord, after one or more of the parts of the second chord has been introduced, gives rise to a variety of dissonances termed *suspensions*, or *syncopations*, and so on. These may be single, or double, or triple, or even quadruple. In order to make the nature of this part of our subject intelligible, but without entering into many details, we shall again have recourse to the successions of common chords already given in this section, and also to the chords of seventh, and of diminished seventh, and of diminished ninth.

No. 54.



At 1 we have a single suspension, that of the fourth; and at 2, a double suspension of sixth and fourth. These are two of the cases formerly alluded to, in which the perfect fourth, though a consonance, is treated as if it were a dissonance when it occurs between the bass and an upper Part. At 3 occurs a single suspension, a major seventh ascending a semitone to its resolution in the octave; at 4, a single suspension of ninth resolving *downwards*, as the ninth almost always does, by descending a tone or a smaller interval, according to the nature of the passage in which it occurs; at 5, a double suspension of ninth and major seventh, in which the ninth is resolved by ascending a tone, and the seventh by ascending a semitone; at 6, a double suspension of ninth and fourth; at 7, a triple suspension of ninth, ♭ sixth, and fourth; at 8, a quadruple suspension of ninth, seventh, sixth, and fourth. Such combinations of dissonances as this last are not frequent; but they sometimes occur in the best instrumental compositions. This *legato* and *syncopated* style belongs more to the old schools of composition than to the modern. The effect of such passages is good on the organ as an accompanying instrument, or as a principal instrument, on account of its powers of producing the *sostenuto* and the *legato*; but is almost null on such an instrument as the piano-forte, from its deficiency in these powers of *sostenuto* and *legato*. Voices and wind-instruments produce great effects in this style of music. It is not so effective in music for stringed instruments. Besides a great variety of suspensions that may take place in an upper Part, there are many that may occur in the bass when its progression is by conjunct degrees ascending or descending. Of the following examples, 1 and 2 are the best, though 3 and 4 are from Beethoven. These last may be used in cases where the combinations of different voices or instruments are suitably arranged, or in the course of a rapid movement.

No. 55.

The nature of what are called *anticipations* (the converse of *suspensions* or *retardations*) will be understood from the following examples.

No. 56.

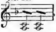
At 1 the anticipations are in an upper part; at 2 they are in the bass. Anticipations such as those at 3 are frequent in music of the time of Handel, and before then.

We give a few examples of what are called *passing* notes, *changing* notes, *transient* notes, &c. which (as well as suspensions and anticipations), are said by theorists to be *unessential* or *accidental* notes.

No. 57.

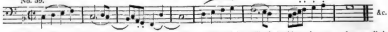
These so called *passing* notes are marked with a small zero. It is needless to multiply examples here, and we shall only refer to one remarkable instance of the use of *passing notes*, which occurs at the beginning of the first movement of the first quartett in Beethoven's fifty-ninth work. The violoncello begins with a fine and dignified subject (key F major), accompanied by the viola and second violin, in the following manner for six bars and a half,

No. 58.



when the harmony changes.

No. 59.



The first violin comes in at the ninth bar, imitating the preceding passage of the violoncello, and accompanied by the three other instruments forming the chord of the second inversion of dominant seventh, as far as the seventeenth bar, where the following bold passage occurs.

No. 60.

With regard to *passing* notes, notes of *grace*, *anticipations*, *substitutions*, *altered* or *chromatic* notes, and so on, the truth seems to be, that theorists have always found them inexplicable upon their favourite principle of the fundamental bass; and that, not knowing how to account for them rationally upon that principle, they have been obliged to treat all such sounds that occur in melody and in harmony as sounds that have no foundation in the *real* structure of the composition; and to assign to them, by way of salvo, any names that might pass current in an obscure and erroneous terminology. But if theorists *will* adhere to the received systems of fundamental basses, they ought to be able to apply these systems to *all* the phenomena of melody and harmony. This is not the case; for it is utterly impossible to refer *all* the combinations of modern (or even of ancient) harmony, to the received systems of fundamental basses. Every candid and intelligent musician will admit this to be true. Among all the systems of fundamental basses, Serre's theory (formerly alluded to) seems the most plausible, although still very imperfect. He assigns to a chord, one, or two, or three fundamentals, which are to correspond to the diatonic or chromatic nature of the sounds and intervals of the chord. But other theorists have their fundamental *suppositions* and *substitutions*; their *after* notes; their *changing* notes; their *passing* notes; their *altered* notes; their *appoggiature*; their *suspensions*; their *anticipations*; and, in short, such a chaos of hypothetically unessential and *unreal* things, that it is no wonder if the study of harmony is looked upon with horror and despair by all students who are trained in the ordinary schools of composition. They meet, at every step, with contradictions as absurd and perplexing as the long established algebraical dogma that there are *quantities less* than *nothing*. A little common sense and logic might have shown that this puzzling dogma is a mere contradiction in terms. *Nothing* being *no quantity* at all, it is obvious that there can be no such thing as a *quantity less* than *nothing*, or even *equal* to *nothing*. If such absurd contradictions in terms pass so long current in the most severe and exact of all sciences—mathematics—it cannot surprise any thinking man that musical theories and systems should abound in similar ones.

It is wrong to say that the *ear* recognises or suggests what are called *suppositions* and *substitutions* in fundamental basses; sounds that are not heard, but are ascribed, by erroneous theory, to such and such chords. The ear hears none of these imaginary and hypothetical things. Were it otherwise, and to carry this hypothesis to the *reductio ad absurdum*, the ear ought to hear all the chords that can possibly be applied to the accompaniment of any given melody. In fact, if two voices, or two instruments, perform a duett, for example, the lower Part is

felt to be the bass for the time being; and there is no other Part felt, or *supposed*, or *substituted*, by the ear. The imagination may suggest an additional Part below the lower Part, or above the higher Part, or intermediate; but this has nothing to do with the theory of the fundamental bass. If another lower Part is added to this same duett, then the ear feels *that* Part to be the bass; and supposing a fourth or a fifth Part, and so on, added still lower, then such added Part becomes the bass, in so far as the ear is concerned. If the lowest Part is overpowered by the upper ones, then the ear pays no attention to it, but to the predominant upper or middle Part or Parts. Experiment will prove this. If a melody is performed by a single voice or instrument, or by a great number of voices or instruments in unison or in octaves, does the ear supply a fundamental bass, or any bass at all? Surely not. As to what are called *passing* notes, chromatically *altered* notes, *suspensions*, *anticipations*, and so on, in melody or harmony; all these *sounds* are just as *real* as any other sounds that are heard in the course of the melody or of the harmony; and if theorists adhere to the received fundamental bass system, then *every* sound that is heard in a melody, or in any Part of a harmony, must have its own fundamental bass, just as much as *any other* sound that exists in the melody or the harmony. This inference is inevitable from rational logic. One of the most absurd hypotheses in musical theories is found in the attempt to explain, according to the fundamental bass system, a series of chords of 6th and 3d ascending or descending by conjunct degrees. It is said that in such passages there is an *ellipsis* of a chord between every two chords of the series, and that the ear understands this to be the case, and supplies the omitted chords!

When musical theorists meet with passages that cannot be explained by the hypotheses advanced, such passages are called *licences*. Unfortunately these *licences* are so numerous in music, that the rules are overwhelmed by exceptions. The easy way for a puzzled system-monger to escape from the difficulties that beset him is, no doubt, to have recourse to such convenient words as *licences*, *exceptions*, and so on, which are not unwillingly received by the public as substitutes for truth. In the works of the greatest composers are found many passages of excellent effect, though prohibited by the rules of theorists. Such being the case, we would again earnestly urge the student to form an extensive acquaintance with the best models of the art, rather than trust to any theories on the subject. He ought never to give up his reason and his feelings to any theoretical authorities. If he do, he will become timid and uncertain. Every thing he meets with different from what his dry rules have taught him, will perplex and terrify him. His energies will be paralyzed, and he will be incapable of producing any thing but cold, feeble, and formal music. To escape this result, he must take a comprehensive view of the art and its accessories; devote himself to no particular composer or school of composition; study the best music of every kind and of every country; and not allow himself to be captured and manacled by any theorist. He ought to keep in view that, in music, nothing is out of rule except what offends the ear, the taste, and the judgment; but that he must not venture to imitate the freedom and the bold effects of the greatest masters, until he has acquired great knowledge and command of the materials of the art. This cannot be acquired but by a well-directed course of study. Young painters are generally ambitious of handling the brush and colours before they have learned to draw correctly with a pencil or a crayon. If they are permitted to follow this course, they never attain eminence in their art. The case of the impatient musical student is analogous. Before he has learned to write correct melody, or correct harmony for two voices or two instruments, he burns to signalize himself by writing a chorus or a symphony, an opera or an oratorio. The lamentable failure of such a premature attempt disgusts and disheartens him. He abandons study as hopeless; and, if a man of genius, deprives the world of an excellent composer by neglect of the old maxim, *festina lente*. It is well to remark here, that Haydn, in the height of his reputation, declared to his friends that he did not recollect having passed a day without working sixteen and sometimes eighteen hours. We may also remark, that Haydn formed his own admirable style by the indefatigable study of every good composition within his reach; by neglecting no opportunity of gaining information regarding his art; and by forming for himself his own theory and principles of musical composition. In the earlier part of his life he studied intently the works of C. P. E. Bach, a musician of the highest order of genius, and also the works of G. B. San Martini of Milan, a composer of great genius and originality, but not possessed of patience enough to cultivate his abilities to the uttermost. In Haydn's earlier works, among others, some of his Sonatas, the resemblance between his style and that of Emanuel Bach is most striking. Indeed, the two styles are hardly distinguishable. But, as his musical horizon extended, he saw that neither E. Bach, nor John Sebastian Bach the father, nor G. B. San Martini, nor many more whom he studied and imitated, would suffice to make him a great and original composer. So he applied himself to the improvement of instrumental music, and to the invention of a new style of composition in instrumental quartetts and symphonies. His best quartetts and symphonies still remain unrivalled, for the admirable management of the subjects and modulations, the judicious employment of the different instruments, the unity of design in each movement, and the clearness of construction and of harmony. Haydn was a great advocate for melody. He used to say, "Every composition that has a fine melody is sure to please;" and experience proves the truth of Haydn's assertion. He was of opinion that the most *recherché* and learned harmony without melody was only an elaborate noise, which, if it did not displease the ear, excited neither the feelings nor the imagination. We shall close this part of our subject with a few remarks that may be useful to the student.

The practice of composition ought to begin with melody for a single voice, with or without a bass Part. The next step is to learn to write correctly for two voices, then for three, then for four, and so on. The custom of writing for voices will induce a habit of correctness not to be acquired by persons who begin by writing for instruments.

The proper manner of accompanying vocal music forms a difficult branch of the art, and cannot be studied with advantage till considerable skill has been acquired in vocal composition. The compass and quality (*timbre*) and powers of different instruments, and their effects in combination, must now occupy the student's attention. He ought to take every opportunity of hearing good instrumental music well performed, not only by orchestras, but also by military bands; and of observing attentively the various effects produced. In whatever he composes, clearness of harmony ought to be carefully preserved. Obscurity of harmony arises from the following causes: Too rapid a succession of sounds, chords, and keys; a complication of different movements that take place simultaneously in the different Parts, especially when these movements are at the same time accompanied by a series of chords that succeed each other very quickly, or by sudden modulations. Two different movements at the same time, unite easily; three not so easily; four may produce obscurity, if they are not very skilfully arranged, and especially if care is not taken, at the same time, that the chords do not suc-

ceed each other, but at the distance of a bar at least. More than four different movements at once almost inevitably produce confusion. It is therefore mere waste of time to attempt to give a different movement to each of the Parts of an orchestra. Harmony for three, and especially for two Parts, is much less liable to become confused than harmony for more than three Parts. For this reason, harmony in two or three Parts should be frequently used, particularly in music written for the public. Besides clearness of harmony, there is another kind of clearness not less important. It depends on the choice of ideas, and the order in which they are connected. Wherever there is neither *unity of ideas*, nor *proportion*, nor *symmetry*, there is confusion.

That excellent composer Piccini, the rival of Gluck and of Sacchini, occasionally employed full and rich harmony in his orchestra, but disapproved of the common practice of keeping all the instruments continually busy. He wished to make the voice the principal Part in his operas, and that the instruments should only sustain the voice, or express what was indicated by the words, or by the action of the persons of the drama, or by the place and circumstances of the scene. He was opposed to those *disegni ostinati* in the accompaniment, which Jomelli brought into fashion, and which are uniformly prolonged through nearly the whole extent of a piece of music, although the words present shades of feeling or ideas which would require corresponding shades in the accompaniment. Multitudes of different instruments, continual orchestral effects, crude masses of harmony, and a perpetual affectation of dissonances, were considered by him as musical monstrosities. He said, "It is not difficult to know what can be put into a harmony. The difficulty lies in knowing what should be left out. The four Parts for stringed instruments, which form the basis of the orchestra, lend themselves almost equally to every kind of expression. This is not the case with the wind instruments, and instruments of percussion. The expression of the oboe differs from that of the clarinet, and that of the clarinet very much from that of the flute. The horns change their expression according to the key in which they are used. The bassoon, whenever it is not confounded with the bass, becomes sad and melancholy. The trombones can express nothing that is not lugubrious. The trumpet, nothing that is not warlike and brilliant. The kettle-drum is altogether military. If each of these instruments were reserved for its proper employment, we should produce varied effects, succeed in describing every thing, and continually diversify our musical pictures. But we are lavish of all these means, all at once, and always. We exhaust and harden the ear. I should like to know what we shall do to awaken it when, as will soon happen, it will be accustomed to this uproar. What new *diablerie* shall we contrive? Perhaps we shall then wish to return to nature, and to the true means acknowledged by art; but you know what happens to persons accustomed to drink brandy." Some combinations of harmony, and treatments of dissonances, &c. not explicable by common theories, will be found in Plates VI., VII., Nos. 28 to 71.

Modulation.

We mentioned, in the section on Melody, that a treatise on melodic modulation is wanted; and we think that a satisfactory treatise on the modulation of harmony is also a desideratum. But neither can be written to any good purpose in the present state of the theory of music, taking the word theory in its most comprehensive sense, as applied to this art. Philosophers seldom understand music; and the greatest practical musicians have neither leisure nor inclination to attempt to analyse its nature; so that, for want of properly conducted investigation, we are likely to remain in the same "*aere senza stelle*" which at present darkens the depths of the art.

Modulation signifies, properly, the regular constitution of melody and of harmony in any given key, but is *commonly* used to express the art of conducting a melody or a harmony from one key into another, or through several successive keys. This change of key might be more properly called *transition*. Many persons believe that there can be no modulation where there is no change of key. But this is an error, since modulation takes place even in the simplest melody confined to one key. Transition is only one kind of modulation, and is worthless if injudiciously employed. We may make a transition from one key to another suddenly, and without any intermediate sounds; or by means of one or more intermediate chords through which we modulate into the new key.

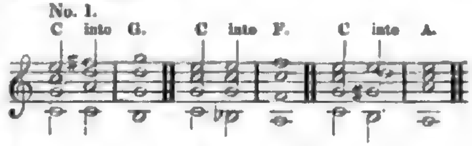
The art of good modulation from one key to another, consists in the choice of these intermediate chords, and in their relative durations. The use of sudden transitions from one key to another, without any intermediate chords, requires attention to a variety of circumstances, in order to produce a good effect. Such transitions should be but sparingly employed in any regular composition. Every regular piece of music is composed in a particular key, in which it begins and ends, and which generally predominates over all the other keys that may happen to be introduced in the course of the piece. If the key is major, what are called its relative keys will be two major ones and three minor. If a minor key, its relative keys will be three major ones and two minor. The following tables will show what these relatives are:—

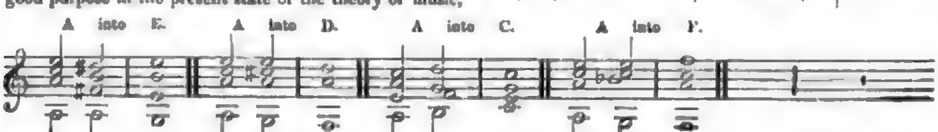
C major, principal key.	A minor, principal key.
D minor, first relative key.	C major, first relative key.
E minor, second relative key.	D minor, second relative key.
F major, third relative key.	E minor, third relative key.
G major, fourth relative key.	F major, fourth relative key.
A minor, fifth relative key.	G major, fifth relative key.

These six keys offer, in their modulated connection, 720 combinations. The nearest related keys to a major key, taken as principal, and into either of which it may easily pass without any intermediate chord, are its dominant, its subdominant, and its sixth; thus, from C major to G major, or to F major, or to A minor.

The keys most nearly related to a minor key, are its third below or above, or its dominant, or its subdominant. It may pass into any one of these without an intermediate chord; thus, from A minor to F major, or to C major, or to E minor, or to D minor. In such cases we do not properly modulate, but make a sudden transition into a new key. In the following examples, we modulate by an intermediate chord:

No. 1.



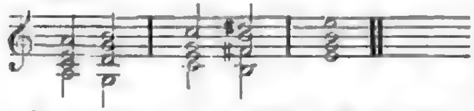


The general rule is, that we can *modulate* into a *relative* key by means of one single intermediate chord, which chord is the dominant seventh, or some inversion of the dominant seventh, of that relative key. We may remain in the new key for some time, or we may quit it immediately, and modulate into a third key, and so on. An example of rapid modulation from key to key by means of intermediate dominant sevenths, or their inversions, occurs in what is called the "Tour du Clavier," or harmonic circle of keys. It is needless to give more of this than a fragment by way of example, since long successions of the kind are not used in modern music. Only short passages of such modulation occur in the best modern compositions.

No. 2.

Not unfrequently we meet with modulations into relative keys brought about by means of an intermediate common chord. For example:

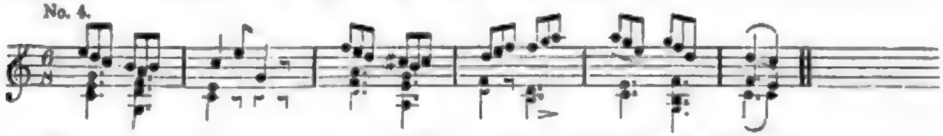
No. 3.



In passing from one key to another, a third, a fourth, or a fifth below, without using any intermediate chord, it is proper to keep in view the following remarks:—1. Transition to third below. In this case, if the former key is major, the second should be minor. For example, C major, A minor. Here the transition is to the minor third below. A bolder and more unusual transition is from one major key to another major key, a major third below; such as from C major to A flat major. If the first key is minor, the second key should be major. Thus, from C minor to A flat major, a major third below. 2. Transition to the fourth below. The two keys ought to be both minor or both major, otherwise they will not be relative. 3. Transition to fifth below. The two keys ought to be both major or both minor, for the same reason that has just been given. To make a real change of key without intermediate chords, we must introduce at least one entire phrase or period in the new key. (See *Melody*, for *phrase* and *period*.) Thus, after a subject in C major, we might introduce a period in G major, in F major, or in A minor, and afterwards return to the key of the subject. Sometimes, but much more rarely, a transition is made from a given key to another a major second or a minor third above it.

The following is an instance of the first kind of transition just mentioned.

No. 4.

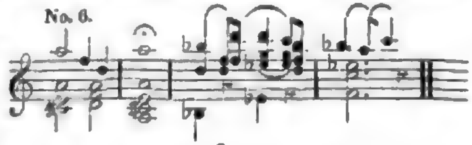


In the case of a transition from one key to another a minor third above it, the first key must be minor and the second major; for instance, from A minor to C major. This kind of transition is found in certain short pieces of music, and, among others, in some Russian airs. Another transition (if so it may be called) which is not unfrequent, occurs when we change the mode without changing the key; for example, when we change C major into C minor, or the converse. We may pass immediately from a major key into a minor key its fifth below; for example, from C major into F minor. Again, after making a cadence upon the dominant of a minor key, we may proceed immediately to the key of the major third below that dominant, or to the key of the minor second above that dominant. For example, from dominant common chord of C minor, we may make a transition into the key of E flat major, or of A flat major. Of the former kind of transition a very beautiful example occurs in the *Adagio sostenuto* in Haydn's second quartett, Op. 16, where, from the dominant common chord of C minor, the change of key is made into E flat major. Also another in the "*Hodie mecum*" of Haydn's "Seven last Words of the Passion," at the 21st measure of the movement. In the same movement, at the beginning of its second section, a very effective modulation occurs from E flat major into F minor, by means of the following passage.

No. 5.

Examples of transition from the dominant common chord of a minor key, to a major key a minor second above that dominant, as at No. 6 below, may be found in the works of Haydn, Mozart, Beethoven, and other composers. An instance may be seen in the Finale to Haydn's Symphony, No. 5 (about the middle of the movement), where the transition is from dominant of F sharp minor to the key of D major. In the "Trio" of the first quartett in Beethoven's Op. 18 there is an example of a transition from the dominant of F major into the key of D flat major. In the sixth measure of the first movement of Beethoven's quartett, Op. 95, we find a very singular transition from the dominant of the key of F minor into the key of G flat major.

No. 6.



In the *allegretto vivace* $\frac{3}{8}$ in the first quartett of Beethoven's Op. 59, there are some curious transitions. Near the beginning there is a transition from the dominant of B flat major to the key of A flat major, and from the dominant of this last key a transition to the key of C flat major. Sometimes, in order to produce a powerful effect of contrast, a transition takes place directly from the tonic of a major key to the major key a semitone above, or a major third below. For example, from C major to D flat major, or to A flat major.

No. 7. No. 8.

At the beginning of the second part of the first movement in Beethoven's first sonata, Op. 12, there is an example of the second kind of transition just mentioned. It is from A major to F major. See another example about the middle of the *andante* in Haydn's Symphony, No. 4; transition from tonic G major to E flat major. Also another in the *adagio cantabile* of second quartett of Haydn's Op. 72; transition from E major to C major. All such powerful contrasts as those we have just spoken of, especially the transition from a given key to another a semitone above, ought to be very sparingly used. In dramatic music, and symphonies for an orchestra, these transitions may be very effective. The judicious composer may occasionally introduce them in music of a different description; for instance, in a cantata, or an instrumental quartett or quintett, &c. Excepting the cases we have mentioned of transitions made from one key to another without any intermediate chords, the general rule to be followed in modulating is to connect together the different keys by intermediate chords. In the proper selection of these intermediate chords consists the art of modulation taken in its widest sense. It depends entirely upon the relation or non-relation between the keys from and into which we modulate, what number of intermediate chords may be necessary to render the modulation smooth and agreeable. The manner in which these intermediate chords are to be disposed—direct or inverted, with or without dissonances or altered chromatic notes, &c.—rests with the composer's skill and imagination. One, or two, or three, or four intermediate chords may be necessary, according to circumstances; but there is hardly any modulation that cannot be effected by means of four of these.

It is necessary to observe that, in many cases, the intermediate chords used in modulating from one key to another must have a sufficient duration given to them: otherwise the effect of the modulation will be harsh and displeasing.

No. 9.

From C major to D flat major. From C major to D major.

Both of these examples of modulation are harsh and unpleasing, because the intermediate chords are too few, and have not sufficient duration allowed to them; and yet they are given in a set of elaborate tables for modulation by Hudl, a German musician. Haydn never falls into errors of this kind. By taking care to prolong his intermediate chords sufficiently, he produces the smoothest and at the same time the most unexpected modulations. The following example, though not Haydn's, will illustrate this:

No. 10.

At A the modulation from B flat major into D flat major is gradually conducted. At B the same modulation is brought about too rapidly, and sounds harsh and unsatisfactory. Some good examples of Haydn's judgment in dwelling upon the intermediate chords when modulating, may be seen in the movement "Ecce mulier," in his "Seven last Words of the Passion." See the first nine measures of the second part of that movement, and from thirty-fourth to forty-fourth measures of same part.

A modulation frequently takes place into a key which is not a relative one to that immediately preceding, though both are related to the principal key of the piece. For example: 1. When the principal key is major, a modulation may occur from the second of the key to the third, from the third to the fourth, from the fourth to the fifth, from the second to the fifth. 2. When the principal key is minor, we may modulate from the fourth degree to the fifth, from the fifth degree to the sixth, from the sixth degree to the seventh, from the fourth degree to the seventh, and the converse of all these cases. In modulating into a key not are lative one (for instance, from G major into F major), care must be taken that the two keys are relatives to a principal key which has previously been sufficiently established; for it is only in such case that a modulation of that kind can be suitably employed. One may easily modulate from G major into F major by means of two intermediate chords in a piece of music of which the principal key is C major or A minor; but one could not do so if the principal key were D major or E minor; so that a modulation which is good in one case may become bad in another. This must always be kept in view with regard to modulations of the kind just mentioned. In order to modulate smoothly into a key more or less remote from the one we quit, we may employ two, three, or four modulations instead of one only. These may be called *compound modulations*. For example, to modulate from G major into F major, we may employ two modulations instead of one; the first, from G into A minor; the second, from A minor into F major.

As we can make a transition immediately from a major

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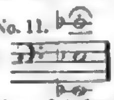
key to the minor key of its fifth below, so we can modulate into all the relative keys of the latter in setting out from the former; for example, into all the relative keys of F minor, beginning to modulate from C major. Again, we can modulate into all the relative keys of C minor, in setting out from C major. It is easier to modulate into keys that increase the number of their flats, than into keys that increase the number of their sharps. For instance, it is more difficult to modulate smoothly from C major into A major, than from C major into A flat major.

Sometimes, instead of using intermediate chords, a pause of some duration is employed between two keys that are not related to each other, and a modulation, or transition, effected in this way from the one key to the other. The longer the pause, the smoother the modulation in such cases. A single prolonged intermediate sound, not a *chord*, placed between two keys not relative, and followed by a pause, may also render the transition from the one to the other sufficiently smooth. For instance, after the chord

No. 11. 

of G minor, introduce a prolonged E flat and a pause, and then pass at once into the key of A flat major. Towards the end of the last movement of Beethoven's third Piano-forte Trio, Op. 1, there is a curious modulation from dominant of C minor into B minor by means of two prolonged sounds, G and F♯. We may modulate from one key to another far remote, by means of a series of chromatic notes performed by one Part that seems to wander uncertain in quest of something. "Or su, or giù, ed or ricirculando." The finest example that we know of this kind of modulation is in the *Adagio Fantasia* of Haydn's sixth Quartett, Opera 76. The whole movement is charming.

As to what are called *enharmonic* modulations, or transitions, we shall pass them by, since they have no real existence upon keyed instruments. We refer to what we have said on this subject in the section on Harmony. We must remark, however, that they are dangerous delusions, and are continually giving rise to a number of harsh and intolerable pseudo-modulations in the music of young composers, and even in the music of experienced composers who ought to know better. No sooner has a young composer (not wisely taught) got acquainted with the *formulæ* of these pseudo-enharmonic transitions, than he is eager to use them on all occasions, in order, as he thinks, to display his learning. He deceives himself, for his indulging in such things only betrays his ignorance of his art. "Modulation," said Piccini, "like all the other processes of the art, ought to be employed as a means of just expression and judicious variety. To modulate for the sake of modulating, is to prove one's ignorance of the object and principles of music. It is to affect a superabundance of imagination and of knowledge, in order to conceal the want of both."

We advise the student to examine carefully the works of the best composers, Italian and German, for examples of modulation, as well as of harmony and melody. There is no other way for him to acquire even a respectable knowledge of his art. As to the books published expressly upon modulation, some of them are written by Germans, and generally contain only mere *formulæ* of the shortest ways in which modulations can be effected. These formulæ the student ought to shun, except for mere reference; because, although the study of them might render him able to modulate in a dry and formal manner, they could never teach him that grace, and freedom, and effect, without which the most elaborate modulations are worthless.

Imitation, canon.

Imitation is a musical artifice, by which a Part, called the *antecedent*, proposes a subject, or melody; and another Part, called the *consequent*, repeats the same melody, after some rests, in any given interval, and so continuing to the end.

Example. Imitation in the Unison.

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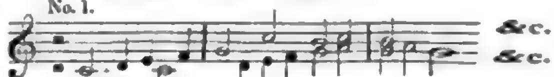


In an imitation the *consequent* is not always obliged to answer to the *antecedent* in the whole extent of the subject proposed by the latter. It may imitate only a part of the subject, and the *consequent* proposing a new melody, becomes, in its turn, the *antecedent*.

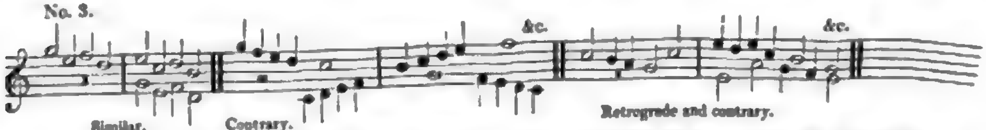
No. 2.

Imitation may take place in several ways. It is called *regular* or *constrained* when the nature of the intervals proposed by the *antecedent* is strictly observed in the response of the *consequent*. This of course happens when the *consequent* imitates the *antecedent* in the unison or the octave. Imitation in the fourth or the fifth is the next nearest to exact correspondence of intervals.

Imitation is called *free* or *irregular* when this exact correspondence is not observed.

Imitation is by similar motion, by contrary motion, by similar retrograde motion, by contrary retrograde motion.

No. 3.



The other kinds of imitation are by *augmentation*, by *diminution*, by *countertime; interrupted, convertible, periodical, canonical*, &c.

Canonical imitation is that in which the consequent answers to the antecedent, note for note, from the beginning to the end. An imitation of this kind is what is called a

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In the symphonies, quartetts, &c. of Haydn and Mozart, instances are frequent of the freest and boldest melodies being used in counterpoint with the best effect; but it is only the highest genius and most consummate skill that can do this.

There are also triple and quadruple counterpoints, susceptible of being inverted in various ways. Of these the best and most usual are in the octave, the tenth, or the twelfth.

No. 4. Triple Counterpoint in the Octave. Quadruple Counterpoint in the Octave.

In these triple and quadruple counterpoints, where the *subjects* are merely doubled in thirds, there is a dryness and want of variety which had better be avoided by writing, in a free style, accessory accompaniments to the counterpoint. Our limits do not permit us to enter farther into this extensive subject. We refer to Marpurg, and Reicha, and Cherubini, for full explanations.

We must add the following passage from Cherubini: "All these examples give rise to an important remark, which is, that in spite of the denominations of *triple* and *quadruple* counterpoint, in the *tenth* or in the *twelfth*, there is no veritable *triple or quadruple* counterpoint, but that in the *octave*."

Fugue.

The fugue is a very complicated piece of music when it is carried to its highest pitch of artifice. It comprehends all sorts of imitations, canonical contrivances, and double counterpoints. Studied with proper views and within proper limits, so as not to interfere with the supremacy of melody and with the genius of a true composer, the fugue is extremely useful as an exercise of the student's ingenuity, and as tending to show him all the resources of artificial harmonic combination. To those who have *learned* to *understand* the artificial mechanism of fugues, and who can enjoy them on that ground, they are often very admirable things, though composers of great genius might have been better employed than in constructing them. Homer, Milton, or Shakspeare, would not have done justice to themselves, had they spent their time in writing difficult poetical puzzles, such as anagrams, acrostics, single, double, and triple poems in the shapes of crosses and triangles, or in which every word began with the same letter, as in the famous *Pugna Porcorum*, beginning "Plaudite porcelli porcorum pigra propago Progreditur," and so on for five closely printed pages. All such poetry is beyond the verge of the enchanted circle of poetical inspiration. So of all calculated artifices in music. If musical *imitations*, or *canons* of any sort, suggest themselves fluently and gracefully to a man acquainted with all the elements of the art, it is well; otherwise not; for mere dry labour ought to have no place in music. Since such artificial harmonic combinations can give pleasure to the initiated only, who have gone through a long training, there seems to be no reason why the laboured contrivances of imitation and fugue should have any *preference* over the simplicity of beautiful and expressive melody, and its adjunct, appropriate and effective harmony. We know well that this is all heterodox doctrine among a certain class of musicians, but do not the less adhere to our long-established opinion. With great respect for the knowledge and ingenuity of all eminent writers of canons or of fugues, we must remark, that all these artifices arose at a time when melody was in its infancy, and had not acquired, like Hercules, the power to strangle the serpents that besieged its cradle. Among the greatest fugue writers are certainly to be reckoned G. P. Colonna, Handel, the Scarlattis, John Sebastian Bach, and his son Emanuel; and more recently Haydn, Mozart, A. Reicha, and Cherubini. Beethoven did not attempt much in this style, and what he attempted in it is not to be classed amongst his best productions. It is no wonder if a man of his towering genius and impetuous character was early disgusted by the arbitrary rules and restrictions imposed upon him by some of his unimaginative teachers, in such laboured music.

Cherubini says (we translate from the French), "The fugue, in spite of the ancient origin of the word, is, then, a creation of modern times, which was not practised in church-music until contrapuntists had freed themselves from the self-imposed obligation of working upon plain chant........There are two kinds of fugue, from which a third kind emanates, and from this arise all the others. The two principal are, the *fugue of the key*, and the *real fugue*; the other is the *fugue of imitation*.[1] All the others, children of caprice, are *irregular fugues of imitation*, or *pieces in fugue style*. The indispensable conditions of the fugue are the *subject*, the *response* or *answer*, the *counter-subject*, and the *stretto*. To these conditions may be added the *pedal*, which is almost always employed in a fugue somewhat developed.......All the artifices which can be introduced into a fugue depend on the knowledge, the skill, and the choice of the composer, and at the same time on the nature of the *subject* and of the *counterpoint*, either or both of which may be more or less susceptible of yielding to these artifices. These artifices consist, in brief, 1. Of the employment of imitations, in detaching, to form them, a portion either of the *subject* or of the *counter-subject*; 2. in the transposition of the *subject* into different keys, and in the advantage which may be derived in this respect from double counterpoints; 3. in the inversion of the *subject* by contrary motion; 4. in a new *subject* which may be introduced, and which can be combined with the first *subject* and the first *counter-subject*; 5. in the manner of introducing the *stretto* in several ways, by drawing closer and closer, each time, the *answer* to the *subject*; 6. in the means that may be employed to make the *subject* and its inversion by contrary motion be heard simultaneously; 7. in the manner of combining the *subject*, the *counter-subject*, and the *stretto* upon the *pedal*; and in the address and the taste employed in enchaining together and introducing these artifices in the course of a fugue. All these combinations, and others besides, may be employed in a *studied fugue*; but, in a fugue for the public, a selection must be made from them, and they must not be all employed, otherwise the fugue would be too long and tiresome."

Reicha says, "it is essential to remark, that in our days the ancient fugue (or in the rigorous style) is no longer

[1] Reicha says, "Since fugues of the key are no longer composed, and as simple canons are not called fugues, the terms *fugue of the key*, *real fugue*, and *fugue of imitation*, are not really necessary, and only serve to confuse our treatises." (P. 66, 2d part.)

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produce effects by voices only,—a difficult study, and one perhaps too much neglected,—and he will find himself, afterwards, much more at his ease when he writes for instruments, and consequently is no longer obliged to confine himself within the limits of voices." Speaking of modulation (after having given general rules for it), Cherubini says, "Modern composers have freed themselves in their compositions from this simple and rational method of modulating, replacing it by a manner too free, and often incoherent; but if their deviations are tolerated in modern works, it is essential, and it is even expressly enjoined, not to follow these wanderings in the case of a composition so severe as the fugue."

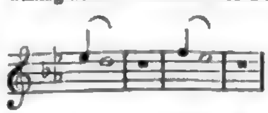
Imitative music.

By imitative music we do not here mean the imitation of one melody or passage of melody by another, which has been already treated of in the section connected with canon and fugue; but the employment of music, more or less appropriately and successfully, to imitate certain natural phenomena, audible or visible. The great mystery of music lies in its power of suggesting and exciting ideas and feelings in persons endowed with a sufficient degree of sensibility and imagination. In this respect it resembles poetry, for poetry is a *dead* art to all who have not sensibility and imagination enough to receive and expand its suggestions. We speak of the higher poetry; not of that which attempts in vain to be minutely descriptive or imitative, and which, by so doing, loses the nobler essence of poetry, without attaining the object proposed.

There are many musical compositions that do not aim at imitation or expression of any determinate kind. Such are the great majority of pieces of instrumental music. Some fanciful persons have gone so far as to imagine a story told, or a scene described, by a quartett or a symphony, although the composer gave no indication of any such purpose, and would have transgressed the true imitative limits of his art by doing so.

One of these fanciful persons, Momigny, in his *Cours Complet d'Harmonie et de Composition*, has ventured to give what he calls "a picturesque and poetical analysis" of the introductory movement and succeeding allegro of Haydn's eighth Symphony in E♭, and to add words here and there, to show what the music is intended to express. Momigny has also adapted words (see his third volume) to the first movement of Mozart's second Violin Quartett in D minor, and tells us that "he thinks he has discovered that the feelings expressed by the composer were those of a loving female on the point of being abandoned by the hero whom she adores," and that this luckless woman was Dido! All this, however, is mere imagination, and every one is at liberty to exercise his own fancy in such cases. In such a composition as Beethoven's famous Pastoral Symphony, it would certainly be impossible for any person to divine, merely from hearing it played, what was meant to be expressed or imitated by the different movements of that remarkable work. Unless he were previously told that such a movement was meant to express the sensations excited by visiting a country scene; such another, those felt beside a river; another movement meant to imitate a storm, and so on; certainly his imagination might lead him to guess very wide of Beethoven's intentions. The only things that he could have no doubt of, if accustomed to such rural sounds, would be the notes of the quail and the cuckoo, introduced in the river scene. As to the nightingale, he could make nothing of it, because the notes that Beethoven uses do not express the subtle song of that bird, any more than Handel's notes do in his song "Sweet Bird," in the *Penseroso*. In the oratorios and operas of eminent composers are to be found many instances of attempted imitations, most of which had better have been omitted. To attempt to imitate, by music, a hail or a snow storm, the leaping or creeping of animals, the falling of walls, and so on, is to mistake the powers of the art. A particular style of music may sometimes be effectively employed to enforce the ideas conveyed by descriptive words. In Haydn's *Creation*, and *Seasons*, we have several instances of this. Among other passages, we may cite the song in the *Seasons* (pp. 398 to 408 of Leipsic Partition), describing the traveller wandering bewildered among the snow; and the chorus, "Oh! the tempest comes" (pp. 203, 230). In other parts of the *Seasons* we find passages intended to express the rustling of leaves, the running of a brook, the buzzing of flies, the crowing of a cock, the croaking of frogs, &c. but most of them unworthy of Haydn's genius. The overture to the *Seasons* is intended to describe the transition from winter to spring; the introduction to summer (p. 138), "the dawn of day;" the introduction to autumn (p. 252), "the husbandman's satisfaction in contemplating the abundant harvest;" the introduction to winter, "descriptive of thick fogs." All these are phenomena not susceptible of musical imitation; and the consequence is, that the fancy of the hearer might lead him to associate the pseudo-imitations with ideas totally different from those which Haydn intended to suggest. The philosopher D'Alembert says, "Si j'avois à exprimer musicalement le feu, qui dans la séparation des *élémens* prend sa place au plus haut lieu, pourquoi ne le pourrois-je pas jusqu'à un certain point par une suite de sons qui iroient en s'élévant avec rapidité?" and, a little after, "Si je voulois peindre le lever du soleil, pourquoi ne le pourrois-je pas par une musique dont le son auroit un progrès assez lent, mais iroit tout à la fois en s'élévant et en augmentant d'éclat, précisément comme le soleil quand il se leve?" Haydn, in the representation of chaos in his *Creation*, and in the introduction to the recitative "In splendour bright," in the same oratorio, seems to have had D'Alembert's ideas in view.

Many striking instances of indirect musical imitation may be found in the operas of Gluck. One of them occurs in his opera of *Iphigenia*, in the scene where Agamemnon deplores his daughter's lot in these words: "J'entends retentir dans mon sein le cri plaintif de la nature," &c. This "plaintive cry of nature" is expressed by the wailing notes of the oboe heard at intervals,



&c. while the "oracles of destiny" are expressed by the gloomy and obstinate responses of the bassoon,

&c.

This remarkable passage is given, with a criticism upon it and some others from Gluck, in the first volume of Forkel's *Musikalisch-Kritische Bibliothek*.

Musical aids to invention.

The famous painter Leonardo da Vinci, in his Treatise on Painting (c. xvi.), thus expresses himself regarding the aids to pictorial invention that may be derived from the contemplation of confused objects: "Se riguarderai in alcuni muri imbrattati, o pietre di varij mischj, potrai quivi vedere l'inventione e similitudine di diversi paesi, diverse battaglie, atti pronti di figure, strane arie di volti, et habiti, e infinite altre cose; perchè nelle cose confuse l'ingegno si desta a nuove inventioni." A painter of such genius as Leonardo da Vinci may have his imaginative faculties thrown into action by "a blotched wall, or by stones of various colours," or by other objects that would

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their art. If we are attentive in collecting every thing that presents itself, and take care to treasure up the ideas which occur in favourable moments, we shall soon form a rich collection of materials from which we can draw when occasion requires. Finally, we must never torture ourselves to find ideas; and must especially shun that mania of originality which induces us to reject easy and natural ideas, and to run after fantastical and perplexed ones. One may often present novelty under a guise almost common. On the contrary, as Boileau says,

> Il est certains esprits dont la fougue insensée
> Toujours loin du droit sens va chercher leur pensée,
> Ils croiroient s'abaisser dans leurs vers monstrueux
> S'ils pensoient ce qu'un autre a pu penser comme eux.

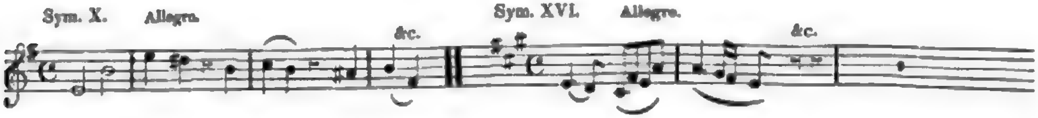
And all this is often mere lost labour; for an idea which at first seems new, on account of the manner in which it is presented, is frequently reduced to nothing when it is brought back to its true expression.

Development of musical ideas, and conduct of a composition.

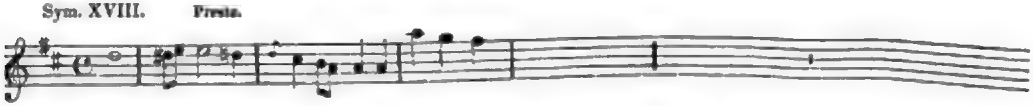
"If the gift of invention is invaluable, we may say that the art of conducting and developing ideas is not less important. We might cite many authors who, though not remarkable for variety or originality, have yet acquired a great reputation by the talent which they have shown in the development of their ideas. Among such authors are Sacchini and Anfossi; and in the works of authors very rich in invention might be pointed out pieces that have become highly celebrated, and of which the sole merit lies in the taste and the art shown in the development of the ideas." Most of Haydn's compositions are unrivalled models of skill and judgment in the development of musical ideas, and the conduct of the melody, harmony, and modulation. The study of double counterpoint, especially of that in the octave, is of essential importance to the attainment of skill in developing musical ideas. A knowledge of double counterpoint offers numerous resources to the composer of a symphony, an overture, an instrumental quartett, &c.; and, indeed, without such knowledge, it is impossible to make the most of one's musical ideas. This kind of knowledge is far remote from the dry and cumbrous learning of most of the older contrapuntists; learning which generally served no better purpose than to enable them with great labour to construct music *for the eye*, and not for *the ear*. To show the advantages that a composer of symphonies may derive from a knowledge of double counterpoint, we have only to refer to Haydn, Mozart, and Beethoven. Among Haydn's symphonies, the following movements occur to us at this moment as containing examples of what we have just been discussing. We refer the reader to the Partitions.

Sym. I. Allegro.

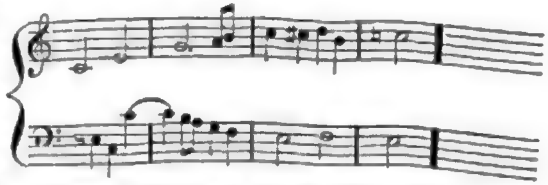
Sym. X. Allegro. Sym. XVI. Allegro.



Sym. XVIII. Presto.



No writer on composition has treated so fully as Reicha of the uses of double counterpoint in the development of musical ideas. (See his *Traité de Haute Composition Musicale*, a large and expensive work, of 596 folio pages.) It is to be regretted that Reicha, in his two large works on composition, does not give examples from the works of the best composers. He does not even give direct references to such passages in the works of these composers as might illustrate his rules and observations. A man so versed as he was in music of all kinds could have done this easily; especially as his treatises were of great extent, and could have admitted of many classical examples, instead of those which he gives composed by himself or by his pupils. He says (p. 140 of first volume), "Now-a-days, it is required that the employment of any counterpoint should be effective. If a composer has not genius enough to accomplish this, he will do well not to make use of counterpoint. . . In all the treatises where counterpoint is spoken of, there is a defect, inasmuch as they neglect to show, in a satisfactory manner, the true resources offered by counterpoint. This is the cause that the public has never had a just idea of invertible harmony, and of its utility. Here is an example of a double counterpoint in the octave.



"This model of four measures gives eight in reckoning its inversion. This is nearly all that is generally known. But what is to be done with eight measures, it is asked, if there are no more? These eight measures may serve as follows.

"1. To form a canon for two unequal voices—(*i.e.* voices of different pitch and compass).

"2. To form an entire double fugue for two, three, or four Parts.

"And, which is more important in our days, these eight measures can be employed, 3*dly*, in the course (chiefly in the second section) of a movement in a symphony, &c. where a very advantageous use of them may be made; as, for example, fragment of a movement in a

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He will make the harmony too full, or too thin, or dispose it in an unsuitable manner. As we have not room for examples of the style of accompaniment suitable to such music, we refer the reader to the edition of Marcello's Psalms, published in Paris some years ago by Mirecki, a pupil of Cherubini. It was revised by Cherubini himself. In that work the accompaniments are given as they ought to be, and may serve as models for the accompaniment of such music, and of much of the music of that period—the latter part of the seventeenth and the earlier part of the eighteenth centuries. The accompaniment of the compositions of that period for voices is generally attempted by modern pianists in mere dry chords read from the thorough bass figures and notes. Such an accompaniment is quite erroneous in so far as regards the composer's intention, because the accompaniment of these pieces was an *accompagnamento figurato* for three Parts, each of which Parts had its own melodic progression, and the whole three were so contrived as to sustain the voice or voices, and enforce the effect of these without overpowering them.

To accompany a Partition from which the pianist has to select, on the instant, those parts most important to the effect, while he leaves out others, or portions of others, requires great practice and knowledge, especially with regard to more modern Partitions. Formerly, the most important parts of a Partition were the two violins, viola, and violoncello, forming a quartett that represented the essential structure of the composition. The wind instruments were at that time employed much more sparingly and less effectively than they afterwards were in more modern music. There are other circumstances in the structure of the older Partitions which render it less difficult to accompany them than the more modern ones. But, with regard to the pianist's accompaniment of Partitions, especially modern ones, we may remark, that the attempt too often made by injudicious accompaniers to crowd into the piano-forte accompaniment all the orchestral effects that they see in a Partition, is worse than useless. The thing is impossible, from the nature and powers of the piano-forte, and its uniformity of *timbre*. We have already alluded to this in the section on Harmony. Where there is any particular and prominent design in the Parts of a Partition, the pianist ought to adhere to it in his accompaniment, in so far as the nature of such design and the powers of his instrument will permit. In many cases he must be content to sacrifice much of the design, and of the grace and freedom of movement, found in the Parts of the Partition, and to arrange his accompaniment in such a way as to make the most of the difficulties presented to him by the construction of the Parts. This will frequently occur to him in accompanying modern Partitions, which often contain so elaborate a construction of Parts as almost to defy any attempt to represent even a shadow of them in the piano-forte accompaniment. The best way of learning how such intricate Partitions may be suitably accompanied by the piano-forte, or how they may be arranged for the piano-forte, so as to accompany the voice Parts (for example) without any other instrument, is to study carefully the best Italian and German arrangements of the best Italian and German operas, oratorios, masses, &c. for the piano-forte, with the voice Parts; for example, Clementi's admirable arrangement of Haydn's *Creation;* the best French or German editions of the similarly arranged masses and operas of Mozart, Winter, Cherubini, Beethoven, &c. To render this study really useful, the accompanier must, at the same time, have before him, and consider attentively, the Partitions from which these arrangements were made. No abstract rules can teach the art of accompaniment. Nothing but talent, experience, and observation can do so; and therefore we would urge the student to go at once to the interesting fountain-head of good models, and not to waste time upon dry technicalities. Many pianists make a very easy matter of accompaniment, by reducing it to a series of dry chords (*accords plaqués*) or else broken chords in the vulgar form of what some musicians used to term "chopped hay." For the proper piano-forte accompaniment of modern songs, duetts, &c. the reader may consult the compositions of this kind by Haydn, Mozart, Cherubini, Beethoven, Himmel, &c. where the accompaniments are written by the composers themselves. The harp, although introduced of late years into orchestras, is not very effective in such a situation, unless when occasionally left nearly alone to accompany some vocal Part in an opera, or in concert-room music. It serves better for an accompaniment in chamber-music. The guitar, skilfully managed, forms a pleasing accompaniment to a single voice in songs of a certain character. Although the greater part of its sounds belong to the bass and tenor range, music for the guitar is written in the treble clef; so that the sounds heard are really each an octave lower than they are represented by the notation.

Before we conclude this section, we must advert to a fault not uncommon in the compositions of Germans for voices with orchestral accompaniments. Even Mozart himself has sometimes committed this fault. It occurs when the harmony for two or three voices is incomplete, and a succession of fourths, for example, is left to have the harmony completed by some of the instruments of the orchestra. This filling up of the harmony by the instruments does not produce the desired effect; for the imperfect harmony of the voices,—from their peculiar and prominent *timbre*,—is still perceived. The best modern Italian composers are more careful in this respect. They make the harmony of their voice Parts complete in itself, and independent of completion from the orchestral accompaniment.

Orchestral music.

The comparative simplicity of orchestral combinations in the works of the older composers has been adverted to in the preceding section. Gluck, in the latter part of the eighteenth century, was one of the first composers who introduced wind instruments into the orchestra in a manner more effective than had till then been practised. Any musician who will take the trouble to examine Gluck's Partitions will perceive that they suggested to other composers many ideas of orchestral effect from the use of wind instruments,—ideas more fully developed by Haydn, Mozart, Cherubini, Mehul, Beethoven, and others. The invention of new instruments, the improvement of old ones, the introduction into orchestras of instruments formerly confined to military music, have produced a superabundance of materials for orchestral effect; a superabundance sadly abused by many modern composers. The consequence of such abuse has been too frequently nothing better than a chaotic confusion, arising from the simultaneous combination of so many heterogeneous instruments. The *elaborate noise* of a modern orchestra is sometimes so great as to stun all ears but those petrified by custom. Men who serve artillery get so accustomed to the din and roar of cannon that they suffer no more annoyance from such noise than other untrained persons do from the distant explosion of a spent rocket in its highest altitude. They come at last to relish the martial din that deafens a common bystander.

In the section upon voices and instruments, we have occasionally adverted to the most suitable employment of some of the latter in orchestral music. We shall here offer a few more remarks upon this subject, and upon orchestra music in general.

A complete orchestra consists of a number of stringed instruments and wind instruments, and a few instruments of percussion; the latter being generally kettle-drums. The nature and magnitude of an orchestra must be regu-

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MUSK, a peculiar secretion found in the preputial gland of a small animal of the natural order Ruminantia. The musk animal (*Moschus moschiferus*, Linnæus) is found in Asia, and is often called the *musk deer*, but it cannot properly be classed under the genus Deer. (For information respecting it, see MAMMALIA.) The gland, or *pod*, as it is technically called, from which the musk is obtained, varies from one inch and a half to an inch and three-quarters in width, and often exceeds two inches in length. When first removed, it contains the secretion in a soft, almost liquid state; but it hardens by careful drying, and when removed is not unlike dark-coloured snuff, coarsely granulated. A good musk-pod contains about two drachms and a half of musk, the great value of which (L.3 to L.3, 10s. per ounce) leads to a variety of ingenious adulterations, in which dried blood and grain tin are much used. The Chinese even imitate the pods, and this, too, with so much success, that it is difficult to detect the fraud, except by very nice and experienced examination. It is imported in *catty-boxes*, usually containing from twenty to twenty-five pods. Musk is employed in perfumery and medicine; and, considering the powerful nature of this perfume, and the only source from which it can be obtained, the quantity used is very considerable. In 1856 the import was rather more than 5000 ounces, and as each pod weighs nearly an ounce when dry, this would necessitate the destruction of 5000 animals for the supply of England alone, where musk is not a favourite perfume, except in combination with other materials.

One of the most remarkable qualities of musk is the extraordinary persistence of its perfume. Specimens have been examined one hundred years old, the scent of which has been as powerful as recent musk; and the nicest balance has failed to detect any loss of weight in musk which has been so placed as to perfume a whole room for upwards of thirty years. In medicine, musk is occasionally used as an antispasmodic. It is also slightly narcotic, but it is not often administered. The duty on musk was reduced in 1832, and repealed entirely in 1845. (T. C. A.)

MUSLIN, a fine kind of cotton cloth, with a downy nap on its surface. The name is said to be derived from Mosul in Asia, where it was originally manufactured. It was first imported into England from India in 1670, and is now manufactured in immense quantities both in Britain and on the Continent, rivalling in quality, and surpassing in cheapness, the finest products of the eastern looms. (See COTTON, and COTTON MANUFACTURE.)

MUSONIUS, CAIUS RUFUS, a Stoic philosopher, was the son of a Roman knight, and was born at Volsinii (*Bolsena*) in Etruria about the beginning of the first century. He early became a disciple of the doctrines of the Porch. But his maxims, as quoted by Stobæus, A. Gellius, and others, have a more direct reference to practical than to speculative ethics. Since the ills of life are essentially paltry, he held that they ought to be met by quiet resignation, not avoided by suicide. The cultivation of the virtues of austerity, disinterestedness, chastity, and temperance, is the sure and the only means of securing happiness. "Everywhere," said he, "one can be happy, for everywhere one can be virtuous." The happiness of man is thus lodged within himself. It is not therefore necessary that we should defend ourselves from the injuries of others by inflicting retribution in return. The best way to make our fellows respect us is to respect ourselves. Such an elevated tone of morality was not palatable to the depraved court of Nero. Musonius accordingly fell into disgrace. Under the pretext of having been privy to the famous conspiracy of Piso against the emperor, he was banished to the isle of Gyaros (*Ghiouro*) A.D. 66. He appears to have returned on the accession of Galba in 68; and he is found shortly afterwards among the deputies who were sent by the Emperor Vitellius to Antonius Primus, the victorious general of Vespasian. Yet he subsequently rose high in the favour of Vespasian, so that he was allowed to remain in the city when all the other Stoics were driven into banishment for their intolerant precepts. The date of his death is unknown. The extant fragments of his works have been collected and published by Peerlkamp, under the title of *C. Musonii Rufi Reliquiæ et Apophthegmata*, 8vo, Haarlem, 1822.

MUSSCHENBROEK, PETER VAN, an eminent natural philosopher, was born at Leyden in March 1692. Studying at the university of his native city, he became a proficient in classics under Perizonius and Gronovius, and in natural philosophy, chemistry, and medicine, under Senguerd, Bidloo, Le Clerc, Burman, Albinus, Boerhaave, and Rau. The teacher, however, from whom he derived the most profit was the eminent mathematician Gravesande. A scientific partnership was formed in 1717 between the master and the pupil, for the prosecution of natural philosophy according to the principles of Newton, and in opposition to those of Descartes. Gravesande concentrated his attention on the theoretical part of the study; Musschenbroek conducted the experiments; and both, by their separate investigations, corrected or confirmed the results obtained by each other. The consequence was, that the downfall of Cartesianism, and the establishment of Newtonianism, were very much accelerated in Holland. In increasing the knowledge, and in determining the future studies of Musschenbroek, the effect was also great. An inaugural dissertation which he delivered in 1718, on the occasion of taking his degree, brought out into full prominence his taste and talent for experimental science. It was entitled *De Æris Præsentia in Humoribus Animalium*, and was full of experiments, carefully prosecuted and clearly explained. His fame was now established. He was appointed professor of natural philosophy and mathematics, and professor extraordinary of medicine in the university of Duisburg in 1719. In 1723 he was promoted to the chair of natural philosophy and mathematics at Utrecht. He was now placed in his proper sphere, and began to prosecute his favourite studies with increased vigour. His first important production was *Epitome Elementorum Physico-Mathematicorum*, 12mo, Leyden, 1726,—a work which was afterwards gradually altered as it passed through several editions, and which appeared at length in 1762, under the new title of *Introductio ad Philosophiam Naturalem*. The publication in 1729 of his next great work, *Physicæ Experimentales et Geometricæ Dissertationes*, raised his reputation to its acme. It threw new light on the subjects of the magnet, capillary attraction, and the cohesion of bodies. Scarcely less instrumental in advancing science was his Latin edition, in 1731, of the Italian work *Saggi di Naturali Esperienze fatte nell' Accademia del Cimento*. The numerous notes which he appended to this translation contained, amid many other curious investigations, a description of a new instrument, the pyrometer, which he had invented, and of several experiments which he had made on the expansion of bodies by heat. His great eminence was acknowledged in this same year by an invitation from the King of Denmark to Copenhagen. He declined this honour, and was promoted in consequence to the chair of astronomy at Utrecht in 1732. The attempt of George II. of England in 1737 to attract him to the newly-established university of Göttingen was also unsuccessful. At length, however, the claims of his native city overcame his resolution to remain at Utrecht, and he took possession of the mathematical chair at Leyden in 1739. Here he resolved permanently to settle. Offers of preferment from Berlin, Madrid, and St Petersburg, were tendered to him in quick succession; yet, declining all these honours, he continued peacefully to instruct his pupils, and to pursue his favourite investigations till the day of his death in September 1761.

Musschenbroek is also the author of *Elementa Physicæ*

8vo, 1731, translated into English by Colson, in 2 vols. 8vo, 1744. He contributed a dissertation on Barometers to the *Memoirs of the Academy of St Petersburg*, and several papers on Meteorology to the *Memoirs of the French Academy of Sciences*, and to the *Transactions of the Royal Society of London*.

MUSSELBURGH, a royal burgh of Scotland, county of Mid-Lothian, at the mouth of the Esk, 6 miles E. of Edinburgh. The town proper stands on the right bank of the river; and on the other side is the village of Fisherrow, with which it communicates by three bridges, one of which is believed to be of Roman architecture. The principal street of Musselburgh extends E. and W., and is nearly straight; the houses being in general well, though not regularly, built. The parish church stands on a hill to the S. of the town; and there are also Free, United Presbyterian, Episcopal, and Independent churches. In the principal street is a town-hall, with a jail attached, the latter having been built in 1590, out of the remains of the ancient chapel of Loretto, which existed in the vicinity. The town contains several schools, two libraries, and a savings-bank. Some Roman antiquities have on different occasions been discovered at Inveresk, where it is supposed that a Roman colony was once settled, and where traces of ancient baths have been discovered. The links, which stretch along the shore of the Firth of Forth, are extensive, and on them the Edinburgh races are annually held. They are also much used for the game of golf. The manufactures are few and unimportant, being chiefly leather, sail-cloth, and fishing-nets. The inhabitants of Fisherrow are, as the name of the place implies, chiefly employed in fishing; and this village, along with Newhaven, supplies the inhabitants of Edinburgh with fish. The harbour of Fisherrow is small, dry at low water, and is only visited by a few vessels of small size. Musselburgh is connected with Edinburgh, by a branch of the North British Railway; and large quantities of coal are conveyed from the pits in the vicinity to Edinburgh and Leith. The town is historically important on account of the battle of Pinkie, which was fought in the neighbourhood in 1547, when the Scottish army was defeated by the English under the Earl of Somerset. Oliver Cromwell also encamped here in 1650; and part of his entrenchments remain near the church. Musselburgh forms one of the Leith burghs which join in electing one member of Parliament. Pop. (1851) 7092.

MUSSET, Louis Charles Alfred de, a distinguished poet, novelist, and dramatic writer of the nineteenth century in France, was born at Paris on the 11th November 1810. He was of noble descent; his father, M. de Musset-Pathay, held the office of *chef du bureau* to the minister of war, and was favourably known as an author. His *Histoire de la Vie et des Ouvrages de J. J. Rousseau* is still held in estimation. Alfred received his education at the same institution with the eldest Prince of the House of Orleans, and the intimacy formed at this early period between the prince and the poet was fondly cherished in after years. The loss sustained by De Musset in the early death of his noble friend, was afterwards consecrated in *Le Treize Juillet*. After completing his elementary education, Alfred de Musset engaged successively in the study of medicine, of law, of art, and of trade; but turned aside from each with equal disgust. He subsequently laid the blame of his want of success in those studies on his superficial education, his indolence, and desultory habits of reading. His first appearance as an author was in 1828, in a pamphlet entitled *L'Anglais Mangeur d'Opium*, and signed with his initials. He published in 1831 his *Contes d'Espagne et d'Italie*, a series of licentious tales in verse, exhibiting vast powers and wild extravagance, possessing singular merits in point of form, and abounding with impassioned and vigorous writing. *Un Spectacle dans un Fauteuil* appeared in 1833, and possessed all the merits, and many of the defects, of his previous poems. They display a power and beauty seldom to be met with, and are never wanting in that subtle wit and delicate observation which so remarkably distinguish his prose works; but they are justly chargeable with extravagance, indecency, and irreligion. His charming *Proverbs*, which appeared in the *Revue des Deux Mondes* in 1833, are much less exposed to censure, and are full of poetical beauties of the highest order. Ten years afterwards they were brought upon the stage at St Petersburg, by Madame Allan, whence their fame travelled back to Paris, and soon called forth the enthusiasm of the Théâtre-Française. In 1835 De Musset visited Italy in company with Madame Dudevant (George Sand), in the ostensible relation of private secretary. In fullness of tone, wealth of colouring, and rich sustained melody, the language and style of these two distinguished contemporaries resemble each other not a little. *La Confession d'une Enfant du Siècle* appeared in 1836, and is alleged by some to be in a great measure autobiographical. The theme is familiar to all readers of modern French fiction; and finds its origin in the conventional view of the mental history of Byron, whose writings have exerted a profound influence over the current literature of France. Musset was poor, and his habits of dissipation did not increase his wealth. When his purse was full, he lived in Paris till it was empty, and then retired to the country. He declined to occupy the distinguished place in society which his genius and manners might have secured for him. By the influence of his early friend the Duc d'Orleans, he was appointed librarian to the minister of the interior. He was deprived of this sinecure office in 1848, but it was subsequently restored to him by the emperor. His *Nouvelles*, originally published in the *Revue des Deux Mondes*, are among the most remarkable of modern tales. These charming stories, so slight and unpretending in their structure, are masterpieces of a fine and subtle genius; and it is only to be regretted that their beauty is so much marred by the dangerous sensualism with which they are pervaded. The beautiful tale of *Frédéric et Bernerette* contains the most delightful portrait of the French grisette ever drawn, and is a special favourite with the Parisians. Musset's earlier collection of *Premières Poésies* comprise the period between 1829–1835; his second *Poésies Nouvelles* embrace the period 1836–1852. At the beginning of this second collection stands *Rolla*, marking the turning-point between the youth and manhood of the author. It is the wildest of all his productions, and in many respects the most remarkable; but the English reader is shocked by its impiety, and his feelings are outraged by the feverish delineations of certain modes of life which are fortunately not known beyond the French capital. Despite all these serious drawbacks, however, the genius of Alfred de Musset possesses qualities seldom hitherto known in French poetry. He occasionally reaches heights of imagination unknown perhaps to the greatest writers of his country; and his lyrics display a passion, tenderness, and musical beauty almost alien to his native soil. Those who consider the life of an author the best commentary on the tendency of his works, will find little difficulty in denouncing Musset's as pernicious; while those who regard works of art from a purely artistic point of view, will find much in his writings to call forth the highest praise. He was not a voluminous writer. A few small volumes contain all his works. His *Nouvelles* occupy less space than an ordinary romance, his poems may be read in a few hours, and his plays are by no means bulky. He died at Paris on the 3d of May 1857.

MUSSOUREE, in Hindustan, a sanatory station on the northern frontier of the Dehra Dhoon, established by the British to relieve and remove the consequences prejudicial to health from the sultry climate of India. There is no

level area of any extent at this station; so that the houses are built at considerable distances from each other, on sites which it has been necessary to level, on a ridge, a crag, or on the southern slope of the mountain. The views are very beautiful, comprising on the N. the Himalaya Mountains, clad in perennial snow; and on the S. the rich and varied expanse of the Dehra Dhoon, beyond which the prospect extends over the vast plain of Hindustan. In the latter part of winter there are smart frosts, with occasional falls of snow; neither, however, occurring after March, when spring sets in. Then succeeds delightful weather, which continues till the middle of June, when the periodical rains commence. Mussouree is abundantly supplied with provisions. It has a church, which was erected in 1837. The little settlement is well managed, and flourishing. Of the diseases contracted in the plains, the effects of a residence here are found favourable to fevers, dyspepsia, dysentery, liver complaint, pulmonary consumption, rheumatism, and general debility. Elevation above the sea, 6282 feet; N. Lat. 30. 27., E. Long. 78. 5.

MUSSULMAN, or MOSLEM, the general name given to all who profess the faith of Mohammed. (See MOHAMMEDANISM.)

MUSTAPHA, the name of several Turkish sultans. Mustapha I. succeeded his brother Achmed I. in 1617, was deposed a few months afterwards, was restored to the throne in 1622, was again deposed in 1623, and was strangled in 1639. Mustapha II. succeeded his uncle Achmed II. in 1695, was deposed in 1703, and died in 1704. Mustapha III. succeeded his cousin Othman III. in 1757, and died in 1774. Mustapha IV. succeeded Selim III. in 1807, was deposed in 1808, and was murdered by his brother Mahmud in 1809. (See TURKEY.)

MUSTARD, the English name of a genus of cruciferous plants, of which several species yield useful seed. The best known and most used is *Sinapis nigra* (Linn.), an indigenous plant, which is extensively cultivated for its seed in some parts of England, particularly in Northumberland and Yorkshire. Large mills are employed for grinding the seed, and for converting it into flour of mustard, the condiment so universally used at our tables. Table-mustard is, however, a compound, as it would not, in the opinion of some, be agreeable in an unmixed state. (See Christison's *Dispensatory*.) The materials added are varied by different manufacturers according to taste. It appears, however, from the published evidence taken before the select committee on the adulteration of food in 1856, that the adulteration of mustard is so extensive, that as a medical appliance it is generally ineffective. (Dr Challice's evid., *Blue Book*, p. 94.) In consequence of the extreme difficulty of obtaining pure mustard, a manufactory of that article has recently been established by government in Her Majesty's victualling-yard at Deptford, so that the Royal Navy is now supplied with mustard perfectly pure. The chief adulterations are flour, turmeric, and gypsum. Turmeric is used to improve the colour of the mustard, and especially to increase the profit of the manufacturer. Its presence may easily be detected by the use of ammonia. (Gay's evidence, *Blue Book*, p. 103 5.) Mustard was not known at our tables in its present form till 1720, when a Mrs Clements of Durham fell upon the present mode of preparing it. Her mustard met with the approval of George I., and soon became highly popular. Mustard is also of considerable importance in the materia medica. *Sinapis alba* (Linn.) is also cultivated for this purpose, but not to a very great extent. It is the sort which is commonly grown with cress in our gardens as a salad herb. The genus has a very wide geographical range, some species being indigenous in Europe and others in India. In the East Indies *Sinapis nigra*, *S. glauca*, and *S. Toria*, are very extensively cultivated for the purpose of expressing oil from the seeds, very large quantities of which are exported to this country for the same objects under the names of *rape* and *sursee* seeds. The total imports of these seeds from India in 1856 was 21,417 quarters, all consumed in the manufacture of oil. Some of the oil so made is used for burning, but the greater portion is employed in dressing woollen goods. (T. C. A.)

MUTINA. (See MODENA.)

MUTINY. (See MILITARY LAW.)

MUTIUS, CAIUS, surnamed *Codrus*, and afterwards *Scævola*, was one of the illustrious Roman family of the Mutii, and rendered his name famous in the war between Porsenna, King of Tuscany, and the Romans. That prince having resolved to restore the family of Tarquin the Proud, went to besiege Rome in the year 507 B.C.; but Mutius determined to sacrifice himself for the safety of his country, and boldly entering the enemy's camp, killed Porsenna's secretary, whom he took for Porsenna himself. Being seized and brought before Porsenna, he told the king boldly that three hundred young men like himself had sworn to murder him; "but since this hand has missed thee," continued he, "it must be punished;" then putting his right hand on the burning coals, he let it burn with such constancy as astonished the beholders. The king, amazed at the intrepidity of the young Roman, ordered that he should have his freedom and return to Rome, and soon afterwards concluded a peace with the Romans. From this action Mutius obtained the surname of *Scævola*, or left-handed, which was enjoyed by his family.

MUTIUS SCÆVOLA, Q., surnamed the *Augur*, was an excellent civilian, and instructed Cicero in the laws. He was made prætor in Asia, and afterwards became consul, when he performed important services for the republic. He must not be confounded with Quintus Mutius Scævola, another excellent civilian, who was prætor in Asia, tribune of the people, and at length consul 95 B.C. He governed Asia with such prudence and equity, that his example was proposed to the governors who were sent into the provinces. Cicero says of him, that he was the most eloquent orator of all the civilians, and the most able civilian of all the orators. He was assassinated in the temple of Vesta during the wars of Marius and Sylla B.C. 82.

MUTTRA, in Hindustan, a British district under the jurisdiction of the lieutenant-governor of the north-west provinces. It lies between Lat. 27. 14. and 27. 58., Long. 77. 20. and 78. 34.; and includes an area of 1607 square miles, with a population of 862,909. Muttra, the capital of the district, is described by Bishop Heber as a striking town, much resembling Benares, its houses being lofty, with the same sort of ornaments as in that city. The place is regarded as sacred in Hindu mythology, from being the birthplace of the divinity Krishna. Towards the close of the last century the town of Muttra was seized by Scindia, the Mahratta chief, who conferred it on the French adventurer Perron, on condition of military service. In October 1803 it was, without resistance, occupied by the British troops, and in the same year permanently ceded to the East India Company by Scindia, under the treaty of Serjee Arjengaum. Muttra is in N. Lat. 27. 30., and E. Long. 77. 45.

MUZIANO, GIROLAMO, an eminent Italian painter, was born at Acquafredda, near Brescia, in 1528. Under Romanino, an imitator of Titian, he studied his art, and became an adept in designing and colouring according to the principles of the Venetian school. But it was not until he had left his native place, and had repaired to Rome about 1550, that he came into notice. There his pictures soon gained for him the surname of *Il Giovane de' Paesi* ("the young man of the landscapes"). Stimulated by success, he tried the more elevated style of historical painting. He imitated Michael Angelo in giving great prominence to the anatomy of his figures, and became fond of painting persons emaciated by abstinence or disease. His great picture of the

"Resurrection of Lazarus" at once established his fame as an historical painter. Michael Angelo praised it, and pronounced its author one of the first artists of that age. It was placed in the church of Santa Maria Maggiore, but was afterwards transferred to the Quirinal Palace. Muziano, with dogged perseverance, continued to proceed in the path on which he had so successfully entered. He grew excellent in depicting foreign and military dresses, and in introducing landscapes into his historical pieces after the manner of Titian. Mosaic working also occupied his attention; and from being a crude art of inlaying coloured stones, it became under his hands a perfect imitation of painting. His ability and industry soon gained for him a handsome fortune. Part of this he expended in assisting to found the Academy of St Luke at Rome. He died in 1590, or, according to another authority, in 1592, and was buried in the church of Santa Maria Maggiore, where his great masterpiece was placed.

Many of Muziano's works are in the churches and palaces of Rome. There is his group of "Anchorites listening to a Saint," in the church of the Carthusians; his "Circumcision," in the church of Gesù; his "Ascension," in the church of Ara Cœli; and his "St Francis receiving the Stigmata," in the church of the Conception. A picture by him, representing Christ washing the feet of his disciples, is in the cathedral of Rheims. (Lanzi's *Storia Pittorica*.)

MYCENÆ or MYCENE, an ancient city of Greece, stood about 7½ miles N.E. from Argos, on a rocky height in a recess of the mountains that border the Argeian plain. Its name is said to have been derived from Mycene, daughter of Inachus, or from the Greek word μύκης. It was founded by Perseus; and, according to a favourite legend, its massive walls were reared by the strong hands of the Cyclopes. After the death of Perseus it was ruled in succession by Sthenelus and Eurystheus; then coming into the power of the Pelopidæ, it gradually rose into importance until, under the sway of Agamemnon, it became the first city of Greece. But no sooner had that powerful prince died, than Argos began to assume a supremacy over the other towns of the plain. The Mycenæans were soon fain to trust to their strong walls, and to an alliance with Sparta for protection against their aggressive neighbours. At length, in 468 B.C., the Argives, summoning to their aid the inhabitants of Tegea and Cleonæ, sat down before Mycenæ. After a blockade, the city was forced to capitulate, and was ever afterwards abandoned to desolation. In the second century A.D., its ruins were visited by Pausanias. They are still very extensive, and are the most ancient in Greece, next to those of Tiryns. The walls of the Acropolis exist, in a greater or less degree of preservation, round almost the entire circuit. They consist in some places of huge misshapen blocks piled up irregularly, and in other places of stones, skilfully hewn and regularly placed. At their N.W. angle is a gate, formed of three long massive stones, surmounted by two enormous lions in bas-relief, and called on that account the Gate of Lions. On the S.W. of the Acropolis the site of the lower town is indicated by the remains of a wall extending from N. to S. In this part of the ruins there are four subterraneous erections in which, according to Pausanias, the treasures of the Atridæ were deposited. One of these, called the Treasury of Atreus, consists of two apartments, the outer of which is large, and the inner comparatively small. (Leake's *Morea*, and Mure's *Tour in Greece*.)

MYCONE, or MICONI, a small island in the Ægean Sea, situated in N. Lat. 37. 29., E. Long. 25. 21. It is of a triangular form, and in length is 8½ miles from E. to W.; in breadth from N. to S., 6 miles. The surface is rugged, but does not rise to a very great height, and the soil is dry but fertile. Wine and fruit are the principal products of the island, and it also contains abundance of game. There is very little water here, and the wants of the inhabitants are for the most part supplied by rain water. The town of Mycone stands on the N.W. coast, and is chiefly inhabited by sailors, who are reckoned among the best in these seas. The roadstead is exposed to all winds except those from the N.N.E. Pop. of the town about 5000; of the island, about 6000.

MYHERE, in Hindustan, a petty native state in the territory of Saugor and Nerbudda, containing an area of 1026 square miles, and a population of 100,000. The present chief is a minor, and arrangements have been made for his education at Agra, under the direction of the British government. Myhere, the principal town, is in N. Lat. 24. 16., E. Long. 80. 49.

MYLÆ (*Milazzo*), an ancient town of Sicily, was situated about 30 miles W. from Cape Pelorus, on the isthmus of a peninsula of 5 miles in length. It assisted, according to Strabo, in 648 B.C., in colonizing Himera. It was for many centuries a dependency of the Greek colony of Messana. Laches took it in 427 B.C.; and the Rhegians, in 394 B.C., attempted to make it the seat of an opposition to Messana. It enjoyed separate municipal privileges in the time of Pliny; and its importance as a military station is still great.

MYLASSA, or MYLASA (*Melasso*), a noble city of Caria in Asia Minor, situated about three leagues from the *Sinus Ceramicus*, in a beautiful plain at the foot of a steep mountain, containing fine white marble, of which its buildings were composed. It was the capital of Hecatomnus, King of Caria and father of Mausolus, and the birthplace and residence of the Carian kings before Halicarnassus became the capital. The chief citizens of Mylassa were made priests of Zeus for life; and the splendour of its temples was the wonder of all who visited it. Caria was taken by Mithridates, and afterwards by Labienus, whose father had been one of Cæsar's generals. Hybrias, whose eloquence and valour entitled him to a distinguished rank amongst his countrymen, in vain encouraged them to make an obstinate defence. He himself was obliged to yield to necessity, and to take refuge at Rhodes; but scarcely had the conqueror quitted the city, when Hybrias returned and restored liberty to his country. Pliny calls it *Mylasa libera*; and Strabo informs us that it was one of the most magnificent cities of antiquity, and that its temples, porticoes, and other public monuments were highly admired. When Pococke visited this place it was comparatively perfect, but at present few traces of it remain. (See Leake's *Asia Minor*, and Fellows' *Journal and Discoveries*.)

MYLNE, ROBERT, the architect of Blackfriars Bridge, London, was the descendant of a family of architects, and was born in Edinburgh in 1734. Having adopted at an early age his hereditary profession, he was sent to the Continent to complete his studies. His enthusiastic prosecution of his art soon brought him into notice. He became a most distinguished pupil, and ultimately a member of the Academy of St Luke at Rome. Returning to England, he executed a design for Blackfriars Bridge, which was chosen from among twenty others. The bridge was begun in 1760, was finished in 1769, and established the fame of its architect. He was employed to erect or improve many edifices throughout the kingdom. The office of engineer to the New River Water-works Company, and the surveyorship of St Paul's Cathedral, were conferred upon him. While holding this latter appointment he suggested the famous inscription to the memory of Wren in St Paul's, "Si monumentum quæras, circumspice." He died in 1821.

MYMUNSING, a district of Hindustan, in the province of Bengal, situated between the 24th and 26th degrees of north latitude. The boundaries of this territory are the Garrow Mountains and the district of Goalpara on the N., Dacca Jelalpoor on the S., Silhet on the E., and Bogra and Rungpoor on the W. The country is intersected by the

Myrpooree ‖ Myriapoda.

great river Brahmapootra, into which flow innumerable streams from both sides; and which overflows its banks during the rainy seasons, causing very abundant crops of rice. Some parts of the country are overrun with jungle, and are but thinly inhabited. The chief town is Bygonbary. The population is 1,487,000, consisting of nearly equal numbers of Hindus and Mohammedans.

MYNPOOREE, in Hindustan, one of the north-western provinces of Bengal. On the N. it is bounded by the province of Budaon, on the N.W. and W. by Furruckabad, on the S. by Etawah and Agra, and on the W. by Muttra and Allyghur. It lies between Lat. 26. 54. and 27. 50., Long. 78. 30. and 79. 30.; and contains an area of 2000 square miles. The population amounted in 1853 to 832,714; of whom 619,659 are Hindu, agricultural; 161,422 Hindu non-agricultural; 20,093 Mohammedans and others, agricultural; and 31,540 of those various classes, non-agricultural. The tract of which this province forms part was included in the Mohammedan empire of the Afghans, overthrown by Baber. On the dismemberment of the empire of Delhi it became part of the transient realm of Nujuf Khan, in virtue of a treaty of partition between him and Shuja-ood-Dowlah, the vizier of Oude. After the death of the former it was seized by the Mahrattas, and in 1803 was ceded to the East India Company by Dowlat Rao Scindia, under the second article of the treaty of Serjee Anjengaum. Mynpooree, the principal town of the province, contains a pop. of 21,000. N. Lat. 27. 14., E. Long. 79. 4.

Myriapoda.

MYRIAPODA,

A WINGLESS tribe of insects, formerly so called, of which *centipedes* (the genus SCOLOPENDRA of Linnæus) form the most characteristic example, are now regarded as a separate class of the articulated tribes, in conformity with the views of Dr Leach and other writers who have studied their structure and economy. Under this title, therefore, as formerly intimated,[1] we shall present the reader with a brief notice of the principal genera, of which the prevailing forms have been already exhibited (in connection with our representations of insects) on Plate CCLII. of this work. We owe the establishment of the class to Dr Leach,[2] M. Lamarck having viewed the Myriapoda as arachnides,[3] while M. Latreille, except in a single work,[4] regarded them as true insects. As such they were likewise included by Linnæus, and the older systematic writers, in the order APTERA.

The Myriapoda are distinguished from true insects by their greater amount of feet (twenty-four and upwards), by the want of any precise or appreciable division into thorax and abdomen, and by the numerous segments into which their bodies are divided. Each segment, with the exception of the first, is furnished with a pair of legs, terminated for the most part by a single hook. The stigmata, or openings for respiration, are placed on each alternate segment, a circumstance which has induced some observers to regard the latter as only semi-segments, in as far as in true insects each ring has its pair of stigmata. But we see no necessity for the establishment of any strict analogy of form between the subjects of two distinct classes of articulated beings; and indeed, if we do so in regard to the character in question, we produce a greater discordance by the necessity, in that case, of assigning to each so-called (double) segment, a couple of pair of legs. The mandibles are bi-articulate, and are followed by a piece in the form of a labium, quadrifid, with articulated divisions resembling little feet, and corresponding in position to the *languette* of the Crustacea. Then succeed two pair of small feet, of which the second, sometimes hook-shaped, seem to replace the four maxillæ of the last-named order, or the two maxillæ and the lower lip of insects. They may be regarded as maxillary feet. The antennæ are two in number. Their form cannot be easily generalised, because, although they may often be, as Latreille says, "courtes, un peu plus grosses vers le bout, ou presque filiformes;" yet in some (genus *Scutigera*) they are very long, and become much more slender towards the extremity. The number of the articulations also varies greatly. The organs of vision are usually formed by a union of smooth or simple eyes; but in some these parts are analogous to the compound eyes of insects, the facettes, however, being proportionally larger, rounder, and more distinct. All Myriapodes are apterous.

The subjects of our present notice differ likewise from insects in this remarkable peculiarity, that the number of their segments, and consequently of the stigmata and legs, increases with the size of the individual. It would even appear, from the observations of Savi the younger,[5] that the genus *Iulus* is born without feet; from which it has been observed, that those Myriapodes are subject, at some early period of their lives, to a regular metamorphosis. Degeer had long before observed, that the number of their parts increased with the general growth of the body.

The organs of respiration consist of two principal tracheæ extending parallel along the body, and receiving air from the lateral spiracles.

Myriapodes are generally supposed to be longer lived, and of more continuous growth, than insects; and, according to Savi the younger, two years elapse (at least in the genus *Iulus*) before the development of the generative system; but it must be borne in mind, that many insects exist for a length of time in the larva state (to which the early condition of the Myriapodes so closely corresponds), and are thus of equal longevity with the many-footed subjects of our present inquiry. The Myriapodes in general shun the light. They conceal themselves under stones, beneath the bark of trees, among old timber, and in various other localities. Some inhabit fruits, and others are destructive to culinary vegetables. Many are carnivorous, seizing upon animal substances, both dead and living, with their curved jaws. They are said to infuse a poisonous juice into their wounded victims.

In our subdivision of the class, as in the preceding generalities, we shall follow the system of Latreille, by whom the Myriapodes are partitioned into two primary groups, which differ from each other both in habits and structure.

ORDER I.—CHILOGNATHA.

This primary group corresponds to the genus *Iulus* of Linnæus. The body is for the most part cylindrical, and of a crustaceous consistence. The antennæ are composed of seven joints, of nearly equal size. The mandibles are thick, without palpi, distinctly divided into two portions by a median articulation, and with teeth implanted in a concavity of their upper extremity. Beneath is a kind of labium or lower lip, divided at its exterior surface, by

[1] See the article ENTOMOLOGY of this work, vol. ix. p. 25, foot note.
[2] Linn. Trans. xi. 376.
[3] *Animaux sans Vertèbres*, v. 24.
[4] *Familles du Règne Animal*, p. 323.
[5] *Memorie Scientifiche*, Pisa, 1828.

notches and longitudinal sections, into four principal areas, tuberculated on the upper margin, and of which the two intermediate are short and narrow, and placed at the upper extremity of another area, which serves them as a common base. The feet are very short, and always terminate in a single hook; four anterior feet placed immediately beneath the labium, resemble the others in form, but are more approximate at their base, with the radical joint proportionally longer. Most of the other legs are attached by double pairs to a single segment of the body. The male organs are placed beneath the seventh pair of legs, those of the female behind the second pair. The stigmata, as usually described, are very small, and placed on alternate segments outside the origin of the legs.

The Myriapodes of this division are slow of movement, and advance, as it were, by a gliding motion. They assume in defence a round or spiral form. The first segment of the body, in some the second, is larger than the others, and presents the form of a corselet or buckler. The double pairs of legs do not occur until we reach the fourth, fifth, or sixth pair; the first three or four pair being free from their origin, or adhering to their respective segments only by a median or sternal line. The two or three terminal segments of the body are usually without feet. On each side of the body there is a series of pores, formerly regarded as stigmata, but which, according to M. Savi, merely emit an acid liquor of a disagreeable odour, and probably intended as a means of defence; the true stigmata, or respiratory openings, as described by the Italian naturalist, being placed on the sternal piece of each segment, and communicating internally with a double series of pneumatic pouches, disposed *en chapelet* along the body, and giving out tracheal branches, which ramify over the other organs. These pouches or vesicular tracheæ, according to M. Straus, are not connected with each other, as among ordinary insects, by a principal trachea.

The form of the newly-hatched bodies of the Iulidæ, as observed by M. Savi in the vicinity of Pisa, was somewhat kidney-shaped, quite plain, and without appendages. After the lapse of eighteen days they underwent their first moult, and only then assumed the form of the adults; but they were still composed of only twenty-two segments, and the total number of their legs amounted to twenty-six pair. These observations are in some measure inconsistent with the assertion of Degeer, who in the young state of these creatures counted only three pair of legs and eight segments: but is it certain, asks M. Latreille, that the moult described by M. Savi was actually the first; or ought we not rather to presume that they do not pass suddenly from an apodal state to the possession of twenty-six pair of legs; in other words, that they are subject to certain intermediate changes, which may have escaped the observance of M. Savi?[1] After the second moult, however, the last-named naturalist informs us, the genus *Iulus* exhibits thirty-six pair of legs, and after the third, forty-three, and the body then consists of thirty segments. In the adult state the number is considerably increased. Two years afterwards another moult takes place, and it is only then that the generative system is developed. From the period of birth, which takes place in March, the renewals of the skin were observed by M. Savi to take place almost monthly till November, and the exuviæ were seen to contain even the membrane which lines the interior of the alimentary canal and tracheæ. The organs of the mouth were the only parts not there observed by M. Savi.[2]

The food of these Myriapodes consists both of animal and vegetable substances, generally dead and decomposed. They deposit a great number of eggs. The generic groups are as follows. We shall enter into few details, as we have illustrated so many of the prevailing forms by means of accurate figures.

GENUS GLOMERIS, Lat. Body convex above, concave below, with a range of small scales along the lower sides. It is composed of twelve segments, exclusive of the head. The male has thirty-two legs, the female thirty-four.

The species are not numerous. Although *G. ovatus* inhabits the sea, the greater proportion are terrestrial, occurring under stones, particularly in mountainous countries. *G. marginata* (Plate CCLII., fig. 1) is common in most European countries.

GENUS IULUS, Lat. Body cylindrical and extended, without any projecting crests or cutting margins.

The larger species are terrestrial, and live in woods; the smaller attack fruits, roots, and various kitchen produce, to some of which they are very destructive. They all assume a spiral position in repose or when alarmed; the head being placed in the centre. Prior to the time of Latreille, this entire division was included under the genus *Iulus*, Linn. But the French naturalist restricted the term to the cylindrical species, and formed of the others his genera *Glomeris*, *Polydesmus*, *Polyxenus*. Various species are described by Dr Leach, in a paper which stands in need of revision.[3] We have here figured *I. sabulosus*, a common European species, Plate CCLII., fig. 3. A monstrous Myriapod is mentioned by Ulloa as inhabiting the district of Carthagena.[4] He describes it (if his terms have not been mistranslated) as sometimes extending a yard in length, and measuring five inches across. Here there is no doubt some gross exaggeration. He adds that its bite is mortal, if a timely remedy be not applied. From its cylindrical form it has been regarded as an Iulus.[5]

GENUS POLYDESMUS, Lat. Body linear, the segments compressed on the under surface, with projecting ridges on the upper, somewhat in the form of transverse oblong scales.

The species of this genus, of which our *Iulus complanatus*, Linn., may be regarded as the type (Plate CCLII., fig. 2), dwell under stones in dampish places. They assume the spiral form when touched, and feed both on animal and vegetable matters in a state of decomposition.

Certain other species, of which the eyes are obvious, form the genus CRASPEDOSOMA of Dr Leach.

GENUS POLYXENUS, Lat. Body soft, membranous, terminated by a tuft of lengthened scales.

The only species of which we have any knowledge is the *Pol. lagurus*, Lat. (Plate CCLII., fig. 5), regarded as a scolopendra by the generality of systematic authors, and described by Degeer under the name of *Iule à queue en pinceau*.[6] It is a very small creature, of rather singular aspect. Our magnified representation just referred to will save the necessity of descriptive details. Its early organization is less complicated than that of the adult state; that is, the young consist of fewer segments and a less number of legs. We know little of its natural habits. It occurs in the clefts of walls, and beneath the bark of old trees.

ORDER II.—CHILOPODA. Lat.

This division of the Myriapoda bears nearly the same relation to the unrestricted genus *Scolopendra* of Linnæus

[1] *Règne Animal*, iv. 332.
[2] See *Osservazione per servire alla storia di una specie di Iulus communissima*, reprinted in *Memorie Scientifiche*, Pisa, 1828.
[3] Linn. Trans. xi. 377.
[4] Voyage, vol. i. p. 61.
[5] Kirby and Spence's Introduction to Entomology, vol. i. p. 128.
[6] *Mémoires*, t. vii. pl. 36.

as the preceding does to the genus *Iulus* of the Swedish naturalist. The antennæ become slender towards the extremity, and are composed of fourteen articulations and upwards. The mouth is composed of two mandibles, each furnished with a small palpiform appendage, and exhibiting in their centre the appearance of a joining, and ending in a spoon-shaped termination, with toothed edges. The labium is quadrifid, with the two lateral divisions larger than the others, transversely ringed, and resembling the membranous feet of caterpillars. This labium is analogous to the lower lip of the chilognathous kinds, which represents in Latreille's opinion the tongue of the crustaceous tribes, but possesses also the functions of maxillæ. It is what Savigny names the first auxiliary lip. Besides these parts, there are two palpi or minute feet, united at the base, and unguiculated at the point; a second labium (*seconde lèvre auxiliare* of Savigny[1]), formed by a second pair of feet dilated and joined at their origin, and terminated by a strong hook, moveable, and pierced at the extremity, for the transmission of a venomous or acrid liquid.

The body of these unseemly creatures is depressed and membranous. Each ring or segment is covered by a coriaceous plate, and usually bears only a single pair of legs; and the terminal segment is generally thrown backwards, and elongated into a kind of tail. The organs of respiration are composed, either in whole or in part, of tubular tracheæ. The sexual parts are interior, and placed at the posterior extremity of the body, as in the generality of insects properly so called. The stigmata are more obvious than in the preceding family, and are either lateral or dorsal.

The species of this division are of much more nimble habits than those of the preceding; and the peculiar mode in which the limbs act produces an undulating lateral motion. They are of carnivorous habits, and, avoiding strong light, usually conceal themselves under stones or old timber, beneath the bark of trees, &c. They are held in some dread by the inhabitants of tropical countries, where they attain a great size, and are consequently capable of inflicting dangerous wounds. But the majority of travellers seem agreed that, although the bite is more painful than that of a scorpion, it is never attended by fatal consequences. In more northern countries they are quite harmless, though disliked in consequence of their repulsive aspect. Our common centipede (*Scolopendra forficata* of Linn.) so frequent in this country under stones, may be mentioned as a familiar example. Leeuwenhoeck, the great Dutch microscopical observer, has described the perforation of the hooks, through which the poison is supposed to flow.

This order (which corresponds to the Syngnatha of Latreille's earlier works, the title adhered to by Dr Leach) is divided into the following genera.

The first two have only fifteen pair of legs; and their bodies, when viewed from above, seem to present fewer segments than when examined from below.

Genus Scutigera, Lamarck.[2] Body covered by eight plates or shields, beneath each of which are two pneumatic pouches or vesicular tracheæ, which receive the air, and communicate with lateral and inferior tracheæ of a tubular form. The under surface is divided into fifteen semi-segments, each bearing a pair of feet terminated by an extremely long, slender, and minutely articulated tarsus. The terminal legs are long, and seem to increase in extent from the foremost to the hindmost pair. The eyes are comparatively large and reticulated. The antennæ are very long and slender, and the palpi projecting and spinous.

The species keep themselves concealed during the day in barns, or the unfrequented parts of houses, lying between old planks, or sometimes under stones. They are seen at night running on the outside walls with great velocity, feeding on *onisci*, and various insects. They seem to pierce their prey with their mouth-hooks, and infuse into them a poisonous fluid, which immediately deprives them of life. These Myriapodes make their appearance in great numbers, chiefly in rainy weather. According to Illiger, they are greatly dreaded by the inhabitants of Hungary. The best known European species is the *S. araneoides* (Plate CCLII., fig. 4). It is the *Scolopendra coleoptrata* of Linn. and Fab. Pallas asserts that it was taken by a friend of his among some fuci in the sea;[3] but as all analogy is against its natural occurrence in such a locality, we may infer that it had fallen accidentally from the timbers of a vessel.

Genus Lithobius, Leach. Body divided into an equal number of segments both above and below, each bearing a pair of legs. The dorsal plates are alternately long and short. The stigmatic openings are lateral.

We have figured our most common species, *L. forficata* (Plate CCLII., fig. 6), a familiarly-known Linnæan scolopendra, as an example of the modern genus. It occurs almost everywhere, throughout the summer season, under stones. The anatomical structure of the genus has been described by M. Leon Dufour.[4]

The remaining generic groups of this order have at least twenty-one pair of legs, and the segments of the body are of nearly equal size, and of similar number, both above and below.

In the genus Scolopendra, properly so called, there are eight distinct eyes, four on each side, and the basal joint of the terminal legs is armed with small spines. We have no British species, but the south of Europe produces *Scol. cingulata*, which presents almost as formidable an aspect as some of the exotic kinds. The great foreign species (one of which sometimes measures above a foot in length) have been as yet but ill defined, several kinds being no doubt described under the name of *Scol. morsitans*, a native of South America (Plate CCLII., fig. 9). A monstrous species, called *Scol. Plumieri*, is figured in Lister's Journey to Paris, and appears to be also represented in Seba's Thesaurus, under the name of *Millepeda major ex Nova Hispana*. India, and the great eastern islands, produce some very large species; and scolopendræ of alarming size likewise occur on the African continent. The bite of these creatures is said to be dangerous; but it seems that the poison of the wound is allayed by the use of ammonia. M. Amoreux is of opinion that no poisonous power is possessed by any of the European species.[6] The whole are carnivorous and voracious, and, all things considered, they may be regarded as among the ugliest of creeping things. Nevertheless they are not without their advantage to the human race. "I have seen Indian chil-

[1] This piece is not attached to the head, but to the anterior extremity of the first semi-segment. The two hooked feet form by the union and dilatation of their first article a plate in the form of a labium or mentum, and the same semi-segment bears the two first ordinary feet. (*Règne Animal*, iv. 336.)

[2] Latreille and others have adopted Lamarck's designation, although the title of *Cermatia* had at a prior period been assigned to this generic group by Illiger. See Rossi's *Fauna Etrusca*, t. ii. p. [illegible].

[3] *Spicilegia Zoologica*, fascic. 9, tab. 4, fig. 16.

[4] *Annales des Sciences Nat.* ii. 81.

[5] *Bulletin de la Soc. Phil.* Januar, 1824, p. 24.

[6] *Insect. Venen.* p. 277.

dren," says Humboldt, "of the tribe of the Chuymas, draw out from the earth and eat millepedes or scolopendræ, 18 inches long and 7 lines broad."[1]

Other species, in which the eyes are obliterated or inconspicuous, and the basal joint of the last pair of legs is free from spines, form the genus CRYPTOPS of Dr Leach.[2] He has described two English species, and nobody appears to have since found any other elsewhere.

Some still more slender kinds, of which the antennæ have only 14 joints, but the legs are so numerous as sometimes to amount to nearly 300, compose the genus GEOPHILUS of Dr Leach. They are remarkable for their extreme tenuity, and at least one British species is at times beautifully phosphoric. We know not, however, whether it is identical with the *Scol. electrica* figured by Frisch, and described by Geoffroy.[3] Dr Leach has described the indigenous species.[4] They are destructive to fruit and vegetables. (J. W.)

MYROBALANS are the unripe drupe-like fruits of a tree found in the East Indies, growing from 40 to 50 feet in height. It is the *Terminalia Chebula*, Roxburgh, of the natural order Combretaceæ. (See BOTANY.) The myrobalan of commerce is about an inch and a-half in length, oval in shape, dry, hard, and wrinkled, and of a brownish-yellow colour. It was first imported in 1842 as a substitute for galls in dyeing black, and was for some time supposed to be a gall, and returned as such in the revenue accounts. The quantity imported during the first three years only amounted to about 8 tons; but so greatly has the demand increased in consequence of the valuable properties of the myrobalan, that in 1856 the importation had reached 3150 tons. The myrobalan is gathered unripe, and then dried in the sun, and packed into pockets containing about half a cwt., and bags holding about one and a half cwt. Of these bags, the number imported in 1856 was 41,250, and of the pockets 2300, nearly all of which are brought from Bombay. The value is, according to quality, from 6s. to 12s. per cwt. With the salts of iron the myrobalan yields nearly as fine a black as the Turkish oak-gall; and from the fact that it contains a large quantity of tannic acid it has been extensively used in tanning when more than ordinarily cheap. Besides black, they yield various shades of yellow and yellowish-green, with proper mordants. There are numerous species of myrobalan, some of which are very useful. They are,—the *Terminalia citrina*, Rox., used as a gentle aperient in Indian pharmacy; the *Terminalia belerica*, Rox., the seeds of which are eaten, and are likewise used in tanning and dyeing; the *Terminalia catappa*, Linn., yielding the edible kernels called Indian almonds; the *Terminalia glabrata*, Forskel, eaten in the Society and Friendly Islands; the *Terminalia angustifolia*, Jacquin, formerly celebrated for its richly odorous gum; and the *Terminalia alata*, used in tanning operations in India. The emblic myrobalan, the fruit of *Phyllanthus emblicus*, Linn., is used for similar purposes in the East Indies. (T. C. A.)

MYRON, one of the most famous of Greek statuaries, was born at Eleutheræ in Bœotia about 480 B.C. He studied along with Polycletus under Ageladas of Argos, and flourished at Athens about the commencement of the Peloponnesian war. Some of his works were executed in marble, but he wrought most successfully in the bronze of Delos. The range of his subjects was not confined to the varied attitudes of the human figure. It also comprised the forms of other animals; and this fact distinguished him from the rest of the great statuaries of Greece. Another characteristic of Myron was the want of all idealization in his works. "He was," says Pliny, "curious in all corporeal detail, but paid little regard to expression." There was an air of ease in his statues which indicated the admirable spontaneity of his genius. The work that first raised him to celebrity was a brazen cow, in the attitude of lowing, and, according to some, of suckling a calf. It was set up in a public place in Athens, and there it stood till at least the time of Cicero, attracting more notice by its simple truthfulness than all the highly-idealized statues of men and gods that abounded in the thoroughfares and streets of the city. Many authors mentioned it both in prose and verse, and no less than thirty-six of the epigrams in the Greek anthology were written in its praise. The last writer who alludes to its existence is Procopius, in the sixth century. It was then standing in the temple of Peace at Rome. The next most famous work of Myron was the "Discobolus," or quoit-thrower. This athlete is described by Lucian as bending one knee in the act of preparing to play, turning his head slightly to one side, and extending his right hand behind his back to take the quoit from his left. Of this bronze statue many marble imitations were probably taken, in accordance with the custom of that age. Some of these are supposed to have been discovered. One found in the Villa Palombra, on the Esquiline, in 1782, and now seen in the Villa Massimi at Rome, closely agrees with the description of the original given by Lucian. Not so faithful is another that was discovered in the grounds of Hadrian's villa near Tivoli in 1791, and is now exhibited in the Townley gallery of the British Museum. It has both knees bent, instead of one only, and the head inclining forwards, instead of turning round.

The following list of some of Myron's other works is given by Pliny:—A dog; Perseus; sea-monsters; a satyr admiring a double flute; Minerva; Delphic pentathletes; pancratiasts; Hercules; and Apollo. There are also mentioned in ancient authors, a colossal group of Jupiter, Juno, and Hercules at Samos; four oxen, which were placed by Augustus in the portico of Apollo's temple on the Palatine; a statue of Apollo, with the name of the artist in small silver letters on the thigh; Bacchus; several athletes; and a drunken old woman, in marble, at Smyrna.

Myron was also a carver in wood and an engraver in metals. He is said to have died in great poverty, leaving a son, named Lycius, who inherited a considerable portion of his father's talents. (*English Cyclopædia of Biography.*)

MYRRH, a resinous gum which exudes from the bark of the myrrh tree (*Balsamodendron myrrha*, nat. ord. Terebinthaceæ), found in Asia. (See the article BOTANY.) As a balsam, myrrh has been highly prized from the most remote times. We find the earliest mention of it in Genesis xxxvii. 25. The Egyptians used it extensively for embalming their dead, and its sweet odour is easily recognisable in the black bituminous material which is now found in large quantities in mummies. The Greeks and Romans employed it in medicine; and Pliny speaks of it as an important article of commerce in his time, and as selling at a price so high as to provoke extensive and ingenious adulteration. (See Pliny's *Natural History*, Bohn's edition.) Myrrh is now imported from Turkey and the East Indies. That from the former country is considered superior in

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[1] *Personal Narrative*, vol. ii., p. 206.
[2] *Histoire des Insectes*, t. ii., p. 678. n. 5.
[3] *Zoological Miscellany*, vol. iii.
[4] *Linn. Trans.* xi. 384.

Mysia | Mysore.

quality, and is easily known from the Indian sort by its paler colour and purer fragrance. It is a true gum-resin, partially soluble in water, and partially in ether or alcohol. It is, however, more soluble in water than in alcohol. Brande gives the following analysis:—Volatile oil, 2·60; resin (soft), 22·24; resin (hard), 5·56; gum (soluble), 54·38; gum (insoluble), 9·32; salts, 1·36; impurities, 1·60; loss, 2·94. It is used in medicine, and enters largely into the composition of tooth-powders; it is also used in incense and other fumigations. Myrrh is packed in chests containing from 1¼ to 2 cwt. The quantity imported into Britain in 1856 was 310 cwt. In that year the most inferior East Indian myrrh sold for L.2, 10s. per cwt., whilst the best Turkey brought L.8. (T. C. A.)

MYSIA, an ancient province in the N.W. of Asia Minor, was bounded on the S. by Lydia, on the E. by Phrygia and Bithynia, on the N. by the Propontis and the Hellespont, and on the W. by the Ægean Sea. The name Mysia, however, was often applied to particular parts of this district. The province was divided into five parts,—Mysia Minor, Mysia Major, Troas, Æolis, and Teuthrania. To the first of these the Mysians were originally confined. They had come thither from the country of the Lydians, as Herodotus asserts, or from Thrace, as Strabo maintains, and as their alleged identity with the Mœsians implies. Gradually they spread themselves southward, encroaching upon the Trojans, Æolians, and Phrygian settlers, until they had attained sufficient importance to communicate their name to the entire province. Little is known about their history. They are mentioned by Homer among the allies of Priam. This country was subject at one time to the Lydian monarchy. It then formed in succession a part of the third satrapy under the Persians, and a part of the Syrian empire that was formed after the death of Alexander the Great. On the defeat of Antiochus, the last King of Syria, in 65 B.C., it was given by the Romans to Eumenes, King of Pergamus. It was afterwards incorporated in the Roman province of Asia.

Mysia was rendered rugged by Mount Temnus, Mount Ida, Olympus, and other offshoots of Mount Taurus. There were many rivers, of which the principal were Caïcus (*Aksou*) in the S., and Æsepus in the N. Pergamum (*Bergaman*), Cyzicus, Abydos, and Adramyttium (*Adramyti*), were the chief towns.

MYSORE, MAHESURA, or MAISOOR, a raj or native principality in the south of India, under the protection and administration of the British government. It is situated principally between N. Lat. 11. and 15., and is completely surrounded by the British territories subject to the Madras and Bombay presidencies. Its length is estimated at 210 miles, and its average breadth at 140. The country consists of a high table-land, inclosed between the Eastern and the Western Ghauts, and elevated 3000 feet above the level of the sea, from which rise numerous lofty hills, containing the sources of many streams. The principal rivers which intersect the country are,—the Cauvery, Tumbuddra, Vedawati, and the Northern and Southern Penna. The elevation of this inland plain varies at different places. The highest mountains of Mysore, namely, those of Bababudin, near Bednore, rise to the height of 6000 feet; the elevation of Sivagunga is 4600 feet; at the Pass of Peddanaik Durgam the height is 1997 feet, according to barometrical observations; at [illegible] galum, 2435; at Bangalore, 2907; at Hurryhur, 1831. The heat of the climate is mitigated by the height of the [illegible] and the climate throughout the whole of this extensive tract is remarkably temperate and healthy. This country has another peculiar advantage, namely, that it is sheltered by the Ghaut Mountains from the violence of the monsoons, which sweep along the lower plains, and deluge with torrents of rain the coasts of Coromandel and Malabar. The clouds which are driven on the land from the Indian Ocean by the south-west monsoons are opposed by the mountain-wall of the Western Ghauts; and although the higher and lighter clouds make their way into the plains, and occasion frequent, and sometimes heavy showers, which refresh the air and the ground, yet they are seldom of long continuance. Occasional showers, however, fall at other seasons, and preserve the verdure of the fields throughout the year.

The country of Mysore, from its elevation and its temperate climate, not only produces all the other grains and vegetables of other parts of India, but also many of the fruits of Europe. It appears to have been formerly in a much higher state of cultivation than at present; but it was nearly ruined, partly by the invasion of armies, partly by the rigorous administration of Hyder, and still more by that of his son Tippoo. It is now rapidly recovering from its depopulation under the sway of the British. Rice is cultivated on the higher and lower grounds; and the cultivation is much aided by means of reservoirs and wells, whence the farmers irrigate their fields and gardens. The soil also produces the sugar-cane, for which the black clayey lands are best adapted. The crop of *raggy*, a species of coarse grain which supplies all the lower classes with their common food, is the most important of any raised on the dry field. Wheat is cultivated in gardens, or in the rich soil of the beds of the tanks, which have been exhausted for the purposes of irrigation. It is only a small quantity, however, that is raised. The *Ricinus communis* is found here, and produces abundance of castor oil, which is used for the lamp and a variety of other purposes. The betel-leaf tree thrives on the low grounds, where it can obtain a supply of water; and the poppy is cultivated, both for making opium, and on account of the seed, which is much used in the sweet cakes that are eaten by the higher ranks of the natives. The cocoa-nut palm begins to produce in this province when it is seven or eight years old. Agriculture is here in a very backward state, and the implements used are very imperfect. The plough has neither coulter nor mould-board to divide and turn over the soil, and it seldom penetrates more than three inches deep. The fields are in consequence very imperfectly cleared; and after six or eight ploughings in all directions, numerous small bushes remain as erect as before the labour commenced. Considerable attention is, however, paid to the manuring of the soil; every farmer collecting a heap from the dung and litter of his cattle, intermixed with the ashes and soil of their houses. The cattle reared are cows, buffaloes, sheep, and the long-legged goat; the native breed of horses here, as in most parts of India, is a small, ill-shaped, vicious pony. Above the Ghauts, asses are much used as beasts of burden. The breed is small, and no pains are taken to improve it. Swine were formerly very common in Mysore, but they were banished by Tippoo from the vicinity of the capital. There are three varieties of sheep—tawny, white, and black. Common salt is found in abundance in many places, and is extracted for domestic or manufacturing purposes. Carbonate of soda is also found amongst the Chitteldroog Hills, mixed with common salt. Iron-ore abounds in different parts, though it is worked in a very slovenly manner. At the iron-works near Chinnarayana Durga, the smelters procure from the ore about 47 per cent. of malleable iron, which is, however, very impure. The principal rivers, which have been already enumerated, are all unnavigable, with the exception of the Cauvery, as long as they continue within the limits of this province. There are many large tanks and reservoirs in the higher grounds throughout Mysore, but there are no lakes. [illegible] pre-ferred on this account to that of wells, which is very frequently brackish. Upon the death of Tippoo Sultan in 1799, the territories of the latter prince were divided, and the portion now bearing the name of Mysore was allotted to the titular rajah of the same name, the representative of

Mysteries. the race which Hyder Ali had supplanted. During the minority of the rajah the country was prosperously administered; and upon his attaining a competent age for taking charge of the government, an accumulation had taken place in his treasury of nearly three millions sterling. This great sum, however, was speedily dissipated, and the annual income so overstepped and anticipated, that in 1832, confusion, insubordination, and, finally, open rebellion ensued, and the British government were compelled to undertake the entire administration of the territory and its revenues, managing them by a commission. The results have been most advantageous The Hindu rite of suttee has been forbidden; the Mohammedan population have settled down to agricultural pursuits; transit duties no longer exist; and in regard to commercial relations with Great Britain, Mysore has been placed upon the footing of a British possession. In 1847 the rajah, to whom a large stipend has been allotted, preferred a claim to be reinstated in his dominions; but it was deemed inadmissible, on the ground of his incompetency for the duties of government. The town of Mysore contains many good and substantial houses. It is surrounded by a rampart and defended by a fort. According to official report, the population of the town amounts to 54,729 It is situated in Lat. 12. 18., Long. 76. 42. Mysteries.

MYSTERIES.

MYSTERIES (Greek Μυστηρια, a word ultimately derivable from the root MU, a sound produced with closed lips) were ceremonies in ancient religions, conducted secretly, and only in the presence of such as had undergone preliminary rites of initiation. The ultimate origin of such ceremonies is doubtless to be sought for in the nature of religion itself, and the feelings of awe and reverence with which its objects are regarded. For to such feelings is directly traceable whatever part sacerdotal exclusiveness or legislative wisdom may be supposed to have had in their institution and preservation. Mystery, in one form or another, is inherent in religion, and will never disappear from it. Mysterious ceremonies, doctrines, and language, are co-ordinate developments of the same religious feelings. The origin and significance of the ancient mysteries have been the subject of much investigation and discussion. On these points some observations will be subjoined to the following succinct account of the most celebrated of these institutions:—

1. *The Mysteries of Isis and Osiris.*—These two deities, like the reigning deities in all mythologies, are preceded in legend by others. A satisfactory explanation of this fact has not yet been reached; it was formerly the main support of the Euhemeristic theory, and has been plausibly explained by that of successive worships, a theory which has also been applied to the explanation of many of the peculiar features of the myths themselves. It is certain, at all events, in the case of Egypt, that the revolutions in her political history were accompanied by extensive changes in her religious systems, and by the displacement or absorption of the ancient and local deities in a more modern group, and the growth of new myths, in which, doubtless, the historical events attending these changes have been partially reflected. Herodotus states, and his statement is confirmed by the monuments, that the Egyptian gods formed three orders (ii. 145). These three orders are successive dynasties of gods whose reign preceded that of mortal sovereigns. Of these three, the most recent is that of Osiris, whose son Horus is the last reigning god. (Bunsen, *Egypt's Place in Univ. History*, vol. i., p. 357.) These two deities alone, Osiris and Isis, were worshipped over the whole of Egypt, and their mythical history formed the subject of the mysteries.

If actual events, as we have supposed, are partially reflected in the story, the whole has been thrown into the prehistoric and dateless periods of mythology, and has been so interwoven with the ideal and purely symbolic, that the elements are not now distinguishable. Osiris, sovereign of Lower Egypt, is, with Isis, his sister-spouse, the originator of agriculture and the arts of peace and civilization. The cultivation of grain and of the vine, settled life, letters, music, and the fine arts, are owing to him. He sets out on a career of conquest and civilization, leaving the government in the hands of Isis, against whom Typhon, brother and implacable enemy of Osiris, wages war in his absence, but is defeated, and affects reconciliation. Osiris visits Ethiopia, India, and Greece, and introduces a new order of things. On his return to Egypt, he is surprised by Typhon at a peaceful banquet, and put into a coffer, which is committed to the Nile. Isis, learning this, searches for his body, and is guided to Biblos in Phœnicia. Her adventures here present a remarkable similarity to those of Demeter at Eleusis; she becomes nurse in disguise to the son of Astarte, the Queen of Biblos. At length she declares herself, gains possession of the coffer, and returns with it to Egypt, where she conceals herself with it. It is discovered by Typhon, who cuts in pieces the body of Osiris, and scatters it over the country. Isis again sets out in quest of the body, and succeeds in finding all the pieces but one, which she replaces with an artificial phallus, and inters the body at Pousiri. According to other legends, she consigns each piece to a separate tomb, in the form of a human body, so that it is impossible afterwards to dishonour them. Horus defeats Typhon and makes him prisoner, but Isis sets him at liberty and banishes him. Of the ceremonies to which this myth corresponds our information is vague and imperfect. They seem to have been six in number, and celebrated at different periods of the year. 1. The Aphanism, or disappearance of Osiris, on the 17th of Athyr (13th Nov.) 2. The Zetesis, or search for Osiris, about the winter solstice. In this ceremony, the sacred cow, symbol of Isis, was led seven times round the temple. (Plut., *De Is. et Osir.* 52.) 3. The finding of Osiris in January. 4. The burial. 5. The resurrection of Osiris. And 6. In March the entrance of Osiris into the moon. At Abydos and Philæ, supposed tombs of Osiris, were celebrated mystic rites, of which we have no certain information. These ceremonies throw considerable light upon the meaning of the legend. Osiris was the active, life-giving power; hence the sun, the Nile, &c., and hence his symbol, the bull: Isis, the passive, life-receiving power; hence Egypt, the earth, vegetation, &c., and hence her symbol, the cow. The life-giving power suffers in the course of the year a temporary death, but is restored to activity again in the vernal season. The Egyptian mysteries of Isis are to be distinguished from those of maritime Isis, established at Corinth, and afterwards so notorious at Rome. We have a description of these mysteries, doubtless embellished by the author's fancy, in the *Metamorphoses* of Apuleius (lib. xi.) The festival was preceded by purification in the sea before sunrise, and at sunrise a procession was formed, in which the sacred coffer and image of the goddess was borne by a train of priests to the shore, when a curiously-adorned vessel was consecrated. The ceremonies of initiation were practised by night. The neophyte, after various lustrations and instructions, was led into the presence of the goddess, and there heard and saw what he dared not reveal. The discourse put by Apuleius in the mouth of Isis is a commentary on the inscription of Sais,—"I am all that has been, is, and will be." The advantages

Mysteries. to be derived from initiation were, length of life, the protection of the goddess, and a happy lot in the next world. The worship of maritime Isis seems to have been introduced into Rome about the time of the empire, and was for a long time held in contempt and detestation. This feeling doubtless facilitated the degradation of these mysteries into what they became under the later emperors,—scenes of debauchery, and all kinds of wickedness. (See Ste Croix, *Recherches*, &c., vol. ii., p. 172.)

2. *The Mysteries of Demeter, of Dionysus, and of the Cabiri.*—While the history and mythology of Egypt cannot be said to be as yet completely deciphered, we have, on the other hand, very full and exact information on the mythology and worship of Greece. In Greece every deity had his peculiar mysteries; Jupiter, *e.g.*, had a mystic worship in Crete, Juno in Argolis, Hecate in Ægina, Diana in Arcadia, &c. The most celebrated of all, however, were those of Demeter at Eleusis in Attica. They owed their fame, doubtless, to the city in which they were celebrated, the influx of cultivated strangers into Athens, and partly also to the nature of the myth itself, of which they were a kind of commemorative representation. The myth, whose most ancient form is preserved in the Homeric hymn to Demeter, is well known: it is that of the wanderings of Demeter in search of Persephone, carried off by Aidoneus (Pluto); her arrival and disguise at Eleusis; her final recovery of her daughter; and her institution of agriculture, arts, laws, and civilized life; according to one legend also, of the mysteries themselves, to the participants in which her protection and the favour of Persephone, queen of the under-world, were secured. The mysteries of Demeter were originally peculiar to the Eleusinians, and were conducted by the Eumolpidæ; when Eleusis became subject to Athens, it was stipulated that they should always continue to do so. Thus, while Athenians were initiated, the superintendence of the festival was in the hands of that family, under the second Archon (Basileus), and associated with the Ceryces (originally of the same family), and with the female descendants of King Celeus. The Hierophantes and the Dadouchos were the chief ministers; the latter had charge of the purifications. Among the inferior offices an important one was that of Exegetes, or interpreter. The Eumolpids had also an authority, subject to appeal, in all matters of sacrilege. The cases of Diagoras (Lysias, *Con. Andoc.*), of Aristotle (Diog. Laert. v. 1), and of Æschylus (Aristot., *Eth. Nicom.* iii. 2), prove the strictness with which the laws were enforced, and the jealousy with which the mysteries were guarded from profanation. (See also Liv. xxxi. 14.) The less and the greater mysteries must be distinguished; the former, held at Agra, on the Ilissus, in the month of Anthesterion (February), consisted mainly in preparatory purifications by the sacrifice of a sow; an oath was administered to the *mystæ*, as they were called, at this stage, and instructions given them. The great mysteries were celebrated in the month of Boedromion (September), probably nine days (15–23). The first five days were occupied with various lustrations; on the sixth a grand procession was formed, bearing the statue of Iacchus from the Eleusinion in Athens to Eleusis, and on the night of this day the last initiation was performed. Proclamation being made by the Hierocéryx commanding the profane to withdraw, an oath was exacted, mystic questions put (the better to prevent intrusion), further purifications practised, and the recesses of the temple were disclosed to the *Epoptæ*. It would appear, from various allusions in ancient authors, that the punishments of the under-world were represented, as the myth required, and probably also the nuptial union of Aidoneus and Persephone. This latter scene, with certain others of a similar kind in the other mysteries, perhaps gave colour to the charges of immorality brought against them by later, especially Christian, writers. These scenes were followed by the *autopsia*, a kind of beatific vision, of which we have no clear account, and which appears to have been accompanied by a prescribed discourse from the hierophant, and then the assembly was dismissed with the mystic formula *Konx, Ompax*, repeated by the audience.

Connected with the Eleusinia were the Thesmophoria, a mystic festival celebrated by the Attic women alone, 14–18 Pyanepsion (October), and which derived its name from the procession to Eleusis on the last day, in which the laws were solemnly carried. These mysteries were also held during the night; were prepared for by continence, fasting, and lustrations; and appear to have had reference to the supposed institution of laws by Demeter.

The mysteries of Dionysus were also celebrated by women alone, in the month of Anthesterion, in the temple of Dionysus ἐν Λίμναις. They were presided over by the wife of the Archon king (Basilissa), assisted by fourteen priestesses, called *geraræ* (venerable), to whom she took an oath that she was pure and unpolluted, and with whom she offered mystic sacrifices for the welfare of the city. The *mystæ* wore skins of fawns, and myrtle, instead of ivy. The sacrifice was a sow, as in the mysteries of Demeter. When these mysteries were introduced into Rome, they speedily degenerated into shameful immoralities; men, as well as women, were initiated; they were held five days in every month; and such were the crimes and excesses committed, that they were at length suppressed by a senatus consult, B.C. 186. (Liv. xxxix. 8–18.)

The names, nature, and origin of the Cabiri are perhaps the most obscure points of Greek mythology. The etymology of the name itself has been the subject of much conjecture. This much appears certain, that the deities worshipped as Cabiri in Samothrace and Lemnos were the gods of an ancient Pelasgian people of the same name, and had relations with the most ancient seat of the Pelasgian worship in Northern Greece. The mystic names of the Cabiri were "Axieros," "Axiokersos," and "Axiokersa," to whom a fourth, "Cadmilus," is sometimes added. But to what Grecian divinities these names corresponded the conflicting testimonies of ancient authors leaves us in entire ignorance. This conflicting testimony has given rise to the conjecture of successive epochs in the Cabiric worship, the last being that in which the Cabiri were confounded with the Dioscuri, and became nothing more than mariner-preserving deities, their former attributes being lost in a haze of tradition. (St Croix, i., p. 44; Limburg-Brouwer, *Hist. de la Civilis. des Grecs*, iv., p. 352.) At all events, preservation from the dangers of the sea came to be the main object of initiators in the mysteries of Samothrace. The initiated were furnished with amulets for this purpose. Of the rites observed in these mysteries nothing certain is known. The myth of the murder of Cadmilus by his brothers appears to have been represented in them.

3. *The Worship of Mithras*, its origin, rites, and meaning, are extremely obscure. (Creuzer, *Symbolik*, ii., p. 193, ff.; Seel, *Mithrageheimnisse*, 1823; Ste Croix, *Recherches*, ii., p. 121.) In the *Zendavesta*, Mithras is the chief of the Izeds, under Ormuzd, who is his creator, and in whose war against Ahriman he is the presiding agent. He covers the earth with fruits and verdure, dispenses light and heat in nature, and guards men from the attacks of Ahriman; he is the judge of man in a future state, one month in the year is consecrated to him, and the sixteenth of every other. He is to be invoked thrice a-day. When the mystic worship of Mithras spread from Persia into Asia Minor with the Medo-Persian power, and afterwards, under the Hellenic monarchies, into Alexandria, and under the Roman empire, into Rome and Europe, the original Persian idea was altered. Mithras was confounded with the sun and the supreme deity, and practices were adopted—celibacy and fasting, *e.g.*,—partly, it is probable, from the Christian religion—quite inconsistent with the Persian worship. We hear of it first

Mysteries. in Rome at the close of the first century, under Trajan. Monuments have been found in Italy, in the Tyrol, and other parts of Europe. On these, Mithras is represented as a young man plunging a sacrificial knife into a bull on which he is seated, and surrounded with mystic, sometimes clearly zodiacal figures,—a physical emblem, it has been held, of the reproductive forces of nature, from year to year bringing life out of death; and a moral emblem of the ever-repeated victory of the good over the evil principle. Nor is there in this duplicity of signification anything repugnant to the spirit of ancient mythology. Mithriac initiation was protracted and severe. The neophyte was baptized, anointed on the forehead, and received bread and wine; a crown was placed on his head, which he rejected with the words, "Mithras is my crown;" and finally he received a sword, and was declared, "soldier of Mithras." This was the lowest grade; the others had mystic names derived from animals sacred to the god.

The discussion respecting the Grecian mysteries has chiefly turned upon the question, what esoteric religious doctrine they were meant to conceal and convey?—a question which should surely have been preceded by the inquiry, whether they were meant or employed to convey any doctrine at all? The former question has also been constantly confounded with another, and a very different one, viz., What is the real import of the myths with which these ceremonies were connected?—it having been assumed, without satisfactory evidence, that the myths, and their interpretation into abstract terms, were handed down together, the former having been invented as a cloak for the latter, to be removed only to a select few, under the strictest bond of secrecy. In the first place, such a notion—and any theory of an esoteric doctrine involves it—is opposed to sound views of mythology. Such explanations are not possible beside the still living and credited myth; a myth not being the secondary but the primary expression of religious thought in the period which produced it,—the spontaneous and living form of the idea. Secondly, the theory of an esoteric doctrine is opposed to a sound criticism of the facts. On the introduction of Christianity, the philosophic adherents of polytheism interpreted the mysteries in an ethical and spiritual way; probably they attempted to modify them in accordance with their views, and largely appealed to those explained and reformed ceremonies in reply to the accusations of immorality and absurdity brought against polytheism and its institutions. The mysteries became in their hands points of contact between philosophy and the popular religion; and by this means what were at first simply secret ceremonies connected with secret symbols, acquired arbitrary significations of profound import,—descent of the soul into union with matter, &c. But when we ascend to earlier writers, we find that every one attempted to allegorize or euhemerize the myths which underlie the mysteries in his own fashion, just as the other myths were dealt with, and that these discordant explanations are frequently without hesitation attributed to the secret tradition revealed to the initiated alone. (Limburg-Brouwer, iv., p. 287.) This of itself is sufficient proof that there was no esoteric tradition at all; nor is there any evidence that the instructions given to the initiated were anything more than the necessary information as to their conduct during the ceremony. The supposed necessity of finding a concealed doctrine has given rise to many singular theories, of which one or two of the most remarkable may be noticed. According to Warburton (*Divine Legation of Moses Demonstrated*), the mysteries had three objects: 1. To commemorate the origin of civilization. 2. To inculcate the doctrine of future rewards and punishments. 3. To reveal the doctrine of the unity of God. In this last consisted the real secret doctrine, and it was revealed only in the great mysteries, to which access was as difficult and rare as it was frequent and easy to the less. On this last assertion,— Mysteries. destitute of all proof, and opposed to everything certainly known of the matter,—and on the further reasoning, that though the revelation of such a doctrine would be fatal to the popular system, it would not affect the worship of beings intermediate as to man and the Deity,—he relies to obviate the invincible objection that polytheism and such mysteries could not have existed together. The paradox reaches an extreme when it is alleged, that legislators established ceremonies subversive of the public religion, for the purpose of furnishing stronger bonds of social faith and order. The uncritical way in which, to support his theory, Warburton treats his authorities, has been ably exposed by Leland, Ste Croix, De Sacy, and Limburg-Brouwer. Ste Croix, while rejecting Warburton's theory, that the secret doctrine of the mysteries was the unity of God, is at one with him in regard to the special moral and religious aims which he attributes to them. According to that learned writer (*Recherches Hist. et Crit. sur les Mystères du Paganisme*, 2de édit., par Silvestre de Sacy, Paris, 1817, 2 vols.), they were instituted by the early legislators to commemorate the blessings of civilization, and, further, to furnish expiation for crimes. The germ of the mysteries is lustration and expiation; the doctrines taught were, the necessity of repentance and confession, the immortality of the soul, and a future state of rewards and punishments. The views of the editor of that work, Silvestre de Sacy, are more sound: there was no secret *doctrine* in the mysteries; certain rites and symbols were secret, and these it was sacrilege to reveal. Theories of explanation and allegory may have found their way from the schools of philosophy into the celebration of the mysteries; but it is utterly erroneous to conceive that any philosophical doctrines had their origin there. Creuzer (*Symb. u. Myth. der alten Völker*, iv., p. 512, ff.) has delivered himself, with little reservation, to the reveries of the Neo-Platonists. Egyptian priests introduced their doctrines into Greece under the veil of the mysteries, instructing the few, who, by submitting to the necessary probations, showed themselves worthy of being instructed in the doctrines of the unity of God, the immortality of the soul, its emanation from the Supreme, &c. When Christianity commenced to threaten the ruin of polytheism, the philosophers at length resolved to betray the great secret which had been concealed for ages in the rites of Eleusis and Samothrace. Perhaps the extreme in this exaggerated estimate of the mysteries has been reached by Schelling. His positions are (*Philosophie u. Religion*, p. 75; comp. Wegscheider, *De Myster. Græcorum Religioni non obtrudendis*, Göttingæ, 1805), that the doctrine taught in them was in the directest opposition with the public religion, that this doctrine included a pure monotheism, and that Christianity is only the publication of their secret. According to F. C. Baur (*Symb. u. Mythol.*, tom. iii., p. 159), the fundamental idea of the mysteries is that of a god (representative of nature and humanity) who suffers and dies, and who afterwards triumphs over death, and has a glorious resurrection. The mystic doctrines included sublime doctrines of cosmogony, of immortality, palingenesia, and of the most refined pantheism. Ouvaroff (*Essai sur les Mystères d'Eleusis*) has maintained that the initiated "not only acquired just notions on the Deity and his relations to man, on the primitive dignity of human nature and its fall, on the immortality of the soul, and the means of its reconciliation with God; but that oral and even written traditions were revealed to them,—precious remains of the great shipwreck of humanity." Heeren (*Ideen.*, &c., vi., p. 76, ff.) maintains generally that the mysteries were instituted to preserve the symbolico-physical signification of the gods of paganism, which without them would have been lost. As already observed, such theories have their origin in the imagined necessity of finding something worthy, *in modern conception*, of concealment in the

ancient mysteries, and derive their support and plausibility from an uncritical confusion of times and authorities. Already Mosheim (Notes to Cudworth, *Intell. Syst.* i., p. 329) and others had taken a more rational view of the subject; but the main credit of introducing sound criticism into the whole discussion is due to Müller, who, in his *Prolegomena to a Scientific Mythology*, first clearly enunciated a principle destructive of the fundamental fallacy of these theories, and especially to Lobeck (*Aglaophamus*, 1830), and Limburg-Brouwer (work cited). The value of their investigations is not inseparable from the positive theories they have advanced on the particular origin of secret worship and initiation (Müller, for example, conjectures that they arose from the attempt by a conquered race to preserve their ancient worship), but consists in having put an end to the unfounded speculations as to an esoteric traditional doctrine, which so long rendered the subject, already sufficiently obscure, a wilderness of perplexity. (W. H. C.)

MYSTICISM is that form of error, whether in religion or philosophy, which mistakes the operations of a merely human faculty for a Divine manifestation. All men, it has been said, are born either Platonists or Aristotelians; and there can be no doubt that the mystical tendency finds a legitimate origin in human nature. It is always a protest—if frequently a blind one—in behalf of what is highest and best in human nature; and its voice is continually heard in an age of formalism and moral degradation. It is a reaction against a spirit of scepticism, and is fostered by that weariness of the world, that shrinking from conflict, and passionate longing for inaccessible rest, which the crushed and timid spirit so frequently displays. The fascination of mystery, also, which attends all forms of this spiritual development, exerts a powerful influence over the earnest imagination.

Classification of mystics.

Mystics have been divided into the three classes of—*Theopathetic*, *Theosophic*, and *Theurgic*. The theopathetic mystic resigns himself with more or less passivity to an imaginary Divine manifestation; and in proportion to the degree of this passivity he becomes either a contemplative quietist, who regards himself as overshadowed by the Deity, like Suso, Molinos, or Madame Guyon; or, believing himself to be impelled by Deity, assumes a more positive and active attitude, like Tanchelm, Gichtel, or Kuhlmann. The theosophic mystic, again, aims at scientific rather than practical results, lives to know rather than to act, and believes himself to be possessed of a certain supernatural divine faculty for theorizing about God or his works. He either believes, with Swedenborg and Behmen, that the mysteries of the Divine dispensations have been disclosed to him by a special revelation; or holds, with Plotinus and Schelling, that his intuitions of the hidden processes of nature and the secrets of the universe are infallible, because Divine; being the result of an identification of the subject and object of thought. But while the theopathetic mystic is content to feel or proselytize, and the theosophist to know, the theurgic mystic aspires to hold converse with the world of spirits, and secure the prerogative of working miracles. As claimants to this supernatural power, Apollonius of Tyana, Peter of Alcantara, Asclepigenia, and St Theresa, all rank as religious magicians.

Oriental mysticism.

As mysticism is the spontaneous product of certain crises in individuals and societies, it consequently presents no proper development, whether traditional or systematic. Its main characteristics are constantly the same, whether they find expression in the Bagvat-Gita of the Hindu, or in the writings of Emmanuel Swedenborg. The earliest mystics known are those of India, and the best exposition of their system is to be found in the heroic poem of the *Bagvat-Gita*. (See Wilkins's translation.) They lay claim to disinterested religious feeling, repel the lifeless formalism of the Vedas, pantheistically identify subject and object, and aim at ultimate absorption in the Infinite. To effect this dissolution, they inculcate an absolute cessation from all activity, and prescribe certain recipes for obtaining this Divine trance, believing that eternity may thus be realized in time. They lay claim also to theurgical powers, and counsel the neophyte to give absolute submission to his guru, or spiritual guide. This guru is a representative and vehicle of Divine power, the principle worshipped by the Hindus, and finds its parallel in the Pir of the Sufis, the middle-age Confessor, and the Directeur of modern France. (See Southey's *Curse of Kehama*, Notes.)

Neo-Platonic mysticism.

The second chronological stage of mysticism is that of the Neo-Platonists of Alexandria, which combines, for the first time, the leading fundamental ideas of the system with the purer and more exalted conceptions of Christianity. Philo was the intellectual father of Neo-Platonism, and he laboured to combine the high monotheism of the Hebrew Scriptures with the doctrines of Plato. From amidst the licentiousness and heartless scepticism of that great commercial Babel, arose the asceticism of the Therapeutæ—a sect who sheltered themselves in secluded cells, and by fasting and contemplation sought for divine illumination around the remote shores of the Lake Mareotis. Of this sect Philo has left us an account in his *De Vitâ Contemplativâ*. The ostensible founder of this school of Neo-Platonism was Plotinus, who, at the age of twenty-eight, began the study of philosophy in Alexandria A.D. 233. Its greatest names, after Plotinus, were Porphyry, Iamblichus, and Proclus, who is the last of the distinguished thinkers among the Alexandrian eclectics. The requisite information respecting those men will be found under the name of each. (See HYPATIA, and ALEXANDRIAN SCHOOL; also Kingsley's *Alexandria and her Schools*, and *Hypatia*.)

Mysticism in the Greek church;

We next come to the reign of mysticism in the Greek Church—to the hermits, saints, and fathers of the desert. (See MONACHISM.) The most noteworthy of these was St Anthony, who flourished during the latter part of the third and the beginning of the fourth century; Macarius, who retired to the deserts of Nitria in the fourth century; and the pseudo-Dionysius, called the Areopagite, who committed the literary forgery of the Platonized theology which goes by his name, and which must have been written about the middle of the fifth century. Among the anchorites of this period are to be found all the theurgic pretensions of later, and especially of mediæval times. (See ANTHONY, *St*; and DIONYSIUS *the Areopagite*.)

in the Latin church.

Gradually the eastern mysticism moved westward, and found itself transplanted into a region of great intellectual activity, such as it had not known before. Neo-Platonism, while acting as a soporific on the moral activities of the East, became a life-giving principle when transplanted to the West. Platonism and mysticism combined in creating a party in the church who were the sworn foes of scholasticism, empty dogma, and hollow quibbling, and who used all their efforts to check the growth of clerical abuses and ecclesiastical pretension. With the mystics of the Latin church monasticism was the avowed panacea. The most distinguished names of this development of mysticism are those of St Bernard of Clairvaux, and Hugo of St Victor, both born during the last years of the eleventh century; also Richard of St Victor, the Scottish pupil and successor of Hugo, a man who possessed all the *perfervidum ingenium* said to characterize his countrymen in those early days. The great business of St Bernard's life was to found and organize convents: the ruling principle of his theological teaching is faith. Reason he all but dethroned, and gave the most vital interpretation to the *credo ut intelligam* of

St Anselm. All doubt was with him the sure sign of a depraved heart, and any divergence from the acknowledged standard of piety unspeakably criminal. He maintained the fundamental maxim, *invisibilia non decipiunt*, of the religio-philosophy of the middle ages to its fullest extent. Knowledge with him was an illumination depending on the state of the heart, and resulting from an essential relationship to the divine source of ideas. Sense and experience were set aside, and the Scriptures were studied, not for their practical teaching, but with an eye to discover in them all manner of absurd symbolisms and recondite abstractions. In this respect Bernard only resembled the whole of the speculators of that period. The mysticism, however, of this distinguished abbot displayed a great degree of practical moderation. If he attempted to transcend humanity as the theosophist, in his zealous advocacy of the humbler Christian virtues and in his loud protest against a life of contemplative sloth, he ranks with the better class of those theopathetic mystics who have laboured to better their race and purify the world. But while the system of Bernard repudiated scholasticism, that of the St Victor school strove to reconcile it with mysticism. This combination is also visible in all the strictly mystical theology of the middle ages, and it is abundantly exemplified in Bonaventura, in the thirteenth, and Gerson, in the fifteenth century. [See in particular Liebner's *Hugo von St Victor und die Theologischen Richtungen seiner Zeit;* also Engelhardt's *Richard von St Victor.*]

German mysticism.

We find ourselves introduced to the German mysticism of the fourteenth century by the Chronicle of Adolf Arnstein, the pious armourer of Strasburg; by Hermann of Fritzlar and his legends; and especially by the notable preacher Master Eckart. What was most peculiar in the mysticism of the latter, as contrasted with the ordinary ecclesiastical and scholastic aspects of that system, was the peculiar emphasis which he bestowed upon "our own consciousness of being the sons of God." Eckart felt that the church could not afford him a secure resting-place for his soul; and he accordingly supplied one for himself in a strange agglomeration of pantheistic metaphysics, which formed a bold and fervid reaction against the orthodox externalism of his time. His theosophy forms a striking anticipation, in some respects, of the idealism of modern German speculation. Hegel calls the system of Eckart "a genuine and profound philosophy;" and there is certainly often a strong resemblance between the doctrines of the Dominican and those of the advocate of the *Logische Idee*. To this period also belong John Tauler; the author of the famous *Theologia Germanica;* Henry of Nordlingen; Nicolas, the layman of Bâle; the Friends of God; the Flagellants; Ruysbroek; Suso; the Monks of Mount Athos; the pious ladies Brigitta, Angela de Foligni, and Catherine of Siena; also Thomas à Kempis, author of the celebrated book *De Imitatione Christi;* and the eminent Frenchman, Chancellor Gerson. But unquestionably the most remarkable of that earnest group of German mystics was John Tauler. He was a man of profound reverence and fervidly pious spirit, who frequently trod upon the verge of the pantheistic abyss of Eckart, but never fell into it. So emphatically does he insist upon total self-abnegation, and the annihilation of everything human in us, that our very finitude seems almost criminal in his eyes, and the possession of individuality something bordering on a sin. To deify man, he would strip him of his humanity: he would divorce the higher faculties of the soul which ally man to God, and those inferior powers which belong to a lower sphere, rather than strive to harmonize them by assigning to each its legitimate functions. But in spite of the numerous contradictions of his negative theology, he was himself an eminently spiritual and fervently pious man. The theurgic and sensuous element of mysticism, such as apparitions, voices, &c., find no place with him; and he certainly rose farther than any of his fellow-mystics above the peculiar dangers of the system. He was a genuine pioneer of the Reformation, and Luther's admiration of him is well known. (See TAULER; also Pfeiffer's *Deutsche Mystiker*, Leips. 1857.)

Mysticism.

Persian mysticism.

Mysticism was not, however, limited to the West, and to Christian communities, during the middle ages; we find a genuine development of this mode of thought and feeling among the poetical effusions of the Persian *sufis*. It might at first sight seem almost an impossibility for mysticism to find any nourishment under the unfriendly shade of the Koran, with its detailed ritualism and cold formality; but, as so often happens, the wants of the human heart prove too strong for creeds, no matter how rigid. At a very early period in the history of Mohammedanism a class of persons gradually arose within its pale who dared to set aside the letter in behalf of the spirit of the Koran. Witness the devout ardours of the female saint named Rabia, who appeared about the end of the first century of the Hegira, and who, in her self-abnegation and disinterested devoutness, bore such a marked similarity to Madame Guyon; and unquestionably some of the brightest names associated with the literature and religion of the false Prophet are found to have been deeply imbued with the genuine mystical spirit. The name generally applied to the mystical asceticism of the Mohammedans is *sufism*. The sufis lay claim to a supernatural intercourse with the Deity, to a mystical union or identity with the Supreme, bringing with it theurgic powers. The name has a very extensive application. It is given alike to poets, philosophers, dervises, and fanatics. Persia is the great centre of sufism, and in its sufi poets mysticism has achieved a success unknown in any country of Europe. The only western sufi which mysticism has known was Angelus Silesius, the author of the religious poem, the *Cherubic Wanderer*. He flourished during the seventeenth century, and assumed the name of Angelus; but his real name is not known. It is pretty obvious that it was *not* John Scheffler, as some have supposed. (See, under this branch of the subject, Tholuck's *Sufismus, sive Theosophia Persarum pantheistica*, Berlin, 1822; Tholuck's *Blüthensammlung aus der Morgenlandischen Mystik*, Berlin, 1825; Schrader's *Angelus Silesius und seine Mystik*, Halle, 1853; and Sir William Jones, *On the Mystical Poetry of the Persians and Hindoos.*)

Mysticism and the Reformation.

It has already been remarked, that not a few of the mystics who preceded the Reformation were genuine reformers; and it cannot be doubted that the way for that grand religious emancipation was in great part prepared by the mystics of the fourteenth century. So long, however, as the standard of truth was internal and subjective, and was very much at the caprice of every fresh dreamer who chose to elaborate a scheme of cosmology, or invent new rules for the regulation of the religious life, a thorough-going reformation of the existing abuses of the church remained impossible. Luther, however, saw into the mistake; and while he sympathized constantly with what was highest and truest among the mystics, he nevertheless endeavoured to supplement their honest efforts by the important announcement, that the Scriptures were the sufficient standard of truth. The more clear-sighted and courageous among the mystics at once hailed the new doctrine as light from heaven; but there remained still a party among them who began by suspecting, and ended by despising, that which alone could have saved what truth they had from utter oblivion. The mystic of the sixteenth century accordingly did what he could to retard the progress of the Reformation. Examples of this sort are only too numerous; and Luther had to contend at the very threshold of his great undertaking with the stupidity and wilfulness of these deluded spiritualists. When holding a public discussion on one occasion with the mystics Stubner and Cel-

larius, Luther called upon the latter to substantiate his positions by a reference to the Scriptures; but the self-sufficient schoolmaster replied, after stamping frantically, and striking the table with his fist, that it was "an insult to speak so to a man of God." The most noted of these spiritualists were, Dr Bodenstein of Carlstadt, the crotchety little professor of Wittenberg; the prophets of Zwickau—Frank the pantheist, Schwenkfeld the pietist, and the silent, earnest Valentine Weigel, who combined the theopathetic and theosophic schemes of Schwenkfeld and Paracelsus, and thus prepared the way for Jacob Behmen. The majority of the mystics, posterior to the Reformation, were of the theosophic class, of which the principal examples are to be found in Cornelius Agrippa, Theophrastus Paracelsus, and Behmen, all of whom will be found under their respective names in the present work. The mystics of a former time were content to seek a union with Deity by ignoring his works, and found their highest knowledge in supreme obliviousness of all sensible things; but now the current of thought took a different turn, and nothing short of a supernatural knowledge of the recondite mysteries of creation, such as was not vouchsafed to ordinary mortals, could satisfy the immoderate desires of this unworldly fraternity. The most distinguished name of this class was unquestionably Jacob Behmen or Boehme, the blue-eyed, gentle-voiced old shoemaker of the little town of Görlitz, born in the year 1575. A genial, manly mystic withal was this withered little shoemaker; free from everything effeminate and sentimental; a genuine Protestant, and stanch Lutheran; but intensely speculative and imaginative. He addressed himself more to the learned than to the lower orders, and his teaching doubtless supplied a real want of those times, inasmuch as Lutheranism was beginning to harden and wax cold, and the current orthodoxy was giving symptoms of a growing literalism and harsh formality hostile to the development of the true life of the soul. His whole life resembled one great dream; but he strove with as much zeal as ever man displayed to benefit his fellow-mortals and exalt the name of God. (See Behmen.)

The Rosicrucians.

Early in the seventeenth century the mysterious order of the Rosicrucians began to make a noise in Germany. A young Lutheran divine of great zeal and courage, named Valentine Andreä, is generally believed now to have been the author of that far-famed little book, published in Germany in 1610, entitled *The Discovery of the Brotherhood of the Honourable Order of the Rosy Cross*. In it he calls upon the learned and devout everywhere who desire to lend their assistance in diminishing the amount of human suffering, ignorance, and moral degradation, immediately to advertise their names. He indicated, however, neither name nor place of rendezvous, but threw out his little anonymous book as a feeler, by which he might ascertain the number of right-minded men who would freely co-operate with him. But superstition was rampant at the time, and the amiable hoax of the young divine proved fertile in fostering some of the very errors he wished to put down. No society, it is believed, was ever actually formed; yet the name Rosicrucian (*rosa, crux*) gradually became a generic term, denoting every kind of occult skill, whether of arcana, elixirs, theurgical symbols, or the philosopher's stone. From this singular origin accordingly sprung in a great measure the secret societies—freemason and otherwise—of the succeeding century. The grand Rosicrucian lodge apparently existed nowhere but in the brains of the superstitious; yet men talked of its secrets with bated breath, and orthodox divines groped in blind wrath for the pillars of the Rosicrucian "Temple of the Holy Ghost." (See *Ueber den Ursprung und die Vornehmsten Schiksale der Orden der Rosenkreuzer und Freymaurer*, von J. G. Buhle, Gött. 1804; also Sir E. B. Lytton's *Zanoni*.)

The opposition offered to the principles of the Reformation by the Church of Rome found its highest development in Spain. There blossomed the flower of fanaticism—there flourished that chivalry of persecution which gloried in shedding the blood of the heretic, and in multiplying the horrors of the Inquisition. Among those zealous luminaries none shine so bright as Ignatius Loyola, St Theresa, and John of the Cross. The two latter were pre-eminently mystics: Rome recognised in Theresa her queen of seeresses, and in John her prince of ascetics. The one was a theurgic, the other a theopathetic mystic, and both carried the peculiarities of these schools to their highest expression. During the previous centuries, particularly the fourteenth, mysticism and freedom of thought were well nigh synonymous; but in the sixteenth and seventeenth the mystical tendency was shown no quarter, unless it proved subservient to the cherished designs of the church in checking the growth of the Reformation. Accordingly, the doctrine of blind obedience to ecclesiastical authority became not only a capital article of faith with the mystics hostile to the Reformation, but formed the ruling principle of their entire lives. Formerly the mystic breathed his deepest emotions in the ear of the Supreme alone; now he must adapt his aspirations to the ear of his confessor, and allow no yearning of the heart, however sacred, to ascend directly to the source of consolation. Appeal to the director or confessor is constantly urged in the writings of Theresa and John; and nothing but "the blackness of darkness of despair" is held in store for those who would in jot or tittle renounce the guidance of that stern functionary. The mysticism, however, of little John of the Cross was of a much more elevated character than that of his saintly contemporary. Nor was he guilty of the pious lies and mean cruelty by which not a few of his zealous coadjutors sought to bring honour to their church.

Spanish mysticism.

Quietism.

This species of slavish mysticism was not destined to remain long without modification and even direct opposition. The mystical system known as *quietism* came into notice during the seventeenth century, and especially about the beginning of the eighteenth. This system was a virtual protest against the mercenary religion of the consistent Romanist, and opposed the unnaturally refined doctrine of "disinterested love" to the vulgar commercial machinery in which superstition delighted to indulge. Thus the extreme of nominalism and insincerity gave birth to the opposite extreme of spiritual "perfection" and complete sanctification by faith. The pure spiritual flame which burned in the heart of Madame Guyon scorched the hand which bound her to her director, and she learned to prize the "prayer of silence"—the yearning, unutterable language of the soul—as immeasurably superior to those so-called prayers repeated by rote in the oratory at the behest of a spiritual guide. As contrasted with the sensuous theurgy of St Theresa, the benevolent quietism of Madame Guyon appears to decided advantage; yet Rome rewarded the fair devotee of Spain with the honour of saintship, while her no less saintly sister of France was constituted a female confessor. (See Guyon.) But, as might have been expected, the encroachments of quietism on the exclusive prerogatives of the Romish clergy were not to be borne with equanimity. Madame Guyon and Molinos were both incarcerated as dangerous enthusiasts, as indeed little John of the Cross had been at the outset of his career. The leader of quietism in Italy was Michael de Molinos, a Spaniard of enlightened piety and blameless life, who was held in high favour by the Pope himself, and who had his abode in the Vatican. He maintained doctrines similar in substance to those of Madame Guyon, and published a book called *The Spiritual Guide*, with the sanction of four inquisitors, in 1675. The dangerous tendencies of these doctrines were soon found out by the ruthless zeal of Louis XIV. and his Jesuit counsellors; and as there was more of the religion of the heart than of

the rosary in Molinos' book, its pious author was, by their influence, condemned to spend the remainder of his days amid the gloom and solitude of a dungeon. A similar fate accompanied the closing years of Madame Guyon. From his connection with St Cyr as one of the directors, and with Madame Guyon, whom he met there, the gentle Fénélon became tainted also with the quietist heresy, and his vain, imperious brother Bossuet pursued the most tortuous courses to involve the good man in disgrace. The "eagle of Meaux" prostrated himself with frantic theatricality at the feet of royalty, when Fénélon published his *Maxims of the Saints* in 1697, and with an affectation of tears implored pardon for not previously disclosing the wicked heresies of his wilful brother. This scene was followed by a great flight on the part of the "eagle," termed *An Account of Quietism*, in which he assailed poor Fénélon and his very moderate admixture of mysticism with the most ruthless violence. A meek and triumphant *Reply* was elicited from Fénélon, *Remarks* from Bossuet, a fresh rejoinder to the *Remarks* from Fénélon, and the controversy came to an end. Louis urged the interference of the Pope to crush the heretic of Cambray: infallibility was constrained to submit to Louis, and Fénélon to succumb to infallibility. The Pope's sentence was pronounced in 1699, and the submission of Cambray is famous in history. (See FÉNÉLON.)

English mysticism.

Unlike the other countries of Europe, Britain was not prepared for the Reformation by the teachings of mysticism. Wycliffe of England, "that morning star of the Reformation," shone with quite a different lustre from the dim, unsteady light of the fervid German Tauler. Indeed, English soil generally does not seem to be favourable to the growth of that delicate plant, mysticism, which always vegetates best where the light is dimmest. English mysticism, if not always sober, is seldom fantastic, and very generally benign. Its best representative is unquestionably George Fox, the pious, gentle-hearted, humble-minded "man in leather breeches." Such wild visionaries as the Muggletonians, Fifth-monarchy men, and Ranters, of the English mystical period, were rather the offscourings of that much-suffering, much-endeavouring time, than the genuine representatives of British mysticism. The wisdom and folly, the greatness and littleness, the expansive benevolence and staid asceticism of George Fox are still partially to be met with in Quakerism, of which he was the father. (See FOX, and QUAKERISM.) In striking contrast with the rude fervour and doubtful prophesyings of the Society of Friends, and the other communities tainted with the mystical spirit during that time, was the mild Platonic mysticism, with its scholarly refinement and retiring devotion, of the English Platonists More, Norris, Gale, and Cudworth. Indeed, it is perhaps hardly just to denominate these men and their little school of wise, devout thinkers as mystics at all. They are never absurdly sentimental or foolishly extravagant: good sense generally pervades all their writings, and they abound in whatever is lofty in thought or tender in emotion. Yet a subtle vein of mysticism, like a silver thread, can be detected by the experienced eye running through their works; a peculiarity which it is impossible perhaps for a religious Platonist to avoid. (See under the name of each.)

Mysticism of Swedenborg.

The theosophic mysticism of Emanuel Swedenborg stands alone among all the mystical systems which have yet been noticed. It is remarkable for its apparent reality and comprehensiveness, and, with the exception of the system of Behmen, it differs from that of all other mystics in three important respects. It strives constantly "to see the spiritual not beyond, but in the natural:" the flesh is no longer evil; and the world ceases to be the birthright of the devil. Hence its hostility to asceticism. In his theology, again, Swedenborg maintained a constant equilibrium between the letter and spirit of Scripture. There is with him no discarding of the letter, no fantastical interpretation, but a rigid adherence to the words of Scripture which is quite unparalleled. Nor, again, does he display any of the rambling theorizing and turbid vehemence peculiar to all theosophists, and Behmen among the rest. With the Swedish seer all is scientific precision and calm serenity; he utters himself always with clear collectedness, and you never find him in a hurry. In his doctrine concerning spiritual influence he is peculiarly temperate and by no means mystical, and if he errs concerning the work of Christ, it arises mainly from his repugnance to Calvinism. His theology is more closely allied to Behmen's than to that of any other writer; yet he expressly informs us that he never read the German theosophist. (See SWEDENBORG; also *E. Swedenborg, a Biography*, by J. G. Wilkinson.)

Nothing really new in the way of mysticism has been produced since the days of the northern seer. German rationalism and French encyclopædism found a protest raised against their exclusive negativeness by the advocates of faith and feeling in religion and philosophy, and by the romanticists in literature. In Germany, Hamann and Jacobi opposed faith to the logic of the sceptic; Schelling gave the romanticists a poetical philosophy; and Schleiermacher taught them to read the Bible in the light of the individual "Christian consciousness." Romanticism finds its best representative in Novalis (Friedrich von Hardenberg); and among the more celebrated of its adherents were F. Schlegel, A. Müller, Z. Werner, and Tieck. (For an able annunciation of the principles of the genuine romanticism, see Tieck's *Prince Zerbino*.) Unmistakeable traces of this tendency are also to be found in the writings of Carlyle and Emerson; and in religion, mysticism still shows itself in the disciples of Fox, Swedenborg, and Edward Irving.

There are perhaps few forms of erroneous human development that have rendered so great service both to religion and philosophy as the system of mysticism. In an age of languid spiritual life, of cold formalism, or of heartless hypocrisy, it has invariably come forth into the moral wilderness, like the Baptist, "eating locusts and wild honey," to expose pretension and insincerity, and preach repentance unto men. In philosophy, likewise, it has ever been found to emerge when an extreme rationalism or a debasing materialism threatened the foundations of faith, and heralded a reign of scepticism. Yet, so entirely relative and limited are the human faculties, that every attempt put forth by them to transcend the natural bounds of legitimate science or of intelligent experience, has hitherto led only to extravagance and folly. The spiritualist, who follows only what his instincts dictate, is as much in error as the rationalist, who believes only what he is capable of sciencing. The idea that there is a special faculty for the discernment of spiritual truth—an inner soul, independent of experience and knowledge—has doubtless, in the hands of many, been a prolific source of mysticism. It is observable in Hugo, Tauler, and the Spanish mystics, and finds countenance in the declared divorce between Reason and Understanding in certain systems of modern speculation. Once confine the ordinary faculties of judging to the outer court of the temple of Truth, and exclude them from the sacred fane of Intuition, and we at once find ourselves in a region of transcendentalism, where nothing is seen and everything is affirmed,—where common sense finds no footing, and mysticism reigns supreme. The boundaries of faith are not necessarily limited by the extent of experience; yet without that experience, and the solid basis of fact which it brings, faith would find itself without any horizon at all, and left entirely at the mercy of wild extravagance or wilful caprice.

(See, in particular, *Hours with the Mystics*, by R. A. Vaughan, 2 vols., 1856; also *Die Christliche Mystik*, by Dr L. Noack; and *Cours de l'Hist. de la Phil. Moderne*, and *Fragmens Phil.*, by V. Cousin.) (J. D—S.)

MYTENS, Daniel, a Dutch painter, was born at the Hague towards the close of the sixteenth century. He formed his style on the principles of Rubens, and grew particularly excellent in inserting warmly-tinted landscapes in the backgrounds of his portraits. He is found at the court of James I. of England as early as 1618. On the accession of Charles I. in 1625, the office of court painter was conferred upon him, and he began to execute those fine portraits still to be seen at Hampton Court. The arrival of Vandyck in 1632 diminished his success, and induced him to return to his native land, after having caught that great master's graceful style of painting costumes. The last notice of Mytens represents him as painting the ceiling of the town-hall at the Hague in 1656. Daniel Mytens had a son of the same name, who was also a painter.

MYTHOLOGY.

Definition.

Is a term compounded of two Greek words, and in its original import it signifies any kind of fabulous doctrine. In its more appropriated sense, it means those fabulous details concerning the objects of worship which were invented and propagated by men who lived in the early ages of the world, and by them transmitted to succeeding generations, either by written records or by oral tradition.

As the theology and mythology of the ancients are almost inseparably connected, it will be impossible for us to develope the latter, without often introducing some observations relating to the former. We must therefore entreat the indulgence of our readers, if upon many occasions we should hazard a few strictures on the names, characters, adventures, and functions of such Pagan divinities as may have furnished materials for those fabulous narrations which the nature of the subject may lead us to discuss.

Origin of fable.

With respect to *fable*, it may be observed in general, that it is a creature of the human imagination, and derives its birth from that love of the marvellous which is in a manner congenial to the soul of man. The appearances of nature which every day occur, objects, actions, and events, which succeed each other by a kind of routine, are too familiar, too obvious and uninteresting, either to gratify curiosity or to excite admiration. On the other hand, when the most common phenomena in nature or life are new-modelled by the plastic power of a warm imagination; when they are diversified, compounded, embellished, or even arranged and moulded into forms which seldom or perhaps never occur in the ordinary course of things; novelty generates admiration, a passion always attended with delightful sensations. Here then we imagine we have discovered the very source of fiction and fable. They originated from that powerful propensity in our nature towards the new and surprising, animated by the delight with which the contemplation of them is generally attended.

Many circumstances contributed to extend and establish the empire of fable. The legislator laid hold on this bias of human nature, and of course employed fable and fiction as the most effectual means to civilize a rude, unpolished world. The philosopher, the theologist, the poet, the musician, each in his turn made use of this vehicle to convey his maxims and instructions to the savage tribes. They knew that *truth*, simple and unadorned, is not possessed of charms powerful enough to captivate the heart of man in his present corrupt and degenerate state. This consideration, which did indeed result from the character of their audience, naturally led them to employ fiction and allegory. From this was derived the allegorical taste of the ancients, and especially of the primary sages of the East.

Boldness of the oriental mythology.

Though almost every nation on the face of the globe, however remote from the centre of population, however savage and averse from cultivation, has fabricated and adopted its own system of mythology, the orientals have distinguished themselves in a peculiar manner, by the boldness, the inconsistency, and the extravagance of their mythology. The genial warmth of those happy climes, the fertility of the soil, which afforded every necessary, every conveniency, and often every luxury of life, without depressing their spirits by laborious exertions; the face of nature perpetually blooming around them, the skies smiling with uninterrupted serenity; all contributed to inspire the orientals with a glow of fancy and a vigour of imagination rarely to be met with in less happy regions. Hence every object was swelled beyond its natural dimensions. Nothing was great or little in moderation, but every sentiment was heightened with incredible hyperbole. The magnificent, the sublime, the vast, the enormous, the marvellous, first sprung up, and were brought to maturity, in those native regions of fable and fairy land. As nature in the ordinary course of her operations, exhibited neither objects nor effects adequate to the extent of their romantic imaginations, they naturally deviated into the fields of fiction and fable. Of consequence, the custom of detailing fabulous adventures originated in the East, and was from thence transplanted into the western countries.

As the allegorical taste of the eastern nations had sprung from their propensity to fable, and as that propensity had in its turn originated from the love of the marvellous, so did allegory in process of time contribute its influence towards multiplying fables and fiction almost *in infinitum*. The latent import of the allegorical doctrines being in a few ages lost and obliterated, what was originally a moral or theological tenet assumed the air and habit of a personal adventure.

Propensity to personification a source of eastern mythology.

The propensity towards personification, almost universal among the orientals, was another fruitful source of fable and allegory. That the people of the East were strongly inclined to personify inanimate objects and abstract ideas, we imagine will be readily granted, when it is considered, that in the formation of language they have generally annexed the affection of sex to those objects. Hence the distinction of grammatical genders, which is known to have originated in the eastern parts of the world. The practice of personifying virtues, vices, religious and moral affections, was necessary to support that allegorical style which universally prevailed in those countries. This mode of writing was in high reputation even in Europe some centuries ago; and to it we are indebted for some of the most noble poetical compositions now extant in our own language. Those productions, however, are but faint imitations of the original mode of writing still current among the eastern nations. The Europeans derived this species of composition from the Moorish inhabitants of Spain, who imported it from Arabia, their original country.

The effects of hieroglyphic writing on mythology.

The general use of hieroglyphics in the East must have contributed largely towards extending the empire of mythology. As the import of the figures employed in this method of delineating the signs of ideas was in a great measure arbitrary, mistakes must have frequently been committed in ascertaining the notions which they were at

the first intended to represent.[1] When the development of these arbitrary signs happened to be attended with uncommon difficulty, the expounders were obliged to have recourse to conjecture. Those conjectural expositions were for the most part tinctured with that bias towards the marvellous which universally prevailed amongst the primitive men. This, we find, is the case even at this day, when moderns attempt to develope the purport of emblematical figures preserved on ancient medals, entaglios, and the like.

The wise men of the East delighted in obscure enigmatical sentences. They seem to have disdained every sentiment obvious to vulgar apprehension. The words of the wise, and their dark sayings, often occur in the most ancient records, both sacred and profane. The sages of antiquity used to vie with each other for the prize of superior wisdom, by propounding riddles, and dark and mysterious questions, as subjects of investigation. The contest between Solomon and Hiram, and that between Amasis king of Egypt and Polycrates tyrant of Samos, are universally known. As the import of those enigmatical propositions was often absolutely lost, in ages when the art of writing was little known, and still less practised, nothing remained but fancy and conjecture, which always verged towards the regions of fable. This, then, we think, was another source of mythology.

Mythology reduced to a kind of system in Egypt.

The Pagan priests, especially in Egypt, were probably the first who reduced mythology to a kind of system. The sacerdotal tribe, amongst that people, were the grand depositories of learning as well as of religion. That order of men monopolized all the arts and sciences. They seem to have formed a conspiracy among themselves, to preclude the laity from all the avenues of intellectual improvement. This plan was adopted with a view to keep the laity in subjection, and to enhance their own importance. To accomplish this end, they contrived to perform all the ministrations of their religion in an unknown tongue, and to cover them with a thick veil of fable and allegory. The language of Ethiopia became their sacred dialect, and hieroglyphics their sacred character.[2] Egypt, of course, became a kind of fairy land, where all was jugglery, magic, and enchantment. The initiated alone were admitted to the knowledge of the occult mystical exhibitions, which, in their hands, constituted the essence of their religion. From these the vulgar and profane were prohibited by the most rigorous penalties. (See MYSTERIES.) The Egyptians, and indeed all the ancients without exception, deemed the mysteries of religion too sacred and solemn to be communicated to the herd of mankind, naked and unreserved; a mode by which they imagined those sacred and sublime oracles would have been defiled and degraded. "Procul, O procul este profani:" "Odi profanum vulgus et arceo." Egypt was the land of graven images; allegory and mythology were the veil which concealed religion from the eyes of the vulgar; and fable was the groundwork of that impenetrable covering.

In the earliest ages of the world mythology had no existence.

In the earliest and most unpolished stage of society we cannot suppose fable to have existed amongst men. Fables are always *tales of other times*, but at this period other times did not reach far enough backward to afford those fruits of the imagination sufficient time to arrive at maturity. Fable requires a considerable space of time to acquire credibility, and to rise into reputation. Accordingly, we find that both the Chinese and Egyptians, the two most ancient nations whose annals have reached our times, were altogether unacquainted with fabulous details in the most early and least improved periods of their respective monarchies. It has been shown almost to a demonstration, by a variety of learned men, that both the one and the other people, during some centuries after the general deluge, retained and practised the primitive Noachic religion, in which fable and fancy could find no place; all was genuine unsophisticated truth.

Fabulous cosmogony, the first mythological system.

As soon as the authentic tradition concerning the origin of the universe was either in a good measure lost, or at least adulterated by the invention of men, fable and fiction began to prevail. The Egyptian Thoth, Thyoth, or Mercury Trismegistus, and Moschus the Phœnician, undertook to account for the formation and arrangement of the universe, upon principles purely mechanical. Here fable began to usurp the place of genuine historical truth. Accordingly, we find that all the historians of antiquity who have undertaken to give a general detail of the affairs of the world, have ushered in their narration with a fabulous cosmogony. Here imagination ranged unconfined over the boundless extent of the primary chaos. To be convinced of the truth of this assertion, we need only look into Sanchoniathon's Cosmogony, Eusebius (*Præp. Evang.* l. 1), and Diodorus Siculus. From this we suppose it will follow, that the first race of fables owed their birth to the erroneous opinions of the formation of the universe.

Having now endeavoured to point out the origin of mythology, or fabulous traditions, we shall proceed to lay before our readers a brief detail of the mythology of the most respectable nations of antiquity, following the natural order of their situation.

Chinese mythology.

The Chinese, if any credit be due to their own annals, or to the missionaries of the church of Rome, who pretend to have copied from them, were the first of the nations. Their fabulous records reach upwards many myriads of years before the Mosaic era of the creation. The events during that period of time, if any had been recorded, must have been fabulous as the period itself. These, however, are buried in eternal oblivion. The missionaries, who are the only sources of our information with relation to the earliest periods of the Chinese history, represent those people as having retained the religion of Noah many centuries after the foundation of their empire. Upon this supposition, their cosmogony must have been sound and genuine, without the least tincture of those fabulous ingredients which have both disguised and disgraced the cosmogonies of most other nations.

Birth and inventions of Fohi.

According to the most authentic accounts, Fohe or Fohi laid the foundation of that empire about four thousand years ago. This emperor, according to the Chinese, was conceived in a miraculous manner. His mother, say they, one day as she was walking in a desert place, was surrounded by a rainbow; and, being impregnated by this meteor, was in due time delivered of that celebrated legislator. This personage, like the Athenian Cecrops, was half a man

[1] This, though plausible enough as a mere supposition or hypothesis, must be taken with more than grains of allowance, seeing it proceeds upon an assumption which is by no means correct in point of fact. It is not true that the *import* of the figures employed in the hieroglyphic delineation of ideas was "*in a great measure arbitrary;*" for, if this had been the case, then the interpretation of such figures would have been, in the same measure or proportion, impossible. *Originally*, no doubt, *arbitrary* values may have been affixed to certain figures or symbols, that is, values not depending on any obvious analogy or principle; but these being *once* conventionally settled, remained *invariable*, and were ever afterwards employed in an uniform sense or acceptation, as much so indeed as if they had been originally *natural* instead of *conventional* signs, expressive of certain ideas. This distinction should never be lost sight of in any observations on hieroglyphical writing, which, in truth, was but ill understood at the period when the above article was composed by its able and ingenious author. If constructed on any other principle than that now stated, it would have been altogether unintelligible.—*Editor.*

[2] The modern doctrine on this subject may be ascertained by consulting the article HIEROGLYPHICS.

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Mythology.

took the shape of a minute fish called *Sap-hari*. After various transformations, and an enormous increase of size in each of them, the lord of the universe, loving the righteous man,[1] who had still adhered to him under all these various shapes, and, intending to preserve him from the sea of destruction caused by the depravity of the age, thus told him how he was to act: "In seven days from the present time, O thou tamer of enemies, the three worlds will be plunged in an ocean of death; but in the midst of the destroying waves a large vessel sent me for thy use shall stand before thee." The remaining part of the mythology so nearly resembles the Mosaic history of Noah and the general deluge, that the former may be a strong confirmation of the truth of the latter. To dry up the waters of the deluge, the power of the Deity descends in the form of a boar, the symbol of strength, to draw up and support on his tusks the whole earth, which had been sunk beneath the ocean. Again, the same power is represented as a tortoise sustaining the globe, which had been convulsed by the violent assaults of demons, while the gods charmed the sea with the mountain *Mandar*, and forced it to disgorge the sacred things and animals, together with the water of life, which it had swallowed. All these stories, we think, relate to the same event, shadowed by a moral, a metaphysical and an astronomical allegory; and all three seem connected with the hieroglyphical sculptures of the old Egyptians.

The Hindus divide the duration of the world into four *yugs* or *jugs*, or *jogues*, each consisting of a prodigious number of years. In each of those periods the age and stature of the human race have been gradually diminished; and in each of them mankind has gradually declined in virtue and piety, as well as in age and stature. The present period they call the *collе*, that is, the corrupt yug, which they say is to last four hundred thousand years, of which near five thousand years are already past. In the last part of the preceding yugs, which they call the *dwa paar*, the age of man was contracted into a thousand years, as in the present it is confined to a hundred. From this proportional diminution of the length of human life, our readers will probably infer, that the two last yugs bear a pretty near resemblance to the Mosaic history of the age of the antediluvian and postdiluvian patriarchs; and that the two first are imaginary periods prior to the creation of the world, like those of the Chinese, Chaldeans, and Egyptians.

The world subject to various dissolutions and resuscitations.

According to the mythology of the Hindus, the system of the world is subject to various dissolutions and resuscitations. At the conclusion of the collе jogue, say they, a grand revolution will take place, when the solar system will be consumed by fire, and all the elements reduced to their original constituent atoms. Upon the back of these revolutions, Brahma, the supreme deity of the Hindus, is sometimes represented as a new-born infant, with his toe in his mouth, floating on a camala or water flower, sometimes only on a leaf of that plant, on the surface of the vast abyss. At other times he is figured as coming forth of a winding shell, and again as blowing up the mundane foam with a pipe at his mouth. Some of these emblematical figures and attitudes, our learned readers will probably observe, nearly resemble those of the ancient Egyptians.

Birth of the god Fo.

But the vulgar religion of the ancient Hindus was of a very different complexion, and opens a large field of mythological adventures. We have observed above, that the Fo or Foh of the Chinese was imported from India; and now we shall give a brief detail of the mythological origin of that divinity. We have no certain account of the birthplace of this imaginary deity. His followers relate that he was born in one of the kingdoms of India near the line, and that his father was one of that country. His mother brought him into the world by the left side, and expired soon after her delivery. At the time of her conception, she dreamed that she had swallowed a white elephant; a circumstance which is supposed to have given birth to the veneration which the kings of India have always shown for a white animal of that species. As soon as he was born, he had strength enough to stand erect without assistance. He walked abroad at seven, and, pointing with one hand to the heavens, and with the other to the earth, he cried out, "In the heavens, and on the earth, there is no one but I who deserves to be honoured." At the age of thirty, he felt himself all on a sudden filled with the divinity; and now he was metamorphosed into Fo or Pagod, according to the expression of the Hindus. He had no sooner declared himself a divinity, than he thought of propagating his doctrine, and proving his divine mission by miracles. The number of his disciples was immense; and they soon spread his dogmas over all India, and even to the higher extremities of Asia.

Doctrines of Fo derived from Egypt.

One of the principal doctrines which Fo and his disciples propagated, was the metempsychosis or transmigration of souls. This doctrine, some imagine, has given rise to the multitude of idols reverenced in every country where the worship of Fo is established. Quadrupeds, birds, reptiles, and the vilest animals, had temples erected for them; because, say they, the soul of the god, in his numerous transmigrations, may have at one time or other inhabited their bodies.

Both the doctrine of transmigration and of the worship of animals seems, however, to have been imported from Egypt into India. If the intercourse between these two countries was begun at so early a period as some very late writers have endeavoured to prove, such a supposition is by no means improbable. The doctrine of the transmigration of souls was early established among the Egyptians. It was, indeed, the only idea they formed of the soul's immortality. The worship of animals among them seems to have been still more ancient. If such an intercourse did actually exist, we may naturally suppose that colonies of Egyptian priests found their way into India, as they did afterwards into Asia Minor, Italy, and Greece. That colonies of Egyptians did actually penetrate into that country, and settle there, many centuries before the Nativity, is a fact that cannot be called in question, for reasons which the bounds prescribed us in this article will not allow us to enumerate. We shall only observe, that from the hieroglyphical representations of the Egyptian deities seem to have originated those monstrous idols which from time immemorial have been worshipped in India, China, Japan, Siam, and even in the remotest parts of Asiatic Tartary.

The incarnations of Vishnu.

Foh is often called *Budha* or *Budda*, and sometimes *Vishnu*; perhaps, indeed, he may be distinguished by many other names, according to the variety of dialects of the different nations among which his worship was established. An infinitude of fables was propagated by his disciples concerning him after his death. They pretended that their master was still alive; that he had been already born eight thousand times, and that he had successively appeared under the figure of an ape, a lion, a dragon, an elephant, a boar, &c. These were called the incarnations of Vishnu. At length he was confounded with the Supreme God; and all the titles, attributes, operations, perfections, and ensigns of the Most High were ascribed to him. Sometimes he is called Amida, and represented with the head of a dog, and worshipped as the guardian of mankind. He sometimes appears as a princely personage, issuing from the

[1] He was sovereign of the world. His name was *Menu*, or *Satyavrata*; and his patronymic was *Vaivaswata*, or Child of the Sun.

Mythology.

mouth of a fish. At other times, he wears a lunette on his head, in which are seen cities, mountains, towers, trees, in short, all that the world contains. These transformations are evidently the children of allegorical or hieroglyphical emblems, and form an exact counterpart of the symbolical worship of the Egyptians.

The enormous mass of mythological traditions which have in a manner deluged the vast continent of India would fill many volumes. We have selected the preceding articles as a specimen only, by which our readers may be qualified to judge of the rest. If they find themselves disposed to indulge their curiosity at greater length, we must refer them to Thevenot's and Hamilton's Travels, to M. Anquétil in his *Zendavesta*, Halhed's Introduction to his translation of the code of Gentoo Laws, Colonel Dow's History of Hindustan, Grose's Voyage to the East Indies, and the Asiatic Researches (vol. i. and ii.).

Persian mythology.

The mythology of the Persians is, if possible, still more extravagant than that of the Hindus. It supposes the world to have been repeatedly destroyed, and repeopled by creatures of different formation, who were successively annihilated or banished for their disobedience to the Supreme Being. The monstrous griffin *Sinergh* informs the hero *Caherman* that she had already lived to see the earth seven times filled with creatures, and seven times a perfect void; that before the creation of Adam, this globe was inhabited by a race of beings called *Peris* and *Dives*, whose characters formed a perfect contrast. The Peris are described as beautiful and benevolent; the Dives as deformed, malevolent, and mischievous, differing from infernal demons only in this, that they are not as yet confined to the pit of hell. They are for ever ranging over the world, to scatter discord and misery amongst the sons of men. The Peris nearly resemble the fairies of Europe; and perhaps the Dives gave birth to the giants and magicians of the middle ages. The Peris and Dives wage incessant wars; and when the Dives make any of the Peris prisoners, they shut them up in iron cages, and hang them on the highest trees, to expose them to public view, and to the fury of every chilling blast.

When the Peris are in danger of being overpowered by their foes, they solicit the assistance of some mortal hero, which produces a series of mythological adventures highly ornamental to the strains of the Persian bards, and which at the same time furnishes an inexhaustible fund of the most diversified machinery.

One of the most celebrated adventurers in the mythology of Persia is *Tahmuras*, one of their most ancient monarchs. This prince performs a variety of exploits while he endeavours to recover the fairy Merjan. He attacks the Dive Demrush in his own cave, where, having vanquished the giant or demon, he finds vast piles of hoarded wealth, which he carries off with the fair captive. The battles, labours, and adventures of Rostan, another Persian worthy, who lived many ages after the former, are celebrated by the Persian bards with the same extravagance of hyperbole with which the labours of Hercules have been sung by the poets of Greece and Rome.

Persia the birth-place of chivalry and romance.

The adventures of the Persian heroes breathe all the wildness of achievement recorded of the knights of Gothic romance. The doctrine of enchantments, transformations, and the like, exhibited in both, is a characteristic symptom of one common original. Persia is the genuine classic ground of eastern mythology, and the source of the ideas of chivalry and romance, which were thence propagated to the regions of Scandinavia, and indeed to the remotest corners of Europe towards the west.

Perhaps our readers may be inclined to adopt our opinion, when we offer it as a conjecture, that the tales of the war of the Peris and Dives originated from a vague tradition concerning good and bad angels. Nor is it, we think, at all improbable, that the fable of the wars between the gods and giants, so famous in the mythology of Greece and Italy, was imported into the former of these countries from the same quarter. (For a more particular account of the Persian mythology, our readers may consult Dr Hyde, *Relig. Vet. Pers.*; D'Herbelot's *Bibl. Orient.*; and Richardson's Introduction to his Persian and Arabic Dictionary.)

Chaldæan mythology.

The mythology of the Chaldæans, like that of the other nations of the East, commences at a period myriads of years prior to the era of the Mosaic creation. Their cosmogony, exhibited by Berosus, who was a priest of Belus, and deeply versed in the antiquities of his country, is a piece of mythology of the most extravagant nature. It has been copied by Eusebius (*Chron.* lib. i. p. 5); and it is likewise to be found in Syncellus, copied from Alexander Polyhistor. According to this historian, there were at Babylon written records preserved with the greatest care, comprehending a period of fifteen myriads of years. Those writings likewise contained a history of the heavens and the sea, of the earth, and of the origin of mankind. "In the beginning," says Berosus, copying from Oannes, of whom we shall afterwards give a brief account, "there was nothing but darkness and an abyss of water, wherein resided most hideous beings produced from a twofold principle. Men appeared with two wings; some with two and some with four faces. They had one body, but two heads; the one of a man, the other of a woman. Other human figures were to be seen, furnished with the legs and horns of goats. Some had the feet of horses behind, but before were fashioned like men, resembling hippocentaurs." The remaining part of this mythology is much of the same complexion; indeed so extravagant, that we imagine our readers will readily enough dispense with our translating the sequel. "Of all these," says the author, "were preserved delineations in the temple of Belus at Babylon. The person who was supposed to preside over them was called *Omoroca*. This word, in the Chaldean language, is *Thalath*, which the Greeks call Θαλασσα, but it more properly imports the moon. Matters being in this situation, *their* god, says Eusebius, *the* god, says Syncellus, came and cut the woman asunder; and out of one half of her he formed the earth, and out of the other he made the heavens; and, at the same time, he destroyed the monsters of the abyss." This whole mythology is an allegorical history copied from hieroglyphical representations, the real purport of which could not be deciphered by the author. Such, in general, were the consequences of the hieroglyphical style of writing.

Oannes the legislator of the Chaldæans.

Oannes, the great civilizer and legislator of the Chaldæans, according to Apollodorus, who copied from Berosus, was an amphibious animal of a heterogeneous appearance. He was endowed with reason, and a very uncommon acuteness of parts. His whole body resembled a fish. Under the head of a fish he had also another head, and feet below similar to those of a man, which were subjoined to the tail of the fish. His voice and language were articulate, and perfectly intelligible; and there was a figure of him still extant in the days of Berosus. He made his appearance in the Erythrean or Red Sea, where it borders upon Babylonia. This monstrous being conversed with men by day; but at night he plunged into the sea, and remained concealed in the water till next morning. He taught the Babylonians the use of letters, and the knowledge of all the arts and sciences. He instructed them in the method of building houses, constructing temples, and all other edifices. He taught them to compile laws and religious ceremonies, and explained to them the principles of mathematics, geometry, and astronomy. In a word, he communicated to them every thing necessary, useful, and ornamental; and so universal were his instructions, that not

Mythology.

one single article had ever been added to them since the time they were first communicated. Helladius is of opinion that this strange personage, whoever he was, came to be represented under the figure of a fish, not because he was actually believed to be such, but because he was clothed with the skin of a seal. By this account our readers will see that the Babylonian Oannes is the exact counterpart of the Fohi of the Chinese, and the Thoth or Mercury Trismegistus of the Egyptians. It is likewise apparent that the idea of the monster compounded of the man and the fish has originated from some hieroglyphic emblem of that form grafted upon the appearance of man. Some modern mythologists have been of opinion that Oannes was actually Noah, the great preacher of righteousness, who, as some think, settled in Shinar or Chaldæa after the deluge, and who, in consequence of his connection with that event, might be properly represented under the emblem of the Man of the Sea.

The nativity of the goddess of beauty and love.

The nativity of Venus, the goddess of beauty and love, is another piece of mythology famous amongst the Babylonians and Assyrians. An egg, say they, of a prodigious size, dropped from heaven into the river Euphrates. Some doves settled upon this egg, after the fishes had rolled it to the bank. In a short time this egg produced Venus, who was afterwards called *Dea Syria*, or the Syrian goddess. In consequence of this tradition, says Hyginus, pigeons and fishes became sacred to this goddess amongst the Syrians, who always abstained from eating the one or the other. Of this imaginary being we have a very exact and entertaining history in the treatise *De Dea Syria*, generally ascribed to Lucian.

In this mythological tradition our readers will probably discover an allusion to the celebrated Mundane Egg; and at the same time the story of the fishes will lead them to anticipate the connection between the sea and the moon. This same deity was the Atargatis of Ascalon, described by Diodorus the Sicilian; the one half of her body being that of a woman, and the other that of a fish. This was no doubt a hieroglyphic figure of the moon, importing the influence of that planet upon the sea and the sex. The oriental name of this deity evidently points to the moon; for it is compounded of two Hebrew words,[1] importing "the queen of the host of heaven."

The fable of Semiramis.

The fable of Semiramis is nearly connected with the preceding one. Diodorus Siculus has preserved the mythological history of this deity, which he and all the writers of antiquity have confounded with the Babylonian princess of the same name. That historian informs us, that the word *Semiramis*, in the Syrian dialect, signifies "a wild pigeon;" but we apprehend that this term was a name or epithet of the moon, as it is compounded of two words[2] of an import naturally applicable to the lunar planet. It was a general practice amongst the Orientals to denominate their sacred animals from that deity to which they were consecrated. Hence the moon being called *Semiramis*, and the pigeon being sacred to her divinity, the latter was called by the name of the former.[3]

Arabian mythology.

We should now proceed to notice the mythology of the Arabians, the greater part of which is, however, buried in the abyss of ages; although, when we reflect on the genius and character of that people, we must be convinced that they too, as well as the other nations of the East, abounded in fabulous relations and romantic compositions. The natives of that country have always been enthusiastically addicted to poetry, of which, in its early stage, fable is the essence. Wherever the Muses have erected their throne, fables and miracles have always appeared in their train. In the Koran we meet with frequent allusions to well-known traditionary fables. These had been transmitted from generation to generation by the bards and rhapsodists, for the entertainment of the vulgar. In Arabia, from the earliest ages, it has always been one of the favourite entertainments of the common people, to assemble in the serene evenings around their tents, or on the platforms with which their houses are generally covered, or in large halls erected for the purpose, in order to amuse themselves with traditional narrations of the most distinguished actions of their most remote ancestors. Oriental imagery always embellished their romantic details. The glow of fancy, the love of the marvellous, the propensity towards the hyperbolical and the vast, which constitute the essence of oriental description, must ever have drawn the relation aside into the devious regions of fiction and fairy land. The religion of Mahommed beat down the original fabric of idolatry and mythology together. The Arabian fables current in modern times are borrowed or imitated from Persian compositions; Persia being still the grand nursery of romance in the East.

Egyptian mythology. Origin of Tsabaism.

In Egypt we find idolatry, theology, and mythology, almost inseparably blended together. The inhabitants of this region, too, as well as of others in the vicinity of the centre of population, adhered for several centuries to the worship of the true God. At last, however, conscious of their own ignorance, impurity, imperfection, and total unfitness to approach an infinitely perfect Being, distant, as they imagined, and invisible, they began to cast about for some beings more exalted, and more perfect than themselves, by whose mediation they might prefer their prayers to the Supreme Majesty of heaven. In this state, the luminaries of heaven, which, they imagined, were animated bodies, naturally presented themselves. These were splendid and glorious beings. They were thought to partake of the divine nature; they were revered as the satraps, prefects, and representatives of the Supreme Lord of the universe. They were visible, they were beneficent; they dwelt nearer to the gods; they were obvious to the worshipper, and always accessible. These were, of course, employed as mediators and intercessors between the Supreme Divinity and his humble subjects of this lower world. Thus employed, they might claim a subordinate share of worship, which was accordingly assigned them. In process of time, however, that worship, which was originally addressed to the Supreme Creator by the mediation of the heavenly bodies, was in a great measure forgotten, and the adoration of mankind ultimately terminated upon those illustrious creatures. To this circumstance, we think, we may ascribe the origin of that species of idolatry called Tsabaism, or the worship of the host of heaven, which overspread the world early and almost universally. In Egypt this mode of worship was adopted in all its most absurd and most enthusiastic forms, and at the same time the most heterogeneous mythology appeared in its train. The mythology of the ancient Egyptians was so various and multiform, so complicated and so mysterious, that it would require many volumes even to give a superficial account of its origin and progress, not only in its mother country, but even in many other parts of the eastern and western world. Besides, the idolatry and mythology of that wonderful

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[1] ADAR or HADAR, *magnificus*, and GAD, *exercitus*, *turma*.

[2] *Shem* or *Sem*, a sign, and *ramah*, high.

[3] As the bounds prescribed for the present article render it impossible for us to do justice to this interesting piece of mythology, we must beg leave to refer our readers for farther information to Diodorus Siculus, lib. ii.; Hyginus, *Poet. Astron. Fab.* 197; Pharnutus, *de Nat. Deor.*; Ovid, *Metam.* lib. iv.; Athen. *in Apol.*; Tzetzes, chil. ix. cap. 276; Selden, *de Diis Syr.* ii. 183.

Mythology.

country are so closely connected and so inseparably blended together, that it is impossible to describe the latter without at the same time developing the former. We hope, therefore, that our readers will not be disappointed, if, in an article of this nature, we touch only upon some of the leading or most interesting articles of this complicated subject.

Reign of gods and demigods in Egypt.

The Egyptians confounded the revolutions of the heavenly bodies with the reigns of their most early monarchs. Hence the incredible number of years included in the reign of their eight superior gods, who, according to them, filled the Egyptian throne successively in the most early periods of time. To these, according to their system, succeeded twelve demigods, who likewise reigned an amazing number of years. These imaginary reigns were no other than the periodical revolutions of the heavenly bodies preserved in their almanacs, which might be carried back, and actually were carried back, at pleasure. Hence the fabulous antiquity of that kingdom. The imaginary exploits and adventures of these gods and demigods furnished an inexhaustible fund of mythological romances. To the demigods succeeded the kings of the cynic cycle, personages equally chimerical with the former. The import of this epithet has greatly perplexed critics and etymologists. We apprehend that it is an oriental word importing *royal* dignity, or elevation of rank. This appellation intimated, that the monarchs of that cycle, admitting that they actually existed, were more powerful and more highly revered than their successors. After the princes of the cynic cycle came another race, denominated *Nekyes*, a title likewise implying royal, splendid, glorious. These cycles figure high in the mythological annals of the Egyptians, and have furnished materials for a variety of learned and ingenious disquisitions. The wars and adventures of Osiris, Orus, Typhon, and other allegorical personages who figure in the Egyptian rubric; the wanderings of Isis, the sister and wife of Osiris; the transformation of the gods into divers kinds of animals; their birth, education, peregrinations, and exploits; compose a body of mythological fictions so various, so complicated, so ridiculous, and often so apparently absurd, that all attempts to develope and explain them have hitherto proved unsuccessful. All, or the greater part, of those extravagant fables, were the offspring of hieroglyphical or allegorical emblems devised by the priests and sages of that nation, with a view to conceal the mysteries of their religion from that class of men whom they stigmatized with the name of the uninitiated rabble.

Worship of brute animals.

The worship of brute animals and of certain vegetables, universal amongst the Egyptians, was another exuberant source of mythological adventures. The Egyptian priests, many of whom were likewise profound philosophers, observed, or pretended to observe, a kind of analogy between the qualities of certain animals and vegetables, and those of some of their subordinate divinities. Such animals and vegetables they adopted, and consecrated to the deities to whom they were supposed to bear this analogical resemblance; and in process of time they considered them as the visible emblems of those divinities to which they were consecrated. By these the vulgar addressed their archetypes, in the same manner as, in other countries, pictures and statues were employed for the very same purpose. The mob, in process of time, forgetting the emblematical character of those brutes and vegetables, addressed their devotion immediately to them; and of course these became the ultimate objects of vulgar adoration.

After these objects, animate or inanimate, were consecrated as the visible symbols of the deities, it soon became fashionable to make use of their figures to represent those deities to which they were consecrated. This practice was the natural consequence of the hieroglyphical style which universally prevailed amongst the ancient Egyptians. Hence Jupiter Ammon was represented under the figure of a ram, Apis under that of a cow, Osiris of a bull, Pan of a goat, Thoth or Mercury of an ibis, Bubastis or Diana of a cat. It was likewise a common practice amongst those deluded people to dignify these objects, by giving them the names of those deities which they represented. By this mode of dignifying these sacred emblems, the veneration of the rabble was considerably enhanced, and the ardour of their devotion inflamed in proportion. From these two sources, we think, are derived the fabulous transformation of the gods, so generally celebrated in the Egyptian mythology, and from it imported into Greece and Italy. In consequence of this practice, their mythological system was rendered at once enormous and unintelligible.[1]

Mercury Trismegistus the author of the Egyptian mythology.

Their Thoth, or Mercury Trismegistus, was, in our opinion, the inventor of this unhappy system. This personage, according to the Egyptians, was the original author of letters, geometry, astronomy, music, and architecture; in a word, of all the elegant and useful arts, and of all the branches of science and philosophy. He it was who first discovered the analogy between the divine affections, influences, appearances, operations, and the corresponding properties, qualities, and instincts of certain animals, and the propriety of dedicating particular kinds of vegetables to the service of particular deities. The priests, whose province it was to expound the mysteries of that allegorical hieroglyphical religion (see MYSTERIES), gradually lost all knowledge of the primary import of the symbolical characters. To supply this defect, and at the same time to veil their own ignorance, the sacerdotal instructors had recourse to fable and fiction. They heaped fable upon fable, till their religion became an accumulated chaos of mythological absurdities. Two of the most learned and most acute of the ancient philosophers have attempted a rational explication of the latent import of the Egyptian mythology; but both have failed in the attempt; nor have the moderns, who have laboured in the same department, performed their part with much better success.[2]

Phœnician mythology.

The elements of Phœnician mythology have been preserved by Eusebius (*Præparat. Evang.* sub init.). In the large extract which that learned father had copied from Philo Biblius's translation of Sanchoniathon's History of Phœnicia, we are furnished with several articles of mythology. Some of these throw considerable light on several passages of the sacred history; and all of them are strictly connected with the mythology of the Greeks and Romans. There we have preserved a brief but entertaining detail of the fabulous adventures of Uranus, Cronus, Dagon, Thyoth or Mercury, probably the same with the Egyptian hero of that name. Here we find Muth or Pluto, Hephestus or Vulcan, Æsculapius, Nereus, Poseidon or Neptune, &c. Astarte, or Venus Urania, makes a conspicuous figure in the catalogue of Phœnician worthies; Pallas or Minerva is planted upon the territory of Attica; in a word, all the branches of the family of the Titans, who in after ages

[1] See, on this subject, Sir William Drummond's *Origines*, &c. b. iv. c. 5, vol. ii. p. 146.

[2] Instead, therefore, of prosecuting this inexplicable subject, which would swell the present article beyond all proportion, we must beg leave to refer those who are desirous of further information, to the following authors, where they will find enough to gratify their curiosity, if not to inform their judgment:—Herodotus, lib. ii.; Diodorus Siculus, lib. i.; Plutarch, *Isis et Osiris*; Jamblichus, *de Myst. Egypt.*; Horus Apollo, *Hieroglyph. Egypt.*; Macrobius, *Saturn.* cap. 23, amongst the ancients; and, amongst the moderns, Kircher's *Œdipus*; Vossius, *de Orig. et Prog. Idol.*; Mr Bryant's *Analysis of Anc. Mythol.*; Gebelin, *Monde Primitif*; and, above all, to the learned Jablonski's *Pantheon Egyptiorum*.

figured in the rubric of the Greeks, are brought upon the stage, and their exploits and adventures briefly detailed.

Grecian mythology derived from Egypt and Phœnicia.

By comparing this fragment with the mythology of the Atlantidæ and that of the Cretans preserved by Diodorus the Sicilian (lib. v.), we think there is good reason to conclude, that the family of the Titans, the several branches of which seem to have been both the authors and objects of a great part of the Grecian idolatry, originally emigrated from Phœnicia. This conjecture will receive additional strength, when it is considered that almost all their names recorded in the fabulous records of Greece may be easily traced up to a Phœnician original. We agree with Herodotus, that a considerable part of the idolatry of Greece may have been borrowed from the Egyptians; at the same time, we imagine it highly probable, that the idolatry of the Egyptians and Phœnicians was in its original constitution nearly the same. Both systems were Tsabaism, or the worship of the host of heaven. The Pelasgi, according to Herodotus, learned the names of the gods from the Egyptians; but in this conjecture he is certainly warped by his partiality for that people. Had those names been imported from Egypt, they would no doubt have bewrayed their Egyptian original; whereas the skilful etymologist will be convinced that every one is of Phœnician extraction.

The adventures of Jupiter, Juno, Mercury, Apollo, Diana, Mars, Minerva or Pallas, Venus, Bacchus, Ceres, Proserpine, Pluto, Neptune, and the other descendants and coadjutors of the ambitious family of the Titans, furnish by far the greatest part of the mythology of Greece. They left Phœnicia, we think, about the age of Moses; they settled in Crete, a large and fertile island; from this region they made their way into Greece, which, according to the most authentic accounts, was at that time inhabited by a race of savages. The arts and inventions which they communicated to the natives; the mysteries of religion which they inculcated; the laws, customs, polity, and good order which they established; in short, the blessings of humanity and civilization which they everywhere disseminated, in process of time inspired the unpolished inhabitants with a kind of divine admiration. Those ambitious mortals improved this admiration into divine homage and adoration. The greater part of that worship, which had been formerly addressed to the luminaries of heaven, was now transferred to those illustrious personages. They claimed and obtained divine honours from the deluded rabble of enthusiastic Greeks. Hence sprung an inexhaustible fund of the most inconsistent and irreconcilable fictions.

Hence the inconsistent fictions of the Greek poets.

The foibles and frailties of the deified mortals were transmitted to posterity, incorporated, as it were, with the pompous attributes of supreme divinity. Hence the heterogeneous mixture of the mighty and the mean which chequers the characters of the heroes of the Iliad and Odyssey. The Greeks adopted the oriental fables, the import of which they did not understand. These they accommodated to heroes and illustrious personages, who had figured in their own country in the earliest periods. The labours of Hercules originated in Egypt, and evidently relate to the annual progress of the sun in the zodiac, though the vain-glorious Greeks accommodated them to a hero of their own, the reputed son of Jupiter and Alcmena. The expedition of Osiris they borrowed from the Egyptians, and transferred to their Bacchus, the son of Jupiter and Semele the daughter of Cadmus. The transformation and wanderings of Io are evidently transcribed from the Egyptian romance of the travels of Isis in quest of the body of Osiris, or of the Phœnician Astarte, drawn from Sanchoniathon. Io or Ioh is in reality the Egyptian name of the moon, and Astarte was the name of the same planet amongst the Phœnicians. Both these fables are allegorical representations of the anomalies of the lunar planet, or perhaps the progress of the worship of that planet in different parts of the world. The fable of the conflagration occasioned by Phaeton is clearly of oriental extraction, and alludes to an excessive drought which in the early periods of time scorched Ethiopia and the adjacent countries. The fabulous adventures of Perseus are said to have happened in the same regions, and are allegorical representations of the influence of the solar luminary; for the original Perseus was the sun. The rape of Proserpine and the wanderings of Ceres, the Eleusinian mysteries, the orgia or sacred rites of Bacchus, the rites and worship of the Cabiri, were imported from Egypt and Phœnicia, but strangely garbled and disfigured by the hierophants of Greece. The gigantomachia, or war between the gods and the giants, and all the fabulous events and varieties of that war, form an exact counterpart to the battles of the Peris and Dives, celebrated in the romantic annals of Persia.

The Greeks ignorant of oriental languages.

A considerable part of the mythology of the Greeks sprung from their ignorance of the oriental languages. They disdained to apply themselves to the study of languages spoken by people whom, in the pride of their heart, they stigmatised with the epithet of *barbarians*. This aversion to every foreign dialect was highly detrimental to their progress in the sciences. The same neglect or aversion has, we imagine, proved an irreparable injury to the republic of letters in all succeeding ages. The aoids, or strolling bards, laid hold on those oriental legends, which they sophisticated with their own additions and improvements, in order to accommodate them to the popular taste. These wonderful tales figured in their rhapsodical compositions, and were greedily swallowed down by the credulous vulgar. Those fictions, as they rolled down, were constantly augmented with fresh materials, till in process of time their original import was either forgotten or buried in impenetrable darkness. A multitude of these Hesiod has collected in his *Theogonia*, or Generation of the Gods, which unhappily became the religious creed of the illiterate part of the Greeks. Indeed fable was so closely interwoven with the religion of that airy, volatile people, that it seems to have contaminated not only their religious and moral, but even their political tenets.

Oracle of Dodona.

The far-famed oracle of Dodona was copied from that of Ammon at Thebes in Upper Egypt. The oracle of Apollo at Delphos was an emanation from the same source. The celebrated Apollo Pythius of the Greeks was no other than the Ob or Aub of the Egyptians, who denominated the basilisk or royal snake Ov Cai, because it was held sacred to the sun. Ob or Aub is still retained in the Coptic dialect, and is one of the many names or epithets of that luminary. In short, the groundwork of the Grecian mythology is to be traced in the East. Only a small part of it was fabricated in the country; and what was imported pure and genuine was miserably sophisticated by the hands through which it passed, in order to give it a Grecian air, and to accommodate its style to the Grecian taste. To enlarge upon this topic would be altogether superfluous, as our learned readers must be well acquainted with it already, and the unlearned may, without much trouble or expense, furnish themselves with books upon that subject.

Roman mythology borrowed from Greece.

The Roman mythology was borrowed from the Greeks. That people had addicted themselves for many centuries to the arts of war and civil polity. Science and philosophy were either neglected or unknown. At last they conquered Greece, the native land of science, and then "Græcia capta ferum victorem cepit et artes intulit agresti Latio." This being the case, their mythology was, upon the whole, a transcript from that of Greece. They had indeed gleaned a few fables from the Pelasgi and others, which, however, are of so little consequence, that they are scarcely worth the trouble of transcribing.

Mythology.

The mythology of the Celtic nations is in a great measure lost. There may possibly still remain some vestiges of the druidical superstition in the remotest parts of the Highlands and Islands of Scotland, and perhaps in the uncivilized places of Ireland. These, we presume, would afford our readers but little entertainment, and still less instruction.

Mythology of the northern nations.

The mythology of the northern nations, that is, of the Norwegians, Danes, Swedes, and Icelanders, is uncommonly curious and entertaining. The Edda and Voluspa contain a complete collection of fables which have not the smallest affinity with those of the Greeks and Romans. They are wholly of an oriental complexion, and seem almost congenial with the tales of the Persians above described. The Edda was compiled in Iceland in the thirteenth century. It is a kind of system of the Scandinavian mythology; and it has been reckoned, and we believe justly, a commentary on the Voluspa, which was the Bible of the northern nations. Odin or Othin, or Woden or Waden, was the supreme divinity of those people. His exploits and adventures furnish the far greater part of their mythological creed. That hero is supposed to have emigrated from the East, but from what country or at what period is not certainly known. His achievements are magnified beyond all credibility. He is represented as the god of battles, and as slaughtering thousands at a blow. His palace is called Valhalla; it is situated in the city of Midgard, where, according to the fable, the souls of heroes who had bravely fallen in battle enjoy supreme felicity. They spend the day in mimic hunting matches, or imaginary combats. At night they assemble in the palace of Valhalla, where they feast on the most delicious viands, dressed and served up by the Valkyriæ, virgins adorned with celestial charms, and flushed with the bloom of everlasting youth. They solace themselves with drinking mead out of the skulls of enemies whom they had killed in their days of nature. Mead, it seems, was the nectar of the Scandinavian heroes.

The hell and devil of the Scandinavians.

Sleepner, the horse of Odin, is celebrated along with his master. Hela, the hell of the Scandinavians, affords a variety of fables equally shocking and heterogeneous. Loke, the evil genius or devil of the northern people, nearly resembles the Typhon of the Egyptians. Signa or Sinna is the consort of Loke; and from this name the English word *sin* is derived. The giants Weymur, Ferbanter, Belupher, and Hellunda, perform a variety of exploits, and are exhibited in the most frightful attitudes. One would be tempted to imagine, that they perform the exact counterpart of the giants of the Greek and Roman mythologists. Instead of glancing at these ridiculous and uninteresting fables, which is all that the limits prescribed us would permit, we shall take the liberty to lay before our readers a brief account of the contents of the Voluspa, which is indeed the text of the Scandinavian mythology.

The Voluspa.

The word *Voluspa* imports, "the prophecy of Vola or Fola." This was, perhaps, a general name for the prophetic ladies of the North, as Sibyl was appropriated to women endowed with the like faculty in the South. Certain it is, that the ancients generally connected madness with the prophetic faculty. Of this we have two celebrated examples; the one in Lycophron's Cassandra, and the other in the Sibyl of the Roman poet. The word *vola* signifies "mad or foolish;" whence the English words *fool*, *foolish*, *folly*. *Spa*, the latter part of the composition, signifies "to prophecy," and is still current amongst the common people in Scotland, in the word *spae*, which has nearly the same signification.

The Voluspa consists of between two and three hundred lines. The prophetess having imposed silence on all intelligent beings, declares that she is about to reveal the works of the Father of nature, the actions and operations of the gods, which no mortal ever knew before herself. She then begins with a description of the chaos; and then proceeds to the formation of the world, and the creation of the different species of its inhabitants, giants, men, and dwarfs. She then explains the employments of the fairies or destinies, whom the northern people call *nornies*, the functions of the deities, their most memorable adventures, their disputes with Loke, and the vengeance which ensued. She at last concludes with a long, and indeed animated description of the final state of the universe, and its dissolution by a general conflagration. In this catastrophe, Odin, and all the rabble of the Pagan divinities, are to be confounded in the general ruin, no more to appear on the stage of the universe; and out of the ruins of the former world, according to the Voluspa, a new one shall spring up, arrayed in all the bloom of celestial beauty.

Such is the doctrine exhibited in the fabulous Voluspa. So congenial are some of the details therein delivered, especially those relating to the final dissolution of the present system, and the succession of a new heaven and a new earth, that we find ourselves strongly inclined to suspect, that the original fabricator of the work was a semi-pagan writer, much of the same complexion with the authors of the Sibylline oracles, and of some other apocryphal pieces which appeared in the world during the first ages of Christianity.

Mythology of Mexico and Peru.

In America, the only mythological countries seems to be Mexico and Peru. The other parts of that large continent were originally inhabited by savages, most of them as remote from religion as from civilization. The two vast empires of Mexico and Peru had existed about four hundred years only before the Spanish invasion; but in neither of them was the use of letters understood; and of course the ancient opinions of the natives relating to the origin of the universe, the changes which succeeded, and every other monument of antiquity, were obliterated and lost. Clavigero has indeed enumerated a crowd of sanguinary gods worshipped by the Mexicans; but he produces nothing either entertaining or interesting with respect to their mythology. Humboldt has gone deeper into the subject, and produced much information that is equally curious and instructive; whilst subsequent travellers, following his example, and extending their inquiries and researches, have thrown new light on both the mythology and antiquities of Mexico. See Mexico.

The only remarkable piece of mythology in the annals of the Peruvians, is the pretended extraction of Manco Capac the first Inca of Peru, and of Mama Ocolla his consort. These two illustrious personages appeared first on the banks of the lake Titicaca. They were persons of a majestic stature, and were clothed in decent garments. They declared themselves to be the children of the Sun, sent by their beneficent parent, who beheld with pity the miseries of the human race, to instruct and to reclaim them. Thus we find that these two legislators availed themselves of a pretence which had often been employed in more civilized regions for the very same purposes. The idolatry of Peru was gentle and beneficent, that of Mexico gloomy and sanguinary. The principle of good predominated in the one, the principle of evil in the other. The former borrowed its complexion from the character of its founders; the latter assumed the dark and repulsive aspect of the tyranny which it was intended to cement and consolidate. In a word, the idolatry of Mexico stood to the idolatry of Peru in a relation somewhat analogous to that which the wild and savage superstitions of the northern nations bore to the more refined and graceful mythology of Greece and of Rome.

In the course of this article, we have not much enlarged upon the mythology of the Greeks and Romans; that subject we conceive to be so universally known by the learn-

ed, and so little valued by others, that a minute discussion of it would be altogether superfluous. We flatter ourselves, however, that in the course of this disquisition we have thrown out some reflections and observations which may perhaps prove more acceptable to both descriptions of readers, and serve to direct their attention to a subject which is yet far from being exhausted. (D. D.)

(For further information on this subject, the reader may consult—K. O. Müller, *Introduction to a Scientific Mythology*, translated by Leitch, 1844; Keightley, *Mythology of Ancient Greece and Italy*, 3d edit., 1854; Kavanagh, *Myths traced to their Primary Source through Language*, 1856; M. Müller, *Essay on Comparative Mythology*, in Oxford Essays, 1856; Voss, *Mythologische Briefe*, 1794; Hermann, *Über das Wesen und die Behandlung der Mythologie*; Buttmann, *Mythologus*; Volcker, *Mythol. des Japetischen Geschlechts*; Lobeck, *Aglaophamus*; Schelling, *Vorlesungen über Mythologie*; Bohlen, *Das alte Indien*; V. Kennedy, *Researches into the Nature and Affinity of Ancient and Hindu Mythology*, 1831; Polier, *Mythologie des Indous*, 1809; Hardy, *Manual of Buddhism*; Shortland, *Superstitions of New Zealanders*; Sir G. Grey, *Polynesian Mythology*; Colebrooke in the *Asiatic Researches*; Prichard, *Analysis of Egyptian Mythology*, 1819; Bunsen, *Egypt's Place in Universal History*, vol. i.; Wilkinson, *Manners and Customs of Ancient Egyptians*, 1837 and 1841; Magnusen, *Den Aeldre Edda*; Petersen's *Asalære and Nordisk Mythologi*, 1849; Thorpe, *Northern Mythology*, 3 vols., 1851; Grimm, *Deutsche Mythologie*; and K. O. Muller, *Prolegomena zu einer Wissenschaftlichen Mythologie*, Gött. 1825, translated by Leitch, Lond. 1844.)

MYTILENE, or MITYLENE (*Castro*), the most important city in Lesbos, was built on the E. coast of the island, on the neck of a peninsula. Its two excellent harbours, one on the N. and the other on the S. of the city, and its proximity to the mainland, rendered it at an early period the centre of the commerce and influence of the island. It is seen taking the lead in military enterprises as early as 606 B.C.; and its history soon becomes in general the history of Lesbos. The Mytilenæans were engaged in some of the greatest wars of antiquity. They furnished a contingent of sixty ships to Xerxes in his invasion of Greece, and they supported first the one side and then the other in the Peloponnesian war. On account of their share in this latter struggle their walls were thrown down, and their territory was occupied by the Athenians. The next important event in the history of Mytilene was its zealous espousal of the cause of Alexander the Great, a policy which brought upon it the attack of the Persians, under Memnon, in 333 B.C., and would have led to its capture, had not the hostile general died on the eve of victory. Still more unfortunate was its adherence to the cause of Mithridates. After a long siege it was taken and sacked by the Romans. Mytilene continued to flourish both during and after the dominancy of Rome. In the middle ages, so thoroughly had it concentrated within itself the wealth and influence of Lesbos, that it gave its name to the entire island. It retains part of its prosperity at the present day. (See LESBOS.)

MYUS, an Ionian town, situated in Caria, on the S. bank of the River Mæander, about 30 stadia from its mouth. It was founded, according to Strabo, by Cydrelus, a natural son of Codrus; and in the days of that geographer its population, already very much lessened, had become incorporated with that of Miletus, and ceased to exist as a distinct political corporation. This desertion of their native town, on the part of the Myusians, is ascribed by Pausanias to the extraordinary number of flies which infested it, and which rendered the life of the inhabitants intolerable. Some think, however, that their removal was more probably owing to the numerous inundations to which, according to Vitruvius, their town was exposed. The King of Persia bestowed Myus, among other towns, upon Themistocles; and Philip of Macedon, after having made it his own, gave it to the Magnesians. We learn from Pausanias that this town possessed a beautiful temple, built of white marble, dedicated to Dionysus. Few traces of Myus now remain; and from the amount of debris annually carried down by the waters of the Mæander, and deposited at its mouth, the original distance of this ancient town from the sea has become very much increased; so that modern travellers have not unfrequently mistaken its site for that of Miletus, and erroneously identified Heracleia with Myus. (See Leake's *Asia Minor*; Fellows' *Journal of a Tour in Asia Minor*; and Smith's *Dictionary of Greek and Roman Geography*.)

MZENSK, a town of Russia, in the government of Orel, is situated at the confluence of the Mzena and the Zoucha, 35 miles N.N.E. of Orel. It is pretty well built, but principally of wood; and has twelve churches and two convents. There is a considerable trade here in corn and hemp, which are grown in the neighbourhood. Pop. (1851) 12,775.

N.

N is the fourteenth letter of the English alphabet, and a liquid consonant formed by placing the tongue against the line of junction between the upper teeth and the palate, and causing the sound to pass mainly through the nasal passage. It is consequently a nasal letter, and an imperfect mute or semi-vowel. N has only one sound, and is almost silent after *m*, as in *hymn*. It is liable to interchange with *l*, *m*, and *s*, of which there are numerous examples in various languages. By the ancients N was used as a numeral, to signify 900; and with a dash over it ($\bar{N}$), it represented 9000. (For the use of this letter in ancient and modern abbreviations, see ABBREVIATIONS.)

NAAS, a town of Ireland, county of Kildare, 18 miles S.W. of Dublin. It consists of a main street and several smaller ones, and is not very well built. It has a parish church, a Roman Catholic, and an Independent chapel; a market-house, court-house, prison, barracks, hospital, dispensary, and several schools. Some remains are still to be seen of an ancient palace, which was the residence of the kings of Leinster, and in the neighbourhood there is a mount, or *rath*, of Danish origin. The name of the town, which signifies "The Place of Elders," has arisen from the circumstance that the states of Leinster used to meet here in the sixth, seventh, and eighth centuries. Naas is inferior in prosperity to many other towns in Ireland not so advantageously situated, and has been for some time in a declining state. A small trade is carried on in grain, provisions, and poultry. The county assizes are held here in spring, and at Athy in summer. Pop. (1851) 2971.

NABIS, a Spartan tyrant, usurped the supreme power in Lacedæmon on the death of Machanidas, at the battle of Mantineia, in 207 B.C. His government was established on a system of unbridled cruelty and rapacity. The most influential citizens were put to death or were driven into exile; temples were plundered; and the wealthy were subjected to exorbitant taxes. If they refused to pay, they were summoned before the tyrant. If their obstinacy still continued, a new engine of torture, made in the form of a woman, and having its breast and arms bristling with spikes, was forthwith produced. "Perhaps," said Nabis, "my wife Apega will be able to persuade you." They were then subjected to the horrid embrace of this automaton, and were tortured into compliance. With the money extorted in this manner the tyrant hired the services of all the vagabonds, ruffians, and cut-throats of the country. Some of these were sent to prowl and plunder throughout all parts of the Peloponnesus; others were employed to dog the footsteps of any dangerous Spartan exile, and to murder him as he fled along the way, or sat in fancied security in some friendly city; the rest were organized into a formidable mercenary army for the support and extension of the tyrant's power.

After this ruthless despotism had awed Sparta into submission, Nabis began to turn his thoughts to foreign conquest. His great project was to regain the Lacedæmonian ascendancy in the Peloponnesus. He began his attempt by invading the territories of Megalopolis, and by then seizing upon Messene. The skilful strategy of Philopœmen, the leader of the forces of the Achæan League, drove him back within his own domains in 201 B.C.; yet in the following year his army was again in the field, and was laying close siege to Megalopolis. About the same time he was pretending to favour the cause of Philip of Macedon against the Romans, that he might obtain possession of Argos. In 198 B.C. he attained his object, and then immediately struck a treaty with the Roman general Flamininus. This detected time-serving, however, did not prepossess his new allies in his favour, and they seized the earliest opportunity to break the truce. In 195 B.C., the year after peace had been concluded between Rome and Philip of Macedon, Nabis received intelligence that Flamininus was marching against him. The most decisive measures for resistance were forthwith taken. To secure the fidelity of his troops, eighty suspected persons were put to death for the sake of example. The defences of Sparta were greatly strengthened; yet after the Lacedæmonians had been twice defeated under their own walls, their capital was forced to capitulate. A treaty was ratified, which deprived Nabis of the fruits of his deceit and aggression, and imposed upon him other severe penalties. The Romans, however, had not long departed from Greece when Nabis broke the truce, and marching southward, laid siege to Gythium. A fleet under Philopœmen, the general of the Achæan League, attempted to relieve the town. With a few ships, hastily collected, he completely frustrated the attempt, and compelled the enemy to retreat. The town was soon afterwards taken. Then hastening northward by forced marches, he succeeded in surprising Philopœmen, who was advancing upon Sparta. But the able Achæan general, instantaneously retrieving the surprise, outwitted his foe in return, cut his army to pieces, and ravaged the country unopposed during the ensuing month. For some time Nabis lay at Sparta, too weak to take the field again. At length, in 192 B.C., he received some Ætolians as a pretended reinforcement. They had come, however, in reality to effect his ruin; and he was assassinated by their leader Alexamenus. The ultimate consequences of his death were, that the Ætolians were massacred in their turn, and Sparta joined the Achæan League.

NABLOOS, or NABULUS, a town of Palestine, in the pashalic of Acre, beautifully situated at the N.E. foot of Mount Gerizim, 30 miles N. of Jerusalem. It is a long and narrow town, with two main streets; and the houses are high and well built of stone. Almost the whole of the streets have a busy and lively appearance; and along one of them runs a stream of clear water. The town contains the remains of an old church in the Byzantine style, with a fine gateway. There are also several mosques and bazaars, the latter of which are well supplied with silk and cloth from Aleppo, Baghdad, and Damascus. Some trade is carried on by means of the caravans which pass this way. Soap and cotton cloth are manufactured here. Nabloos is believed to occupy the site of the ancient Shechem, and derives its name from *Neapolis*, the title given to it when restored by the Romans in the time of Vespasian. There are some ruins on Mount Ebal, a short distance to the N.; and the tombs of Joseph and Joshua, as well as Jacob's well, are to be seen there. Pop. estimated at 8000.

NABONASSAR, first king of the Chaldæans or Babylonians, whose name marks an era commencing 26th February 747 B.C. (See CHRONOLOGY.)

NACHITSHEVAN, a town of European Russia, government of Ekaterinoslav, on the right bank of the Don, 7 miles E.N.E. of Rostov. The houses are well built, and the streets are broad, straight, and clean. It is the seat of an Armenian archbishop, and contains three churches, a convent, an Armenian school, and a printing-office. There is also a bazaar, which is well stocked with Indian and Persian goods. Manufactures of silk, cotton, leather, soap, brandy, and other articles, are carried on here, and there is an active trade, which is chiefly in the hands of Armenian merchants. Goods are brought from Turkey to supply the fairs of all the neighbouring provinces, and commercial intercourse is also carried on with Turkestan. Pearls and

precious stones are the most profitable articles of commerce here. The town was founded in 1780 by Catherine II., and is almost exclusively peopled by Armenians. Pop. (1851) 14,160.

NACHITSHEVAN, a town of Asiatic Russia, in the province of Erivan, occupies a lofty plain, near the Aras, 175 miles S. of Tiflis, and 64 S.E. of Erivan. It has three churches and a town-house; carries on the manufacture of leather and of earthenware; and is also a place of some trade. It was formerly the chief town in Armenia, but has recently much declined, and seems to have been much injured by the earthquake which took place in 1840. Pop. (1851) 5157.

NADIR SHAH. See PERSIA.

NÆVIUS, CNEIUS, one of the earliest of Roman poets, is generally supposed to have been a native of Campania, and to have been born in the former half of the third century B.C. He served in the first Punic war, and was thus an eye-witness of those exploits which he afterwards described. On his return to Rome, his literary career was commenced by the production of a drama, in the style introduced a few years before by Livius Andronicus. He continued to write many plays, both tragic and comic, which are known to us only by their titles, and by some of their fragments quoted in other authors. Several of his comedies, if we may judge from their names, seem to have been adapted from the Greek. It is certain, at least, that they lampooned the Roman aristocracy after the bold, sarcastic manner of the early comic poets of Greece. A fragment preserved by Gellius commences with a grandiloquent eulogy on the great deeds and matchless renown of the elder Africanus, and ends suddenly with a low scandal about his incontinence. In another quotation, the Metelli are declared to have been elected consuls merely by the evil genius of Rome. This latter cut was retaliated by the Metelli. They arraigned Nævius for the capital offence of libel. Barely escaping with his life, he was thrown into prison. There he was suffered to lie until he had written two plays for the purpose of retracting the imputations of which he had been convicted. His satirical spirit, however, was not tamed. Soon after his release he was caught in his old offence, and was sentenced to exile. He repaired to Utica, and there he spent the close of his life in composing his epic on the first Punic war. His death took place, according to Cicero, in 204 B.C. (*Tusc. Quest.* i., c. 1.)

The poetry of Nævius was still popular in the Augustan age. His humour is praised by Cicero in the *De Oratore*. So highly esteemed was the *Bellum Punicum*, written though it was in the antiquated Saturnian metre, that Virgil is said to have borrowed from it the description of the storm, and the conversation between Jupiter and Venus, in the first book of the *Æneid*. Horace also, in his second epode, talks of Nævius, who, "though not in the hands, is still in the minds of men." The fragments of Nævius were published among the *Fragmenta Poetarum Latinorum*, 8vo, Paris, 1564. They were also published separately by Klussmann, 8vo, Jena, 1843.

NAGASAKI, or NANGASAKI, a seaport-town of Japan, in the island of Kiu-siu, is situated on a peninsula formed by the Bay of Ohomura, on the west coast of the island; N. Lat. 32. 43., E. Long. 129. 51. It is built with considerable regularity on the slope of a hill, and the streets are broad and clean. The houses, which seldom exceed one storey in height, are constructed of a mixture of clay and straw on a framework of wood; and are covered with a cement that has the appearance of stone. The place of glass is supplied in the windows by strong oiled paper. Most of the better sort of houses have a large portico in front, and the back part of the house, where the family live, projects in a triangular form into a garden. The gardens, which are attached to all the houses of Nagasaki, are generally laid out in a picturesque style, with rocks, trees, and waterfalls. In most of them there is also a small chapel. The slight materials of which the houses are built render them very liable to fires, which are frequently very destructive to the town. In order to provide against these, there is generally a detached storehouse, all the wood-work of which is thickly covered with clay, and there is also kept at hand a large vessel of liquid mud with which to besmear the walls in cases of danger. In these storehouses the inhabitants keep their most valuable property. The principal buildings in Nagasaki are,—the palaces of the princes of the empire and of the government officials; the numerous *ya siros*, or temples, in the town and neighbourhood; theatres; and tea-houses. The temples are surrounded with pleasure-grounds, which are much resorted to; and attached to them are large apartments, used for the accommodation of travellers or for banquets, and let out for such purposes by the priests. The Chinese factory stands in the southern suburb, and that of the Dutch in the island of Dezima, which is connected with the land by a bridge of stone. To this island, not more than 200 yards in length and 80 in breadth, the Dutch were for a long time strictly confined, and were not allowed to erect anything more substantial than wood and bamboo buildings on it. Beyond it they might not go, except with the permission of the governor of the town, to whom they must give twenty-four hours' previous notice; and when leave was obtained, each man was attended by a large number of official spies, all of whom had to be entertained at his expense. These restrictions, however, have been modified by the treaty concluded between the Dutch and the Japanese, 9th November 1855, which allows the Dutch full liberty to leave the island of Dezima. Nagasaki is now also open to the English, Americans, and Russians. The harbour affords good anchorage, and is deep, safe, and well sheltered. It is about 7 miles in length, by 1 in breadth, and has a depth of 5 or 6 fathoms. The estimates of the population vary considerably, but it is probably about 70,000.

NAGPORE, in Hindustan, a large town of the Deccan, and the principal place of the British province of the same name. It is about 7 miles in circumference, but very straggling and irregular, and possesses but one good street, the others being mean and narrow. The greater part of the houses are built of mud, some being thatched, and others tiled; but there are a few of large size built of brick and mortar, with flat-terraced roofs. Throughout the town there is no specimen of fine architecture; and even the palace of the former rajahs, which is the most considerable building, is totally devoid of symmetry or beauty. According to the last census the dwellings were,—thatched huts, 14,680; tiled houses, 11,120; houses of brick and mortar, 1301; making a total of 27,101, inhabited by a population amounting to 111,231, of whom about 2½ per cent. were Mohammedans, and the rest Hindus. The town is distant from Bombay, N.E., 440 miles; from Calcutta, W., 605; Lat. 21. 10., Long. 79. 10.

The British province, of which this town is the chief place, is bounded on the N. by the Saugor and Nerbudda territory, on the E. by the British districts of Sumbulpore and Odeipoor, and on the S.W. and W. by Hyderabad, or the territories of the Nizam. It lies between Lat. 17. 50. and 23. 5., Long. 78. 3. and 83. 10.; and contains an area of 76,432 square miles, with a population of 4,650,000. The principal rivers are,—the Wyne Gunga, the Mahanuddee, the Wurda, the Kanhan, and the Sew.

The rajahs of Nagpore, now an extinct dynasty, were the rulers of a state which was a branch of the great Mahratta confederacy and the heritage of a family distinguished by the appellation of Bhoonsla. Its founder was Parsojee, originally a private soldier, but who rose to power through the gratitude of Rajah Saho, the son of Sevajee, whose

standard he was the first to join, when that chief was liberated from the captivity in which he had been held by the Emperor of Delhi. Ragojee, one of the successors of Parsojee, united his forces in 1803 with those of Scindia in the war against the British consequent on the treaty of Bassein. The victories of Assaye and Argaum compelled him to sue for peace, and by a treaty concluded in 1804 he surrendered the province of Cuttack. Upon the death of Ragojee in 1816, the reins of government were assumed by his cousin, the notorious Appa Sahib. This prince concluded a treaty with the British government, but shortly afterwards he entered into intrigues with the Peishwa, with whom the British were then at war, and on the 26th November 1817 he consummated his treachery by an open attack on the British troops at Seetabuldee, an eminence on the outskirts of the town of Nagpore. The disproportion of numbers was great, a British force of 1400 strong being opposed to a body of native troops amounting to 20,000; but the best dispositions which the suddenness of the attack allowed were promptly made. A noble charge, headed by Captain Fitzgerald with a small party of cavalry, upon a large body of the enemy's horse, decided the fortune of the day. The British resident, Mr Jenkins, was on the ground throughout the day. His first assistant, Mr Sotheby, also repaired to the scene of action, and was there killed. After a contest of eighteen hours, the conflict terminated in favour of the British. Appa Sahib subsequently entered into fresh hostilities, and was ultimately deposed. The vacant throne was supplied by the elevation of a youth descended from Ragojee. The latest engagement made with this prince was in 1829. He died on the 11th December 1853 without issue. The succession in the Bhoonsla family was hereditary in the entire male line from the first founder of the dynasty, to the exclusion of females. There was no one who could pretend to this qualification, and Nagpore was consequently incorporated with the territories of the East India Company, and now forms a constituent part of the British dominions.

NAGY, a word, signifying in the Hungarian language "great," prefixed to the names of several places in Hungary and Transylvania.

Nagy-Banya, a town of Hungary, in the county of Szathmar, 28 miles E.S.E. of the town of that name. In the neighbourhood there are gold, silver, and lead mines; and the town contains a mint, a mint inspector's office, and a chief office for mining. Nagy-Banya has also manufactories of earthenware, linen and cotton factories, smelting furnaces; and an active trade in litharge, chestnuts, &c. Pop. 5300.

Nagy-Becskerek, a market-town of Hungary, in the county of Torontal, 40 miles S.W. of Temesvar. It contains the ruins of an ancient castle, has a Protestant grammar school, and silk-mills; and trades to some extent in agricultural produce. Pop. 15,500.

Nagy-Enyed, *Egidstadt*, or *Strassburg*, a market-town of Transylvania, not far from the Maros. It is the seat of a superintendent and consistory of the Reformed Church, and contains a college, with a library and museum. The manufacture of paper and the cultivation of the vine are carried on here. Pop. 5500.

Nagy-Karoly, a town of Hungary, in the county of Szathmar, 44 miles N.E. of Grosswardein. It has a large palace and gardens belonging to the dukes of Karoly, a college, school, and linen and cotton factories. Vines, maize, and tobacco are grown in the vicinity. Pop. 12,000.

Nagy-Körös, a town of Hungary, in the county of Pesth, is situated in a sandy country, 40 miles S.E. of Pesth. It contains a school. Horned cattle and sheep are raised, and the vine cultivated, in the neighbourhood. Pop. 19,000.

Nagy-Szeben. See Hermannstadt.

Nagy-Varad. See Grosswardein.

NAIADS. See Nymphs.

NAIGEON, Jacques André, a French encyclopædist, was born at Paris in 1738. After acquiring some knowledge of philosophy and of the exact sciences, he was introduced into the famous society of atheists and deists that gathered round Diderot and Baron d'Holbach. Henceforth Naigeon was the aping pupil and devoted worshipper of Diderot. He spoke and wrote nothing which he had not received in responses from the mouth of his oracle. He even assumed the gestures and voice of his great model. This slavish disposition prevented his common-place intellect from rising above the offices of editor, translator, and compiler. Besides his editions of Fontaine, Racine, and Montaigne, and other standard works, he published the works of Diderot, accompanied with an indifferent and unsatisfactory memoir of that author. He also edited many philosophical rhapsodies which their writers themselves, through very shame, had not avowed. His encyclopedic contributions, the chief of which is his "Dictionary of Philosophy, Ancient and Modern," in the *Encyclopédie Méthodique*, scarcely deserve to be called anything else than compilations. Naigeon died at Paris in 1810.

NAILS. Iron nails may be *wrought*, *cast*, or *cut*. Wrought nails may be forged from iron rods, which are now often prepared from plates rolled for the purpose, by slitting them into *nail-rods*, or *split-rods* of various sizes and qualities, by means of splitting rollers. For *horse-shoe nails* the best refined iron is used, to allow them to be drawn out fine, and not break in the hoof; *wheel-wrights' nails* and *hurdle-nails* require to be made of a tough fibrous iron. Nails are variously named according to their shapes, or the uses to which they are applied. There are upwards of three hundred varieties of nails, and at least ten different sizes for each variety. A few of the principal forms are as follows:—1. *Rose-sharp*, a kind much used for coopering, fencing, and other coarse purposes in hard wood. A thinner sort, called *fine rose*, is used for softer woods, the broad spreading heads serving to hold the work down. 2. The *rose* with *flat* or *chisel* points, which being driven with their edges across the grain, prevent splitting. 3. *Clasp-nails*, where the heads projecting downwards clasp the fibres. 4. *Clout-nails*, with flat circular heads, round shanks, and sharp points, are used for nailing iron-work, &c., to wood. 5. The *counter-clout* is counter-sunk under the head, and has a chisel point. It is used by wheel-wrights and smiths. 6. *Fine-dog*, and *strong* or *weighty dog nails*, are used for nailing down stout iron-work, &c.; they have round shanks and spear-points. 7. The *Kent-hurdle*, used for nailing and clenching hurdles; *gate-nails* are similar in form. 8. *Rose-clench*, much used in ship and boat building; they have square ends, so as to punch out their own holes, and the ends are *clenched* by hammering, sometimes with the addition of a small diamond-shaped metal plate called a *rove*. 9. *Horse-nails*, with counter-sunk heads, so that they may lie flush in the groove made for them in the horse-shoe. 10. *Brads* and *tacks* also form useful and numerous varieties of nails. Nails of cast-iron are brittle, but very cheap, and are adapted to such purposes as fixing the lathing of plasterers, nailing up trees to garden walls, nailing stout shoes, boots, &c. Immense quantities of nails are also made by cutting and punching. (C. T.)

NAIRN, a parliamentary and municipal burgh of Scotland, capital of the county of the same name, is situated on the left bank of the River Nairn, near its mouth, and 16 miles N.E. of Inverness. It contains a town-house and jail, and possesses a harbour adapted for fishing-boats and small vessels. The first charter of the burgh now extant is one granted by James VI., bearing to be a renewal of a charter by Alexander I. Nairn is governed by a provost and 17 councillors. By railway it is connected with Inverness, and the line between it and Aberdeen is now

Nairnshire.

all but completed. Markets on Tuesday and Friday. Pop. (1851), parliamentary burgh, 2977; municipal burgh, 3401.

NAIRNSHIRE, a small maritime county of Scotland, on the Moray Firth, which bounds it on the N., while on the other sides it has the counties of Inverness and Moray. It is 18 miles in length by 10 miles in breadth, and contains an area of 137,500 acres. The coast, which is about 9 miles in length, is low, bare, and sandy, and is rendered dangerous in its approaches by the numerous sand-banks. Sand-hills occupy the greater part of the coast district, and extend into Morayshire. A short distance from the shore, however, a bluff terrace-bank rises to the height of 90 feet, from which the country stretches in an undulating plain to a chain of hills from 4 to 5 miles inward. This level district consists of a great deposit of sand and gravel, rendering the soil light and porous. The hills in the interior, which attain a height of 1500 feet at the frontiers of Inverness-shire, are skirted where they border this plain by a strip of Devonian associated with a coarse conglomerate formation. The mountains themselves, however, are composed of granite and gray gneiss, with occasional beds of bluish granular limestone. The only important rivers in the county are the Nairn and Findhorn, neither of which are navigable. Rising from the Strathnairn Hills in Inverness-shire, the former enters the county at Clava, and discharges itself into the Firth at Nairn, after a course of about 30 miles. The Findhorn traverses the southern part of the county, and enters Morayshire at Dunduff. Agriculture was formerly in a very backward state here, but for the last ten years it has been making good progress. Like the neighbouring county of Morayshire, its arable land is restricted to the level country near the sea-shore; while the highlands of the interior are devoted to pasturage. The breeds of cattle and sheep, and the modes of tillage here adopted, are much the same as those of the adjacent county. Arable farms average 70 acres in extent; and the number of occupants of such were 426 in 1857. In the same year there were 30,311 acres under tillage in Nairnshire, of which 7346 acres were under oats, 4678 turnips, 3182 barley, 2062 wheat, 1407 potatoes, and 10,810 acres of grass and hay under rotation. The number of live stock in the same year were,—sheep, 35,985; cattle, 8965; horses, 1932; and swine, 1420. The old valued rent of the county was L.1263, while that of 1856 was L.23,960. Nairnshire having no good harbours, has not the same advantages of communication by sea as the neighbouring counties. The Great North of Scotland Railway, however, traverses the northern portion of the county, and connects it with Inverness on the one hand, and Aberdeen and the south on the other. The county unites with Morayshire in returning a member to Parliament. It belongs to the northern circuit, and the assizes are held in Aberdeen; while, ecclesiastically, the county pertains to the synod of Nairn. In 1851 there were 10 places of worship in Nairnshire, 3 of which belonged to the Established, 4 to the Free, 2 to the United Presbyterian, and 1 to the Independent denominations. Education in the same year was communicated in 21 schools, 7 of which were private seminaries. The number of poor who received relief in the year ending 14th May 1856 amounted to 315, and the sum collected for this purpose was L.1710, against L.1801 expended. The population of Nairnshire was, in 1831, 9854; in 1841, 9217; and in 1851, 9956; of which last 4695 were males, and 5261 females. It contained only one town, Nairn, the capital, with more than 2000 inhabitants. This county, which anciently belonged to the province of Moray, contains a few remains of antiquity. Among these are Finlay and Rait castles, in the parish of Nairn; and the celebrated Cawdor Castle which is still entire, and is one of the seats of the Earl of that name.

Namaqua Land | Namur.

NAMAQUA LAND forms the western portion of the country of the Hottentots in South Africa, and is divided into Great and Little Namaqua Land; the former lying to the N., the latter to the S. of Orange River.

NAMUR, a province of Belgium, is bounded on the N. by South Brabant, E. by Liège and Luxemburg, S. by France, and W. by Hainault. Its length from N. to S. is 55 miles, greatest breadth 45; area 1409 square miles. The surface of the province is much varied by hill and dale, and in some parts, especially in the valley of the Meuse, between Namur and Liège, the scenery is extremely beautiful and romantic. The principal rivers are the Meuse, and its tributary the Sambre, which joins it at Namur; the former flowing from the S., and the latter from the E. In a geological view, nearly the whole of this country belongs to the Carboniferous system, and contains strata of limestone, sandstone, coal, and iron. The iron mines of Namur are very rich, and employ a large proportion of the industry of the province. There were in 1855, 25 coal-pits in this province, producing coal to the value of L.74,000. Lead mines are also worked to some extent; and building-stone, slate, and marble are quarried. The soil for the most part consists of a rich marl of no great depth. It is very fertile, and well cultivated; about one-half of the whole extent being under cultivation, and one-third occupied by wood. Wheat, rye, oats, barley, fruits, hemp, flax, and chicory are the principal crops raised in some parts; vines are also grown. Oak, beech, ash, hornbeam, birch, and hazel, are the principal trees in the forests; and these supply excellent timber, and wood for fuel. The forests of the province abound in game, and the rivers in fish. Large numbers of horses are reared, which are strong and of good breed. The principal manufacture of Namur is cutlery, for which the province is famed; and trade is actively carried on. The province is divided into three arrondissements,—namely, Dinant, Namur, and Philippeville; and had in 1856 a population of 286,075.

NAMUR (Flem. *Naemen*, Germ. *Namen*), a town of Belgium, capital of the province of that name, is situated at the confluence of the Meuse and the Sambre, 35 miles S.E. of Brussels. Defended by walls of considerable thickness, by well-constructed outworks on both sides of the rivers, and by a castle which stands on a rocky eminence at their junction, it is a place of great strength. The streets are broad and clean, and there are several fine squares. The houses are well built of stone, and covered with slates. There are two bridges, one across each river; and the town is entered by 11 gates. The cathedral of Namur is a fine modern building in the Corinthian style, adorned in front with several statues in white marble. In the interior the most remarkable objects are the statues of St Peter and St Paul, on each side of the great altar; and the pulpit, which is adorned with very fine carving in oak. This church contains the tomb of Don John of Austria, natural son of Charles V., and famous as the conqueror of the Turks at the battle of Lepanto. The church of St Loup is also a fine building, richly adorned in the interior with marble and carving in stone. Namur contains several other churches, a town-hall, several schools, an athenæum, an academy of painting, and a public library; a deaf-and-dumb asylum, and other charitable institutions; a penitentiary, arsenal, barracks, &c. The manufactures are considerable, and of these, cutlery is the principal; so that the town has been called the Sheffield of Belgium. Its productions in this branch of industry are more nearly equal in quality to those of Sheffield than those of any other town on the Continent. The manufacture of leather is also largely carried on; and a great number of the inhabitants are employed in the mines and quarries of the neighbourhood. The situation of Namur gives it great commercial advantages; and a consider-

able export trade is carried on. Steamers ply on the Meuse as far up as Liège, with which town Namur is also connected by railway, as well as with Brussels and Paris. Namur has suffered much from the ravages of war. It was taken by Louis XIV. in 1692, an event which was recorded by Racine, and celebrated in verse by Boileau; but was recovered in 1695 by the British and Dutch under William III., after a siege of ten months. The fortifications were destroyed in 1784 by Joseph II. of Austria; but restored and strengthened in 1817 under the inspection of the Duke of Wellington. Pop. 22,218.

NANCOWRY, one of the Nicobar Islands, in the Bay of Bengal, N. Lat. 7. 57., E. Long. 93. 43. The soil is rich, and produces cocoa-nuts, plantains, limes, bread-fruit, tamarinds, and other tropical fruits. The inhabitants exchange poultry for cloth, cutlery, tobacco, and other articles. There is a large and good roadstead between this island and those of Camorta and Trincutty. The island is about 25 miles in circumference.

NANCY, a town of France, capital of the department of Meurthe, is situated in a beautiful and fertile plain, bounded by wooded hills, on the left bank of the Meurthe, 177 miles E. of Paris. It is one of the finest towns of France, not only on account of the beauty of its environs, but for its fine public walks and splendid buildings. It consists of an old and a new town; the former of which is irregularly built, with narrow and gloomy streets, although it contains some fine private houses and most of the public buildings. The new town consists of wide and regular streets, lined with handsome houses. There are several fine squares, of which the principal is the Place Royale, bordered on three sides by the town-hall, the episcopal palace, the theatre, and the custom-house. This square is adorned with four elegant fountains at the corners; and has in the centre a statue of Stanislas Leszczynski, King of Poland and Duke of Lorraine, to whom the town owes many of its improvements and embellishments, and among the rest a very fine triumphal arch which leads from this square to the Place Carrière. Besides these, the Place d'Alliance, which has a beautiful fountain and a fine avenue of limes, and the Place St Epore, are worthy of mention. The principal public walk in Nancy is the Cours d'Orleans, extending from the Place de Grève to the Porte Neuve, one of the gates of the town, which is built in the form of a triumphal arch. The cathedral of Nancy is a handsome modern edifice in the composite style, with two towers surmounted by domes. The church of St Epore is also a handsome building, and contains some remarkable paintings and sculpture. The church of the Cordeliers contains, among other monuments, the mausoleum of the dukes of Lorraine, a beautiful marble structure of an octagonal form. Near this church are the remains of the palace, which was formerly the residence of the dukes of Lorraine, but is now used as a barrack. Besides the buildings already mentioned, the town contains a university, with a library of 23,000 volumes, a theological college, a school of medicine, an academy, a normal school, an agricultural society, school of design, botanic garden, &c. It is the see of a bishop; and has a court of appeal, a court of first instance and one of commerce, and a council of *prud'hommes*. The manufactures of Nancy are considerable,—consisting of cloth, hosiery, calico, lace, cotton, embroidery, muslin, paper, oil, wines, leather, and chemical substances. There are also dyeworks, and establishments for the refining of saltpetre. A considerable trade is carried on in its articles of manufacture, as well as in corn, wool, hides, iron, &c. Three yearly fairs are held. The origin of this town may be traced as far back as the tenth century. It was formerly the capital of Lorraine, and the residence of the dukes of that country. It was taken by Charles the Bold in 1475; but he lost it the year after, and in 1477 was killed in a battle with René II., Duke of Lorraine, under the walls of Nancy. Pop. (1856) 43,452.

NANGASAKI. See NAGASAKI.

NANI, or NANNI GIOVANNI, an eminent artist, was the son of a wealthy proprietor, and was born at Udine in 1487. From his birthplace he was often called *Da Udine*. He also inherited the surname of *Ricamatore* from his ancestors, who were famous embroiderers. His taste for painting was developed at a very early age. When he was wont to go out hunting or fowling with his father he never tired in sketching the figures of the dogs and the game. This decided bias induced his father to place him under the celebrated painter Giorgione da Castel Franco at Venice. In no long time, however, the young artist had grown so enthusiastic an admirer of Raphael, that he could not rest contented until he had repaired to Rome, and had become a pupil of that great master. His pencil soon began to acquire the soft, graceful, and beautiful manner of his teacher. He became an adept at imitating all natural objects, especially birds, foliage, fruits, and flowers. It was not, however, until the excavations in the palace of Titus had laid bare in the subterranean chambers the grotesque and stucco works of antiquity that Nani found the subject most adapted to his taste and genius. His whole time was forthwith unweariedly spent in studying and imitating these decorations. After many an experiment he succeeded in producing the stucco of the ancients, and in moulding it into copies of the antique which rivalled their originals. This success led Raphael to employ him in decorating the gallery of the Vatican. The ability with which he executed the stucco ornaments, and the ingenuity with which he enriched his decorations with foliage, shells, birds, and landscapes, brought him into great repute. He was employed by Leo X. to adorn, in a similar manner, some other halls and galleries. Then Giulio, the Cardinal de' Medici, taking him under his patronage, conferred upon him the dignity of a knighthood of San Pietro, and sent him to Florence to ornament a gallery in the Medici palace which had been designed by Michael Angelo. On his return to Rome he continued to prosecute his art with great success until the death of Leo X. in 1521. During the short and unpropitious pontificate of Adrian VI. Nani lived at his native Udine. On the accession of Pope Clement VII. in 1523, he was restored to his position in the public favour at Rome. A pension of eighty ducats was conferred upon him, and he was sent to Florence to decorate the new sacristy of San Lorenzo, which was already adorned with the noble sculptures of Michael Angelo. This elaborate undertaking was just on the eve of being completed when Pope Clement died in 1534, and Nani lost the hard-earned reward of his toil. He once more retired in disgust to Udine, and was employed for several years in painting and adorning with stucco-work several chapels and edifices in the neighbourhood. Of these works, the most notable which still exist are the picture of the "Virgin and the Child," on a rich banner belonging to the fraternity of Castello in his native city; and a chamber decorated with stucco-work and paintings, in the palace of the patriarch of Aquileia in Venice. Towards the close of his life he returned to Rome, and received employment from Pius IV. He died at the age of seventy-seven. (Vasari's *Lives of the Painters*, and Lanzi's *History of Painting*.)

NANKING, or KIANGNING FU, the ancient capital of China, now the chief town of the province of Kiangsu, and the residence of the governor-general of three provinces, is situated about three miles from the south bank of the Yang-tse-Kiang, about 100 miles from its mouth. This city was once the most celebrated in the empire, whether regarded as to its extent, its buildings or its manufactures; but since the removal of the imperial residence to Pekin

Nantes.

by Kublai Khan in the end of the thirteenth century, it has very much declined. The walls at present surrounding the town are said to be about 20 miles in extent, but from existing remains those of the ancient town seem to have been about 35 miles in circumference. It is, however, impossible to say how much of the larger space was occupied with buildings; but at present not more than one-half of the area inclosed by the walls is actually occupied by the city. The ancient palaces have almost entirely disappeared, and the only remarkable monuments of royalty that now remain are some sepulchral statues of gigantic size, near an ancient cemetery known as the Tombs of the Kings. At some distance from these statues are a number of rude colossal figures of horses, elephants, and other animals.

Nanking consists of four rather wide and parallel avenues, which are intersected by others of less width, and are on the whole clean, well paved, and lined with handsomely-furnished shops. The town is very unhealthy, being situated in an extensive marshy plain, which, especially in the hot season, gives off noxious vapours. The three gates on the eastern side of the city are approached by three well-paved causeways. That part of the town occupied by the Manchoos is separated from the Chinese town by a high wall. Nanking possesses no public buildings of importance, except the famous porcelain tower, an edifice superior to anything of the kind in the empire. It is of an octagonal form, each side being 15 feet wide; and is about 260 feet in height. Its base rests upon a solid foundation of brick-work, 10 feet high, up which a flight of twelve steps leads into the tower, where there is a spiral staircase leading to the top. The body of the edifice is composed of brick, the outer face of which is covered with slabs of glazed porcelain of various colours, principally green, red, yellow, and white. It consists of nine storeys, decreasing gradually in size to the top, and at each storey is a projecting roof covered with green tiles, with a bell suspended at each corner. Each storey forms a saloon, which is finely painted and gilt, and adorned with numerous gilded images. The whole is covered by a gilt conical roof, and from the summit rises a mast 30 feet in height, surrounded by an immense iron coil, and surmounted by a large gilded ball. This edifice was nineteen years in building, and was completed in A.D. 1430. The entire cost is said to have been about L.800,000.

Nanking has extensive manufactures of fine satin and crape, and of the cotton cloth called, after the city, *nankeen*. Paper and ink of fine quality, and beautiful artificial flowers of pith paper are produced here. The commerce of the city is very considerable, owing to its position near the great River Yang-tse-Kiang. It communicates with Peking by means of the Imperial Canal, which leaves the river about 40 miles below the city. Nanking is not less celebrated for literature than for its manufactures and commerce; and is considered one of the first places of learning in the country. The arts and sciences are studied here with great diligence; and its libraries are extensive and valuable. The booksellers' shops are well stocked with the best native publications, and the editions published here are the most esteemed in the empire. It was here that terms of peace were concluded between the English and Chinese in August 1842. Pop. estimated at about 400,000.

NANTES, an important commercial town of France, the seat of a bishop, and capital of the department of Loire-Inferieure, on the right bank of the Loire, about 30 miles from its mouth, 208 miles S.W. of Paris. N. Lat. 47. 13., and W. Long. 1. 32. It stands partly on the mainland, intersected by the Erdre and Sevre-Nantaise, and partly on three islands formed by the irregular course of the Loire. Thus situated, the town enjoys the advantages of water-communication between its various quarters. The old part of the town occupies the right bank of the river, and is divided into two portions by the Erdre, which forms the outlet of the Nantes and Brest Canal. Many of the houses here are antique and picturesque in appearance, but in the newer parts of the town the houses are generally elegant, and the streets spacious. The quays which line the river are extensive and commodious, and add much to the gay aspect of the town. But the most striking quarter of the city is that occupied by the boulevards of St Peter and St Andrew, and the Place Louis XVI. These, which are ornamented with rows of trees, stretch from the St Felix branch of the Loire to the Erdre, and form a delightful promenade. The islands of Feydeau and Gloirette, connected with the main and with each other by several bridges, are occupied by well built streets, while the latter has a dock and excellent quays. A larger island, in mid stream, is chiefly laid out in parks and private villas, and is also provided with a dock and quays. The chief public edifices are as follows:—St Peter's cathedral, commenced in 1434, is a plain though massive building near the centre of the town, and contains a very fine monument of Duke Francis II. of Brittany, and his spouse Margaret of Foix. This forms an altar tomb of marble, on which the effigies of the duke and duchess are recumbent, supported at each corner by statues of Power, Justice, Temperance, and Prudence. The castle, an old building of the fourteenth century, stands at the extremity of the boulevard of St Peter, close upon the river. It is still entire, is provided with a portcullis, and defended by a ditch. This fortress for long formed an occasional residence for the French kings, and it was here that the famous edict of Nantes was signed in 1598. The other buildings of note are—the gallery of paintings, the public library with 30,000 volumes, the natural history museum, and a new court-house. There is likewise a large new church called St Nicholas, in the Gothic style, which is nearly completed.

Nantes.

From its situation Nantes enjoys a large shipping trade, and ranks in importance as the fourth port in the empire. Manufactures have, from a like cause, much increased here, and comprise cotton yarn, refined sugar, serge, blankets, preserved provisions, &c. The imports include timber, pitch, raw cotton, iron, and coal; while the exports comprise corn and flour, wine, brandy, silk, paper, &c. Shipbuilding is likewise carried on to some extent, while several vessels are fitted out here for the whale and cod fisheries. From the numerous sandbanks which obstruct the Loire, vessels of more than about 300 tons burden must unload at Paimbœuf, 24 miles lower down the stream.

In the year 1855, 278,168 tons entered, and 236,034 tons cleared at the port. Of these numbers 139,518 tons entered, and 121,632 tons cleared, coastwise; while eight vessels with 982 tons entered from, and seven vessels with 1628 tons cleared to, the cod fisheries during the same year. Engaged in foreign commerce in 1855, 1143 vessels with 137,668 tons entered, and 649 vessels with 112,774 tons cleared, at the port. During the same year there were registered at the port 593 sailing vessels, with 87,440 tonnage, and 20 steamers, with 4124 tonnage. The amount and value of various articles imported here in 1855 were 83,100 tons, of the aggregate value of L.1,280,000. With the interior Nantes has abundant means of communication. The Loire is navigable for barges for many miles above the town, while a canal connects it with Brest on the one hand and St Malo on the other. A line of railway likewise brings the town within a few hours' distance of Paris. The city is governed by a civil tribunal, and the trade is regulated by a chamber of commerce.

The history of Nantes reaches back to the time of the Romans, when, under the name of *Condivicnum*, it formed

Nantucket — Nantwich.

the chief town of a Gallic tribe called the Nannetes. It seems to have remained in the hands of the Romans until the beginning of the fifth century, when they were driven from the town. The Normans captured it in 853 and 859, and held possession for nearly a century; after which the town suffered many sieges—in 1343 by the English; in 1380 by the Earl of Buckingham, when it was relieved by Oliver of Clisson; and again in 1491 by Charles VIII. This monarch afterwards espoused Anne of Brittany, with whom he obtained the province, and thereafter Brittany formed part of the French dominions. During the Reformation Nantes escaped the horrors of the great Huguenot massacre by the manly spirit of its chief magistrate, who resolutely refused to execute the bloody order sent him by the Duc de Montpensier. The famous edict of Nantes that followed this event was signed here in 1598 by Henri IV., but was afterwards revoked by Louis XIV. in 1685. More recently, the town suffered much from the Vendean civil war of 1793. In June of that year the Vendean army, 50,000 strong, under Cathelineau, laid siege to the city, then defended by Generals Beysser and Canclaux, but were repulsed with great loss—their general being among the slain. Cartier, one of the leaders of the republicans, about the same time committed the greatest atrocities on the inhabitants, who are said to have suffered during the civil wars a loss of from 6000 to 9000 men, women, and children. Nantes was the birthplace of Anne of Brittany, of the navigators Cassart and Cailland, and of the naturalist Dubuisson. It was from Nantes that Prince Charles Edward embarked for Scotland in 1745. Pop. of Nantes (1851) 91,303; (1856) 101,019.

NANTUCKET, an island off the coast of Massachusetts, N. America, is situated 30 miles S. of the peninsula Cape Cod, and 10 E. of the island of Martha's Vineyard. It is of a triangular shape, 15 miles in length, by 4 in average breadth; area 50 square miles. The surface is level, with the exception of some hills in the southern part. The soil is generally sandy; but affords in some places good pasture. Maize, potatoes, and grass, are the principal crops raised on the island. The inhabitants are employed to a great extent in navigation and fishing, especially in the whale fishery. The town of Nantucket is situated on a bay in the N. coast of the island, in N. Lat. 41. 17., W. Long. 70. 6., and about 105 miles S.E. by S. of Boston. It is compactly built, with narrow streets and wooden houses; and contains 8 or 9 churches, 2 newspaper offices, a bank, and an athenæum with a library and museum attached to it. On the 13th of July 1846, the town was devastated by fire; and no fewer than 350 buildings were destroyed; among which were a church, 2 banks, the athenæum, and 7 oil and candle manufactories. The total loss was estimated at L.40,000; and the number of families who suffered by it was 450. Nantucket was the earliest town in the States to engage in the whale fishery, in which it holds a prominent position, but is still in this respect inferior to New Bedford. The registered tonnage of the port amounted in 1852 to 27,231; of which 18,015 tons were employed in whale fishing, 3048 tons in the coasting trade, 403 in the cod and mackerel fisheries, and 479 in steam navigation. About 2000 men are generally employed in whale fishing, and a capital of L.100,000 or L.120,000. The harbour of Nantucket is large, deep, and well sheltered by two promontories, which leave an entrance only three-quarters of a mile broad. A light-house with a fixed light stands on its south side. A steamer plies between Nantucket and New Bedford. Pop. 8452.

NANTWICH, a market-town of England, county of Chester, in a low, flat country, on the right bank of the Weaver, 17 miles S.E. of Chester. It consists of four principal streets; and the houses are for the most part old, and built of wood or brick. There is a fine church, in the form of a cross, with an octagonal tower and a stone pulpit. Nantwich has also several dissenting churches, almshouses, several banks, a market-house, and a theatre. Salt was formerly the principal article of manufacture here, and was obtained from numerous springs in the neighbourhood; but only one of these is at present worked. The manufactures consist chiefly of cheese, shoes, gloves, and cotton. Some trade is carried on in cheese and other farm produce. A battle was fought at Nantwich in 1643, in which the royalists were defeated by the parliamentary troops under Fairfax. Nantwich was the birthplace of Gerarde, a botanist, in 1545. Pop. (1851) 5426.

Napakiang — Napier.

NAPAKIANG. See Loo Choo.

NAPIER, Sir Charles James, G.C.B., was the eldest son of Colonel George Napier, comptroller of accounts in Ireland, and was born at Whitehall on the 10th August 1782. At an early age he removed with the family to Celbridge, a small town on the Liffey, about ten miles from Dublin, and there he attended school. By this time he held a commission in the 4th regiment, and was longing for an opportunity to wield his warlike weapons. An opportunity occurred during the Irish rebellion of 1798; and the boy-soldier bore himself with all the self-confident courage of a man. For the next ten years the most prominent incidents in his life were the changes which he made from one regiment into another. In 1800 he changed into the Rifle corps; in 1803 he was promoted to the staff of General Fox; and in 1806 he became a major in the 50th regiment. About this time large squadrons of troops were embarking for the French war. The fiery Napier chafed under the order that kept him in ignoble ease at home. At length in 1808 his regiment was ordered to the Peninsula, and he arrived in time to fight under his favourite general Sir John Moore. On the field of Coruña he led the 50th into the thickest of the battle, and was left, covered with wounds, in the hands of the enemy. His friends gave him up for lost, and were already disposing of his effects, when he arrived in England on patrole about two months after his capture. The reports of Wellington's victories soon rekindled his military enthusiasm, and in 1809 hurried him as a volunteer to the scene of war. For the next three years he shared in the perils and triumphs of the peninsular battles. He had two horses shot under him at Coa, and was taken up for dead on the field of Busaco. Promotion, hardly earned and long delayed, came at length in 1812, and drew him once more from active service. He was sent out to the Bermudas as lieutenant-colonel of the 102d regiment. A cruising expedition against America was fitted out in the following year, and Napier was appointed second in command. He was still employed in capturing vessels and making night descents on the coast of the United States, when the long-continued struggle with Napoleon was fast approaching a crisis. His return to Europe was hastened; but he arrived in time to find that the decisive blow had been struck three days before at Waterloo. With all its characteristic ardour his mind was next applied to study; and after an attendance of three years at the Military College he received a first certificate.

In 1825 Napier's talent for administration obtained for the first time a fair field of exercise, by his being appointed governor of the island of Cephalonia. His rule was characterized by an earnest and disinterested philanthropy. More than 100 miles of road were made; spacious streets were erected in the room of narrow dirty lanes; the administration of justice was reformed; and agriculture and commerce were encouraged and stimulated. At the same time, he co-operated with Lord Byron in the plan for the liberation of Greece, and would have accepted the offer of the chief command in that enterprise, had circumstances permitted. His career as a social benefactor was suddenly checked by his recall in 1830. Yet the Cephalonians con-

pletely annulled this implied censure by continuing to call him their father as long as he lived.

Napier had been for about two years commanding the military district of the north of England, and managing to suppress the Chartist demonstrations without bloodshed, when he was appointed commander of the Bombay army in 1841. On arriving at his destination, he found that the British cause was endangered by the recent defeats and disasters in Afghanistan. It therefore became his chief aim to retrieve the national reputation. With this view he drew up a plan for the Afghan campaign, which received the approbation of the newly-appointed governor-general Lord Ellenborough. In 1842 he entered into active service as commander-in-chief in Scinde. This province was then under the military despotism of the Ameers, who, under cover of an ill-defined and ill-understood treaty made with Lord Auckland, the late governor-general, were cruelly oppressing their subjects, and carrying on a cunning system of intrigues against the British power. To define this crude treaty, to elevate the Scindians from their abject slavery, and to bring their tyrants to bay, were now the difficult tasks to which Charles Napier, at the age of sixty, with a constitution shaken by wounds and disease, and under an oppressive climate, addressed himself. The enterprise went rapidly on towards a successful issue. Early in 1843 the Ameers found themselves convicted of perfidy, and forced to the alternative of signing a new treaty or of resorting to open warfare. They chose the latter. Napier was immediately on the field, and was already aiming a sudden and decisive blow. This was the capture of Emaum Ghur, a solitary fortress that stood in the middle of a waste wilderness of drifting sand, and was therefore considered the chief stronghold and ultimate refuge of the Ameers. By a laborious and ably-conducted march the British forces reached the desert castle, found it deserted, and shattered it to atoms with gunpowder. After thus achieving what the Duke of Wellington afterwards called "one of the most curious and extraordinary of all military feats," Napier returned to face the enemy in the field of battle. On the 17th February 1843 he confronted an army of 35,000 at Meeanee. To oppose this overwhelming force he had only 2000 raw soldiers. Yet his bold tactics and fiery courage inspired his men with a resistless valour. After a hard fight of four hours they defeated their foes, and drove them from the field. The Ameers resigned their swords, and the city of Hyderabad capitulated. In a short time, however, the conqueror was surrounded on all sides by hordes of wild Beloochees, and threatened in front by a large army under Shere Mohammed, surnamed "the Lion." Entrenching himself in Hyderabad, he dared his enemies to attack him, until he had contrived to procure a reinforcement. Then marching out at the head of 5000 men, he attacked and routed the 26,000 of "the Lion" at Dubba. "The Lion" retired to his native deserts, and soon returned with another army; but the brave barbarian was no match for the skilful English general. By the 8th June 1843 his force was hemmed in on all sides and forced to fight; his power was completely crushed; and the last blow was struck in the conquest of Scinde. Napier was now appointed governor of the province he had subjugated. Under the prostrating influence of the climate, the attacks of disease, and the more irritating attacks of intriguing malice, the old general began to rule the discordant elements of barbarism with the same fiery vigour and success with which he had swayed the fickle destinies of battle. The native laws were re-organized, an effective system of police was established and all evil customs, such as sutteeship, infanticide, the murder of women, and the military tenure of land, were abolished. The Hindoo trader was protected, the Scindian slave was liberated, and the Beloochee cut-throat was tamed into a peaceful civilian. Commerce, suddenly springing into new life, made her principal seat at Kurachee; and the province, which was little else than a hunting forest for the Ameers, became in a few years a well-cultivated land, waving with rich harvests and enlivened by industrious villages. This work of reform would have been carried out still further had not Sir Charles Napier been compelled by the declining health of his wife to return home in 1847. He had not enjoyed his retirement long when the news of the disasters of the Sikh war reached England. The general voice of the nation called upon Napier to save once more the British honour in India. He was reluctant to expose his reputation again to his enemies in the Indian government. But the Duke of Wellington's laconic argument, "If you don't go, I must," overcame his unwillingness. He embarked in March 1849, and in forty-three days was in Bombay. The war by this time had been successfully ended by Lord Gough; but there were abuses that Napier considered as dangerous enemies as the Sikhs. Applying himself resolutely to the invidious task of reform, he travelled through the country, suppressing a mutinous spirit among the sepoys, and schooling the British officers in a severer discipline. At the end of two years the venerable warrior returned to England, worn out by his life-long and ill-appreciated labours in his country's service. He died on the 29th August 1853 at his seat of Oaklands, near Portsmouth, surrounded by the trophies of his many campaigns.

Sir Charles Napier was the author of *Colonization in Southern Australia*, 8vo; *History of the Colonies—Ionian Islands*, 8vo; *Indian Misgovernment and Lord Dalhousie*, 8vo; *Lights and Shades of Military Life*, 8vo; and *Remarks on Military Law of Flogging*, 8vo. He was brother to the present Sir William Napier, and cousin to the present Admiral Sir Charles Napier. The former has written his Memoirs in 4 vols. 8vo, London, 1857.

NAPIER, *John*, Baron of Merchiston, the distinguished inventor of logarithms, was the eldest son of Sir Archibald Napier of Edinbellie and Merchiston, by his first wife Janet Bothwell, and was born at Merchiston Castle, near Edinburgh, in 1550. After passing through the ordinary courses of liberal study at the university of St Andrews, he travelled in France, Italy, and Germany. Upon his return to his native country, his accomplishments soon rendered him conspicuous, and might have raised him to the highest offices of state; but declining all civil employments, he retired from active life to pursue those scientific and literary researches in which he subsequently made such uncommon progress. He applied himself chiefly to the study of mathematics, and of the Holy Scriptures; and in *A Plain Discovery of the Revelation of St John*, his first publication, he displayed great acuteness and striking ingenuity, but did not succeed in fathoming the mysteries of the Apocalypse. This work was printed abroad in several languages, particularly in French at Rochelle in the year 1602, in a quarto volume, revised by himself. But what has rendered his name for ever illustrious was his discovery of logarithms. That he had begun before the year 1594 the train of inquiry which led to this great achievement, appears evident from a letter to Crugerus, written by Kepler in the year 1624, wherein, mentioning the *Canon Mirificus*, he writes thus:—"Nihil autem supra Nepierianam rationem esse puto; etsi Scotus quidem literis ad Tychonem, anno 1594, scriptis jam spem fecit canonis illius mirifici." This allusion agrees with the idle story mentioned by Wood in his *Athenæ Oxonienses*, and explains it in a way perfectly consonant to the rights of Napier as the inventor.

When Napier had communicated to Henry Briggs, mathematical professor in Gresham College, his wonderful Canon for Logarithms, that learned professor set himself to apply the rules in his *Imitatio Nepierea*; and in a letter

to Archbishop Usher, written in the year 1615, he thus expresses himself:—"Napier, Baron of Merchiston, hath set my head and hands at work with his new and admirable logarithms. I hope to see him this summer, if it please God; for I never saw a book which pleased me better, and made me more wonder." The following passage from the *Life of Lilly* the astrologer gives a picturesque view of the meeting between Briggs and the inventor of the logarithms, at Merchiston, near Edinburgh:—"I will acquaint you," says Lilly, "with one memorable story related unto me by John Marr, an excellent mathematician and geometrician, whom I conceive you remember. He was servant to King James I. and Charles I. When Merchiston first published his logarithms, Mr Briggs, then reader of the astronomy lectures at Gresham College in London, was so much surprised with admiration of them, that he could have no quietness in himself until he had seen that noble person whose only invention they were. He acquaints John Marr therewith, who went into Scotland before Mr Briggs, purposely to be there when these two so learned persons should meet. Mr Briggs appoints a certain day when to meet at Edinburgh; but failing thereof, Merchiston was fearful he would not come. It happened one day as John Marr and the Baron Napier were speaking of Mr Briggs; 'Ah, John,' said Merchiston, 'Mr Briggs will not come.' At the very instant one knocks at the gate: John Marr hasted down, and it proved to be Mr Briggs, to his great contentment. He brings Mr Briggs up to the Baron's chamber, where almost one quarter of an hour was spent, each beholding the other with admiration, before one word was spoken. At last Mr Briggs began:—'Sir, I have undertaken this long journey purposely to see your person, and to know by what engine of wit or ingenuity you came first to think of this most excellent help into astronomy, viz., the logarithms; but, Sir, being by you found out, I wonder nobody else found it out before, when now being known it appears so easy.' He was nobly entertained by the illustrious baron; and every summer after that, during the baron's life, this venerable man, Mr Briggs, went purposely to Scotland to visit him."

There is a passage in the *Life of Tycho Brahe* by Gassendi, which might lead some to suppose that Napier's method had previously been explored by Herwart at Hoenburg. But Herwart's work, published in 1610, solves triangles by prostaphaeresis, a mode totally different from that of logarithms. Kepler, who was ignorant that Napier had been deceased for more than two years, addressed a letter to him, dated 28th of July 1619 (prefixed as a dedication to his *Ephemerides* for the year 1620), in which he expresses his high admiration of the *Canon Mirificus*, and his astonishment and delight on first becoming acquainted with the importance of Napier's great discovery. In the archiepiscopal library of Lambeth the original of a letter still exists, addressed by Baron Napier to Anthony Bacon in 1596, entitled "Secret Inventions necessary in those days for the Defence of this Island, and withstanding Strangers, Enemies to God's Truth and Religion." These inventions consisted of burning mirrors designed to fire the enemies' ships at a distance, by reflecting the sun's rays, or "the beams of any material fire or flame," to a focus. It does not appear that the invention attracted much notice at the time, owing probably to the modesty or humanity of the author, who, in relation to this matter, remarked on his death-bed, that the instruments of human destruction "should never be increased by any new conceit of his."

Baron Napier's last work was his *Rabdology and Promptuary*, published in 1617, and dedicated to the Chancellor Seton. He died at Merchiston on the 4th of April of the same year, in the sixty-eighth year of his age.

Napier was twice married. By his first wife, who was a daughter of Sir James Stirling of Keir, he had only one son, named Archibald. He was appointed a privy councillor by James VI., under whose reign he also held the offices of treasurer-depute, justice-clerk, and senator of the college of justice; and by Charles I. he was raised to the peerage. By his second wife, a daughter of Sir James Chisholm of Cromlix, he had a numerous family of sons and daughters.

We have two Lives of the inventor of logarithms; one by the late Earl of Buchan, with an analysis of Napier's printed works by Dr Walter Minto, published in 1787; the other by Mr Mark Napier, advocate, published in 1834; both in 4to. (For additional information respecting this illustrious mathematician, see LOGARITHMS.) The following is a correct list of his different publications:—

1. A plaine Discouery of the whole Reuelation of Saint Iohn; set downe in two treatises: the one searching and prouing the true interpretation thereof; the other applying the same paraphrastically and historically to the text. Set fourth by Iohn Napeir L. of Marchistoun younger. Edinburgh, printed by Robert Waldegrave, 1593, 4to. In republishing this work in 1611, the author subjoined "A resolution of certaine doubts, mooved by some well-affected brethren." The "fifth edition" was printed at Edinburgh, 1645, 4to. It was translated into French by George Thomson, and printed at Rochelle, 1602, in 4to. On the title, it is said to have been revised by the author himself ("reveue par lui-même"), and was reprinted in 1606, and again in 1607, in 8vo.

2. Mirifici Logarithmorum Canonis Descriptio, ejusque usus, in utraque Trigonometria, ut etiam in omni Logistica Mathematica amplissimi, &c., explicatio. Edinburgi, ex officina Andreae Hart, 1614, 4to.

3. Rabdologiae, seu Numerationis per Virgulas libri duo: cum Appendice de expeditissimo Multiplicationis Promptuario. Quibus accessit et Arithmeticae Localis liber unus. Edinburgi, excudebat Andreas Hart, 1617, 12mo. Reprinted at Lyons in 1626, and again in 1628, 12mo.

4. Mirifici Logarithmorum Canonis Constructio, et eorum ad naturales ipsorum numeros habitudines; una cum Appendice, de alia eaque praestantiore Logarithmorum specie condenda. Quibus accessere Propositiones ad triangula sphaerica faciliore calculo resolvenda, &c. Edinburgi, excudebat Andreas Hart, 1619, 4to. This posthumous work was published by the author's third son, Robert Napier. Some copies of it occur, along with the *Canonis Descriptio*, having a general title-page for both, dated 1619, the original title of 1614 being cancelled. Both works were reprinted at Lyons in 1620, 4to; and the first, followed with copious "Observations," was included in Baron Maseres's large collection, entitled *Scriptores Logarithmici*, vol. vi., London, 1807, 4to.

NAPIER'S RODS, or *Bones*, an instrument invented by Baron Napier, whereby the multiplication and division of large numbers is much facilitated. Suppose the common table of multiplication to be made upon a plate of metal, ivory, or pasteboard, and then conceive the several columns, standing downwards from the digits on the head, to be cut asunder; these are what are called *Napier's Rods of Multiplication*. But then there must be a good number of each; for as many times as any figure is in the multiplicand, so many rods of that species, or with that figure on the top of it, must we have, though six rods of each species will be sufficient for any example in common affairs. There must also be as many rods of 0's. But before we explain the mode of using these rods, there is another thing to be known, namely, that the figures on every rod are written in an order different from that in the table. Thus the little square space or division in which the several products of every column are written is divided into two parts by a line across from the upper angle on the right to the lower on the left; and if the product is a digit, it is set in the lower division; but if it has two places, the first is set in the lower, and the second in the upper division. The spaces on the top are not divided. There is also a rod of digits not divided, which is called the index-rod, and of this we require only one single rod.

Multiplication by Napier's Rods.—First lay down the index-rod; then on the right of it set a rod whose top is the figure in the highest place of the multiplicand; next to this again set the rod whose top is the next figure of the multiplicand, and so on in order to the first figure. Then the multiplicand is tabulated for all the nine digits; for in the same line of squares standing against every figure of the index-rod, we have the product of that figure, and therefore we have no more to do but to transfer the products and sum them. But in taking out these products from the rods, the order in which the figures stand obliges us to employ a very easy and small addition. Thus, begin to take out the figure in the lower part or units place of the square of the first rod on the right, add the figure on the upper part of this rod to that in the lower part of the next, and

so on, which may be done as fast as we can look on them. To make this practice as clear as possible, take the following example:—To multiply 4768 by 385. Having set the rods together for the number 4768 against 5 in the index, we find this number by adding, according to the rule 23840

according to the rule	23840
Against 8, this number	38144
Against 3, this number	14304
Total product	1835680

To render the use of the rods yet more regular and easy, they are kept in a flat square box, the breadth of which is that of ten rods, and the length that of one rod, as thick as to contain six, or as many as may be required, the capacity of the box being divided into ten cells for the different species of rods. When the rods are put up in the box (each species in its own cell distinguished by the first figure of the rod set before it on the face of the box near the top), as much of every rod stands without the box as shows the first figure of that rod; also upon one of the flat sides without, and near the edge upon the left hand, the index-rod is fixed; and along the foot there is a small ledge, so that the rods when applied are laid upon this side, and supported by the ledge, which makes the practice very easy. But in case the multiplicand should have more than nine places, the upper face of the box may be made broader. Some make the rods with four different faces, and figures on each for different purposes.

Division by Napier's Rods.—First tabulate the divisor; then we have it multiplied by all the digits, out of which we may choose such convenient divisors as will be next less to the figures in the dividend, and write the index answering in the quotient, and so continually till the work is done. Thus 2179788 divided by 6123 gives in the quotient 356. Having tabulated the divisor 6123, we see that 6123 cannot be had in 2179; therefore take five places, and on the rods find a number that is equal or next less to 21797, which is 18369; that is, three times the divisor. Wherefore set 3 in the quotient, and subtract 18369 from the figures above, and there will remain 3428; to which add 8, the next figure of the dividend, and seek again on the rods for it, or the next less, which will be found to be five times; therefore set 5 in the quotient, and subtract 30615 from 34288, and there will remain 3673, to which add 8, the last figure in the dividend, and finding it to be just six times the divisor, set 6 in the quotient. Thus,

6123)2179788(356.

Napier, *Macvey*, descended from an ancient and respectable family in the west of Scotland, was born in 1776. He received his elementary education in the public school of his native parish; and subsequently studied in the Universities of Glasgow and Edinburgh, at both of which he attracted the favourable notice of some of the most distinguished professors. Being destined for the profession of the law, he was apprenticed to a member of the Society of Writers to the Signet. But the literary and philosophical studies to which he had early attached himself, withdrew his attention from the less interesting though more lucrative business of the law; and he speedily began to regard the latter as being, in his case at least, subsidiary only to his advancement in the former.

When yet very young, he was elected to the responsible situation of librarian to the Writers to the Signet. In this capacity Napier discovered an extensive knowledge of books, and a judicious discrimination in the selection of those best suited to the establishment over which he presided. At a subsequent period, the Writers to the Signet gave a marked proof of the increased estimation in which he was held, by selecting him for a lectureship on conveyancing, founded by the society, and shortly afterwards converted into a professorship in the university of Edinburgh. When the late Mr Constable purchased, in 1814, the copyright of the *Encyclopædia Britannica*, he at once fixed upon Napier as the individual best qualified to carry into effect the great improvements he projected in that publication. He was not disappointed in his expectations; and it is not going too far to say that the appearance of the *Supplement to the Encyclopædia Britannica*, edited by Napier, forms a memorable era in the history of British literature. Such was the confidence placed in the discretion and good taste of the editor, that the names of a host of individuals distinguished for learning, philosophy, and science are to be found among the contributors to this great work; which in consequence became the depository of a lengthened series of original and profound disquisitions in most departments of human knowledge.

The experience he had acquired in conducting the Supplement, his extended acquaintance with literature and literary men, and the confidence placed in him by the latter, naturally pointed Napier out as the proper, or rather as the only, person to undertake the task of editing a new edition of the Encyclopædia itself which should be worthy of the age and of the country. The misfortunes by which Mr Constable was unhappily overtaken made no change in this respect. The proposed edition was completed under its present publishers on the same scale on which it had been originally projected.

A vacancy in the situation of principal clerk of session having occurred some time after, when the Whig party came into power in 1830, Napier was appointed to the vacant place; and on receiving this appointment, he resigned his office of librarian.

Mr Napier had for a lengthened period been an occasional contributor to the *Edinburgh Review*; and on the appointment of Jeffrey to be dean of the Faculty of Advocates in 1829, he succeeded him as editor. Though he wrote little himself, his contributions are remarkable for ability, research, and perspicuity of statement; and he commanded in a high degree the confidence and esteem of those whose assistance was most necessary to sustain and extend the reputation of the leading Whig journal. Those who knew Napier only through the works he edited, or even through his lectures, could form no just idea of the man. He was at once a firm, an intelligent, and an honest friend.

For many years previously to his death, his health was very indifferent, and he occasionally suffered much. But his habitual cheerfulness never forsook him; and he continued to the last in the full enjoyment of his intellectual powers and of the society of his friends. He died in his seventy-first year, on the 11th February 1847.

NAPLES.

NAPLES (Italian *Napoli*, Greek Νεάπολις, Latin *Neapolis*, German *Neapel*), the capital of the kingdom of the Two Sicilies, and the largest and most populous city in Italy, disputes with Constantinople the claim of occupying the most beautiful site in Europe. It is situated on the northern shore of the ancient *Crater* or *Sinus Cumanus*, now called from it the Bay of Naples, in 40. 52. N. Lat., and 14. 15. 45. E. Long., as taken from the lighthouse on the mole.

No other spot in the world combines within the same compass so much natural beauty with so many objects of interest to the antiquary, the historian, and the geologist, as the Bay of Naples. Its circuit from the Capo di Miseno, on the N.W., to the Punta della Campanella, on the S.E., is about 35 miles, and is more than 52 miles if the island of Ischia, at the N.W., and the island of Capri, at the S. entrance, be included. At its opening between these two islands it is 14 miles broad; and from the opening to its head at Portici it is 15 miles deep. It affords good anchorage, with nearly 7 fathoms water, and is well shel-

tered, except from winds which blow from any point between S.E. and S.W. There is a perceptible tide of nearly 9 inches.

On the N.E. shore of the bay, E. of Naples, is an extensive flat, forming part of the great plain of ancient *Campania Felix*, and watered by the small stream Sebeto and by the Sarno, which formerly flowed by Pompeii. From amidst this flat, between the sea and the range of the Apennines, rises Vesuvius, one of the most active volcanoes in the world, at the W. base of which, on the sea-shore, are the town-like villages of San Giovanni Teduccio, Portici, Resina, Torre del Greco, Torre dell' Annunziata, &c., and the classic sites of Herculaneum and Pompeii. At the S.E. extremity of the plain, 3 miles beyond the outlet of the Sarno, a great offshoot of the Apennines, branching from their main ridge near Cava, and projecting more than 12 miles due W. into a peninsular form, divides the Bay of Naples from the Bay of Salerno (*Sinus Pæstanus*), and ends in the bold promontory of the Punta della Campanella (the *Promontorium Minervæ* of the ancients), which is divided by a strait of 4 miles from the island of Capri. On the N. slope of this peninsular offshoot, where the plain ends and the coast abruptly bends to the W., stands the town of Castellammare, near the site of *Stabiæ*, at the foot of Mount Santangelo, which rises suddenly from the sea to a height of 4722 feet. On the same N. slope, but further W., and nearly opposite to Naples across the bay, are Vico, Meta, Sorrento, Massa, and many other villages.

The N.W. shore of the bay, to the W. of Naples, is more broken and irregular. The promontory of Posillipo, which projects due S., divides this part of the bay into two smaller bays—the eastern, in which is Naples; and the western, or Bay of Baiæ, which is sheltered from all winds. Beyond Posillipo is the small island of Nisida (*Nesis*); and at a short distance inland are the extinct craters of Solfatara and Astroni, and the Lake of Agnano. Further W., on a tongue of land, stands Pozzuoli (the ancient *Puteoli*); and beyond it, round the Bay of Baiæ, are Monte Nuovo, a hill thrown up in a single night in September 1538; the classic site of Baiæ; the Lucrine Lake; Lake Avernus; the Lake of Fusaro, or *Acherusia Palus*; the Elysian Fields; and the port and promontory of Misenum. Still farther to the S.W. stand the islands of Procida (*Prochyta*), and Ischia (*Pithecusa* or *Inarime*), which divide the Bay of Naples from the extensive Bay of Gaeta.

Some of the local antiquaries, especially the learned Mazzocchi and Martorelli, on the evidence of etymological derivations, ascribe a Phœnician origin to Naples. All ancient writers, however, agree in representing it as a Greek settlement, though its foundation is obscurely and differently narrated. It seems that it was originally founded by a colony from the neighbouring Greek town of Cumæ, who gave it the name of *Parthenope*, from a legendary connection of the locality with the siren Parthenope, whose tomb was still shown at the time of Strabo. A number of Chalcidic and Athenian colonists seem to have afterwards joined the original settlers, and to have built for themselves separate dwellings, which they called *Neapolis*, or the new city, in contradistinction to the old settlement, which in consequence was styled *Palæpolis*, or the old city. All modern attempts to define the respective extent and situation of Palæpolis and Neapolis have utterly failed; but Livy's testimony leaves no doubt that they were close to each other, and identical in language and government.

In the year 328 B.C. the Palæpolitans having provoked the hostility of Rome by their incursions upon her Campanian allies, the consul Publius Philo marched against them, and having taken his position between the old and the new city, laid regular siege to Palæpolis. By the aid of a strong Samnite garrison which they received, the Palæpolitans were long able to withstand the attacks of the consul; but at length the city was betrayed into the hands of the Romans by two of her citizens. Neapolis possibly surrendered to the consul without any resistance, as it was received on favourable terms, had its liberties secured by a treaty, and obtained the chief authority, which previously seems to have been enjoyed by the older city. From that time Palæpolis totally disappeared from history, and Neapolis became as an allied city—*fœderata civitas*—a dependency of Rome, to whose alliance it remained constantly faithful, even under most trying circumstances. In 290 B.C. Pyrrhus unsuccessfully attacked its walls; and in the second Punic war Hannibal was by their strength deterred from attempting to make himself master of the town. During the civil wars of Marius and Sylla, a body of partizans of the latter having entered it by treachery, 82 B.C., made a general massacre of the inhabitants; but Neapolis soon recovered the blow, as it was again a flourishing city in the time of Cicero. It became a *municipium* after the passing of the *Lex Julia*; under the Empire it is noticed as a *colonia*, but the time when it first obtained that rank is uncertain—possibly under Claudius.

Though a municipal town, Neapolis retained long its Greek culture and institutions; and even at the time of Strabo had gymnasia and quinquennial games, and was divided into *phratriæ*, after the Greek fashion. When the Romans became masters of the world, many of their upper classes, both before the close of the republic, and under the empire, from a love of Greek manners and literature, or from indolent and effeminate habits, resorted to Neapolis, either for education and the cultivation of gymnastic exercises, or for the enjoyment of music and of a soft and luxurious climate. Hence we find Neapolis variously styled—by Horace as "otiosa Neapolis," by Martial as "docta Parthenope," by Ovid as "in otia natam Parthenopen." It was the favourite residence of many of the emperors. Nero made his first appearance on the stage in one of its theatres, Titus assumed the office of its Archon, and Hadrian became its demarch. It was chiefly at Neapolis that Virgil composed his *Georgics*; and after his death his remains were transferred and buried on the Hill of Pausilypus, the modern *Posillipo*, in its neighbourhood. It was also the favourite residence of the poets Statius and Silius Italicus, the former of whom was by birth a Neapolitan.

After the fall of the Roman Empire, Neapolis suffered severely during the Gothic wars. Having espoused the Gothic cause in the year 536, it was taken, after a protracted siege, by Belisarius, who, having turned aside an aqueduct, marched by surprise into the city through its channel, and put many of the inhabitants to the sword. In 542 Totila besieged it and compelled it to surrender; but being soon after recovered by Narses, it remained long a dependency of the Exarchate of Ravenna, under the immediate government of a duke, appointed by the Byzantine emperors. The Longobard invasion of Italy, and their subsequent conquests in Southern Italy, greatly narrowed the limits of the Neapolitan duchy. In the beginning of the eighth century, at the time of the Iconoclastic controversy, the Emperor Leo Isauricus having forced compliance to his edict against the worshipping of images, the Neapolitans, encouraged by Pope Gregory III., threw off their allegiance to the Eastern emperors, and established a republican form of government under a duke of their own appointment. Under this *régime* Neapolis retained her independence for nearly 400 years, though constantly struggling against the powerful Longobard Dukes of Benevento, who twice unsuccessfully besieged it. In 1027, however, Pandolfo IV., a Longobard Prince of Capua, succeeded in making himself master of it; but was expelled in 1030 by Duke Sergio, chiefly through the aid of a few Norman adventurers. In reward for their services, and as a security for their constant support, Sergio gave these Normans some land be-

Naples. tween Naples and Capua, on which they built the town of Aversa. Many other Normans soon poured south under the guidance of the sons of Tancred of Hauteville; and having eventually conquered the whole of South Italy and the island of Sicily from the Longobards, the Saracens, and the Greeks, Roger, a son of the great Count of Sicily, attacked Neapolis in 1130, and after a long siege, having compelled it to surrender, founded the present kingdom of Sicily and Naples. The history of Naples became ever since identified with the history of the kingdom, and will be given in this work under the head, SICILIES, *Two*.

Of ancient Neapolis there are few vestiges extant; all its buildings having gradually been changed and modernized. Two arches of an ancient theatre, in the street Anticaglia; two columns and other fragments of the temple of Castor and Pollux, preserved in the façade of the church of S. Paolo, a few arches of the Julian aqueduct, constructed by Augustus, which are called *Ponti Rossi;* and the extensive catacombs on the flanks of the hill of Capodimonte, are almost the only remains of its classic times.

The modern town is built at the base and on the slope of a range of volcanic hills; and, rising from the shore like an amphitheatre, is most advantageously seen from the water. A transverse ridge, branching from the steep hill crowned by the castle of St Elmo, and descending south to the shore, where it forms the promontory of Pizzofalcone, divides the town into two natural crescents; of which the one to the east includes within its circuit the largest and oldest part of the city—the ports, the arsenal, and the principal churches, palaces, and public establishments, and is traversed from north to south by a street two miles long, the lower part of which is called Toledo. The western crescent, known as the Chiaia, is a long and narrow strip between the sea and the hill of Vomero, and is the fashionable quarter of the town, where are the principal hotels, and where foreigners chiefly reside. The Riviera di Chiaia, a broad street, a mile and a-half long, bordered on the north by fine houses, and on the south by the public gardens, called Villa Reale, and by the sea, runs along this crescent from east to west, and ends in the quarters of Mergellina and Piedigrotta, at the foot of the hill of Posillipo. The ridge between these two crescents, or the Pizzofalcone, is chiefly the residence of the Neapolitan aristocracy. The eastern and western crescents are connected by a broad street or quay, which runs along the shore at the base of Pizzofalcone from the royal palace to the Villa Reale. The length of the town along the shore is 4 miles, and its breadth, from the Capodimonte to the Castel dell' Ovo, is $2\frac{1}{2}$ miles.

The streets are all well paved with lava or volcanic basalt, but, with the exception of the Toledo, the Riviera di Chiaia, the Largo delle Pigne, and the Molo, have no side footpaths. They were first lighted at night in 1806 with oil lamps, which in 1840 were superseded by gas in the principal streets. Many of the streets, especially in the old part of the town, are irregular and narrow, and, from the height of the houses, have a gloomy aspect. They are tolerably clean, filth being carried into the sea by a well-arranged system of sewers. The houses are more remarkable for their size than for their taste or elegance. They are mostly five or six storeys high, are covered with plaster made of a kind of pozzuolana, which hardens by exposure to the atmosphere, and have large balconies and flat roofs, which are frequently ornamented with flowers, shrubs, and small trees, planted in boxes filled with earth.

The city is defended by four castles—the castle of St Elmo, built on a steep hill commanding both crescents by King Robert the Wise, in 1343; the Castel dell' Ovo, so called from its oval shape, erected in 1154 by William I., on a small island which Pliny calls *Megaris*, and which is now joined to the shore at the foot of Pizzofalcone by a causeway on arches 800 feet long; the Castel Nuovo, built near the harbour in 1283, from the designs of Giovanni Pisano, by Charles I. of Anjou, whose residence it was for some time; it is very picturesque, and contains, between two of its old round towers, the triumphal arch erected in 1470 to Alfonso of Aragon—the Castel del Carmine, founded near the east end of the town in 1484 by Ferdinand I. of Aragon. There are two ports—the Porto Grande and the Porto Militare. The former was begun in 1302 by Charles II. of Anjou, and completed in 1740 by Charles III. by the carrying out of an arm to the N.E. In its deepest parts it has from three to four fathoms water, and is protected from all winds; but a S.W. gale makes its entrance difficult. At its extremity there is a lighthouse, reduced to its present form in 1843. West of this port is the Porto Militare, begun in 1826, and finished by the present king. It is intended exclusively for Neapolitan ships of war, and has a depth of about five fathoms. Naples.

Naples has more than 300 churches, most of which are more remarkable for the richness of their internal decorations than for real architectural beauty. The most important of them is the cathedral or *Duomo*, which stands on the site of two temples, dedicated to Neptune and Apollo. The present building was begun in 1272 from the designs of Masuccio I., and dedicated to the Virgin of the Assumption, but was not completed till 1316. It contains several granite columns, taken from the original temples on the site of which it stands; but is an incongruous mixture of different styles of architecture. This is mainly owing to the numerous restorations of the building, caused by its repeatedly suffering from earthquakes. The interior consists of a nave and two aisles, separated by pilasters, to which are affixed columns of Egyptian granite, Cipollino and Africano, taken from the ancient temples of Neptune and Apollo. The baptismal font, on the left of the principal entrance, is an ancient vase of Egyptian basalt, adorned with Bacchanalian emblems in relief. Under the high altar is a subterranean chapel, supported by Ionic columns, and containing the tomb of San Gennaro, the patron saint of Naples; near which is a kneeling statue of Cardinal Carafa, attributed to Michael Angelo. Within the cathedral there are many chapels, the most remarkable of which is the Cappella del Tesoro, built in consequence of a vow made by the citizens during the plague of 1527, and dedicated to San Gennaro. It was begun in 1608, and completed after twenty-nine years. The entrance to it is through a magnificent bronze door. The interior is in the form of a Greek cross, and has seven altars, with pictures by Domenichino and Spagnoletto, and forty-two columns of brocatello, with niches containing nineteen bronze colossal statues of saints. In a silver tabernacle behind the high altar are preserved the two phials containing the blood of San Gennaro, supposed to have been collected by a lady during his martyrdom. The ceremony of the liquefaction of this blood takes place twice a year, in May and in September. If it liquefy quickly, the joy exhibited by the lower classes is great; but if there be any delay beyond the expected time, the tears, prayers, and cries are even greater, as the non-performance of the miracle is supposed to announce some dreadful impending calamity. Attached to the cathedral is the extensive palace of the Archbishop of Naples, who is always a cardinal. The other more important churches, both for architecture and for the monuments and paintings they contain, are—Santa Chiara, San Domenico Maggiore, San Filippo Neri, San Francesco di Paola, opposite the royal palace, the Gesù Nuovo, San Giovanni a Carbonara, the Incoronata, San Lorenzo, Santa Maria del Carmine, Santa Maria la Nova, Santa Maria della Pietà de' Sangri, San Martino, Montoliveto, and San Severino.

The royal palace, begun in 1600 by the viceroy Count de Lemos, from the designs of Domenico Fontana, partly destroyed by fire in 1837, and since repaired and greatly

Naples.

enlarged by the present king, is an enormous building, with a front 448 feet long and 95 feet high, exhibiting the Doric, Ionic, and Composite orders in its three storeys. It stands on the N.E. side of a large square, which takes its name from it, is connected with the theatre of San Carlo, the arsenal, and the Castel Nuovo, and commands a most lovely view of the Bay, Vesuvius, and the Apennines. The reception apartments contain a fine collection of pictures by the best Italian masters. In the chapel attached to it there is an altar of lapis lazuli, agate, and many precious marbles. Adjoining the private apartments of the king there is his private library, which is very large, and contains a most valuable collection of prints and original drawings.

The private palaces most remarkable, either for their architecture or for the objects of art which they contain, are,—the general post-office, formerly Palazzo Gravina; the palaces Berio, Cavalcanti, Maddaloni, Forquet, formerly Stigliano, and Angri, in the street of Toledo; the Marigliano and Santangelo, formerly Carafa, in the street St Biagio de' Librai—the latter of which contains the largest private numismatic collection in Italy; the Cellammare, the Davalos, the Bisignano, the Fondi, and many others.

Hospitals and charitable institutions for relieving distress are very numerous, and generally well endowed. The most remarkable are—the Casa Santa degl' Incurabili, founded in 1521 by a lady, and enriched in later times by numerous benefactors. Its vast revenue is administered by a board appointed by the king. It is open to persons of both sexes and of every rank, and sometimes contains about 2000 in-patients, besides those that are sent to its convalescent branches in the suburbs of the city,—namely, the Ospedale de' Pellegrini, for the sick and wounded of all classes; and the Albergo de' Poveri, a magnificent building, one-third of a mile long, begun in 1751 by Charles III., as an asylum for orphans and for children whose parents cannot afford to give them an education. With several small institutions, which are its dependencies, it contains nearly 5000 inmates of both sexes, of whom some are taught the elementary branches of education, and music and drawing; whilst others are brought up to trades. Many of the boys brought up in it are sent into the army.

Naples abounds in theatres. The Teatro Reale di San Carlo is the largest and most splendid opera-house in Europe. It was erected by order of Charles III., by the architect Carasale, and first opened to the public in 1737. Having been accidentally burnt down in 1816, it rose from its ashes in seven months, under the direction of the architect Nicolini. It has six rows of boxes, 32 in each row, a pit capable of holding more than a thousand spectators, and a very spacious stage. Adjoining it are the concert and ball-rooms of the Academia Reale, the most select and aristocratic club in Italy, to which foreigners obtain admission through their minister. The Teatro Reale del Fondo is another opera-house, smaller than San Carlo, but very elegant. The Teatro Nuovo and Della Fenice are also smaller opera-houses, chiefly for the opera buffa. The Teatro de' Fiorentini is devoted to the Italian drama, and is very popular. The Teatro di San Carlino, though very small, is much frequented by all classes, and the performances are always in the Neapolitan dialect.

Scientific and literary institutions are also very numerous, —a university, a royal society, a botanic garden, an observatory, a Chinese college, a college of music, &c., &c. The university, which was founded by the Emperor Frederic II. in the thirteenth century, is under the direction of a president, assisted by a rector and a secretary-general, and has fifty-four different professorships. Admission to the lectures is free. A library, and cabinets of the various branches of natural history, are attached to it. The Chinese college was founded in 1732 by the celebrated Father Ripa for the education of young Chinese, who are afterwards sent back to China as missionaries. The Royal Society meets once a year, and is divided into three branches,—the Accademia delle Scienze, of thirty members; the Accademia Ercolanese di Archeologia, of twenty members; the Accademia di Belle Arti, of ten members. Each branch has a triennial president, a perpetual secretary, and meets twice a month. The observatory, which is situated on the hill of Capodimonte, and commands a magnificent view, was finished in 1820 on the plan of the celebrated Father Piazzi. The College of Music, which is of European celebrity, is under royal direction, and supplies gratuitous instruction to 100 pupils.

Naples.

But of all public institutions at Naples the Museo Borbonico, called also the *Studii*, is by far the most important and interesting. The building was begun in 1586 for cavalry barracks, but was remodelled in 1615, and adapted for the university. It was enlarged and reduced to its present form in 1790, and converted into a royal museum, which, besides the Farnese collection inherited by the Bourbons of Naples, has been since so far enriched by the objects found in Herculaneum, Pompeii, Stabiæ, Puteoli, Capua, Nola, Nuceria, Pæstum, &c., that it may now be considered as the finest in Europe, and quite unique with respect to Grecian and Roman antiquities. It is divided into seventeen collections, which are arranged as follows:—

On the ground floor,—1. Ancient frescoes, found chiefly at Herculaneum and Pompeii. There are more than 1600 objects, and there is a daily increase from the progress of the excavations. Among them are large historical pictures, wonderfully well executed, and admirable with respect both to accuracy of outline and beauty of composition. 2. Mosaics and mural inscriptions. 3. Egyptian antiquities. 4. Ancient sculptures, a large and most interesting collection; —the "Wounded Gladiator," "Ganymede and the Eagle," the "Farnese Minerva," a sitting statue of Agrippina, the "Flora Farnese," the "Aristides," and the "Psyche," being some of its numerous gems. 5. Inscriptions. Here are placed the "Ercole Farnese," and the celebrated group of the "Toro Farnese," described by Pliny as one of the most remarkable monuments of antiquity. It was the joint work of the Rhodian sculptors Apollonius and Tauriscus, who cut it from a single block of marble; and it was brought from Rhodes to Rome, where it was found much injured in the Baths of Caracalla. It represents Zethus and Amphion tying Dirce by the hair of her head to the horns of a bull, in revenge for her seducing the affection of their father Lycus, King of Thebes, from their mother Antiope, who interposes in favour of her rival. It was brought to Naples in 1786, and placed in the Villa Reale, whence it was removed to its present place. 6. Gallery of bronzes, the most extensive collection of the kind in the world. A "Drunken Faun," "Mercury in Repose," the "Sleeping Faun," and the "Dancing Faun," are generally considered the finest bronze statues in the world.

On the staircase,—7. A collection of more than 4000 specimens of ancient glass, showing the skill the Romans had attained in this manufacture. 8. A collection of upwards of 5000 articles of pottery. 9. Cinquecento objects. 10. A reserved cabinet, admission to which is difficult. It contains several Venuses, among which is the "Venus Callipyge," the rival of the "Venus de Medicis." It is attributed to Praxiteles, and was found among the ruins of the Golden House of Nero.

Upstairs,—11. A collection of 1750 papyri, most of them discovered in the year 1752 in a suburban villa at Herculaneum. The scrolls of papyri are so precisely like charcoal that the workmen destroyed those that had at first been met with; but on a room being opened, in which the scrolls were ranged in presses round the walls, this remarkable arrangement excited curiosity, and led to the discovery of

Greek and Latin words on these supposed pieces of charcoal. Seven inkstands, with a stylus in its case, were found in the same apartment. After several unsuccessful attempts at unrolling these papyri, Padre Piaggi at length invented an ingenious machine for separating and unrolling them, which, though slow and tedious, is still in use as the best that has been suggested. Those hitherto unrolled are 500 in number. Two volumes of them were published, the first in 1793, and the second in 1809; a third volume has long been preparing for the press. No known work has yet been discovered; and, so far as the examination has advanced, the collection seems to consist of treatises on the Epicurean philosophy, on music, and on rhetoric. It is conjectured, that of the MSS. still unrolled twenty-four are in Latin and the remainder in Greek. 12. Cabinet of gems and cameos. 13. A collection of about 40,000 medals and coins, chiefly of Magna Græcia and Sicily. 14. Seven rooms of small bronzes, which bring before us the manners, habits, and every-day life of the inhabitants of Pompeii. 15. A collection of upwards of 3000 Greek and Etruscan vases, comprising the finest specimens existing. 16. An extensive gallery of paintings, containing some of the finest pictures of the best Italian masters. 17. The public library, called the Biblioteca Borbonica. It contains 4000 MSS., and 200,000 printed books, of which 6000 are works printed in the fifteenth century. Among the MSS. there are many of great rarity and importance. We shall only mention the celebrated *Uffizio Farnese*, written by Montorchi, and illustrated by Giulio Clovio, which is considered the gem of illuminated works.

As there is not a museum in any country which in all respects can be compared with this, and as it forms the chief object of curiosity in the city, we have thought it advisable to give a faint idea of its contents. Access may always be had to it from nine in the morning to two in the afternoon, on all but festival and gala days.

The other public libraries in Naples are the *Brancacciana*, with more than 70,000 printed books, and about 7000 manuscripts; the *Biblioteca dell' Università*, with 28,000 printed volumes; and the *Biblioteca de Girolomini*, with 18,000 printed books, and 60 manuscripts. There are besides many large private libraries.

Naples is abundantly supplied with vegetables, fruit, and all kinds of provisions from the fertile fields in the vicinity. The average prices of the chief articles of sustenance are,—bread and flour, 2d. per lb., beef 5d., mutton 3d., pork 2d., cheese 6d., butter 1s. 4d., &c. The fishing in the neighbouring water gives occupation to a large portion of the male population, and supplies abundance of food. Maccaroni, vermicelli, and other varieties of paste prepared from the wheat brought from Apulia, which is distinguished by its hardness, form a very common kind of sustenance with the Neapolitan people. A notice of the imports and exports of Naples, in which city most of the foreign trade of the continental part of the kingdom is carried on, will be found under SICILIES, *Two*.

The climate of Naples is, upon the whole, salubrious and mild; but in February and March is subject to cold and sharp winds, rendered more trying to weak lungs by the heat of an always powerful sun. It is well suited for invalids labouring under general debility and deranged health, or nervous dyspepsia; but it is questionable whether it is suited as a winter residence for consumptive patients. For the latter class of invalids the local physicians recommend those parts of the city which are removed from the sea, and have a less irritating and more constant atmosphere. The city is well supplied with water, but not all of equally good quality; the water especially with which the quarter of Chiaia is supplied, having often at first a tendency to produce dysentery in strangers, who would do well to see that they get the Acqua del Leone, a pure spring in the Mergellina. There are two mineral springs of great local celebrity,—the Acqua Sulfurea, containing sulphuretted hydrogen and carbonic acid gas, and the Acqua Ferrata, a chalybeate spring, largely impregnated with carbonic acid and iron. They rise on the sea-shore at the foot of Pizzofalcone, at a short distance from each other.

The population of Naples has of late years been steadily increasing, notwithstanding two severe visitations of cholera. In 1830 it was 358,550; on the 1st January 1851 it was 416,475. There were in the latter year 3651 marriages; 14,991 births, of whom 7606 were males, and 7385 females; 1977 foundlings; and 124 illegitimate children. In the same year there had been 15,015 deaths, a number above the average mortality, which, on a calculation of ten years, gives an excess of nearly 1100 births per annum. On the 1st January 1857 the population had increased to 419,850. These numbers include a garrison of about 20,000 men, but do not include strangers, of whom there is always a considerable number at Naples, especially in the winter months.

At Capodimonte, which is a suburb on the N. of the city, there is a magnificent palace, begun by Charles III., and finished by the present king. It is surrounded by a large park, and contains a fine gallery of modern paintings, chiefly by Neapolitan artists. Another large royal palace is at Portici, 4 miles S.E. of Naples. At the W. extremity of the city, where the Riviera di Chiaia terminates, is the Grotta di Pozzuoli, a tunnel 2244 feet long, 21½ feet wide, and varying from 69 to 25 feet in height. It was excavated in classic times through the hill of Posillipo, in the old volcanic tufa, and in the fifteenth century enlarged by Alfonso I. of Aragon. It opens a direct communication between Naples and Pozzuoli.

Numerous and most interesting excursions can be made in the environs of the city. Pozzuoli, the Lake of Agnano, and the Grotta del Cane, Lake Avernus, the Lucrine Lake, Baiæ, the ruins of Cumæ, Misenum, the islands of Procida, Ischia, and Capri, the remains of the vast amphitheatre of Capua, the splendid royal palace of Caserta, Beneventum, Vesuvius, Herculaneum, Pompeii, Stabiæ, Castellammare, Sorrento, Amalfi, Salerno, Pæstum, &c., are all within a short distance of Naples, and contribute to its attractions as a winter, or even summer residence for strangers. Caserta, Capua, and Castellammare are easily reached by railway. Two railways are to connect Brindisi and Rome. (* * *)

NAPOLEON.

NAPOLEON BUONAPARTE, or BONAPARTE, was born at Ajaccio, in Corsica, on the 15th of August, 1769. He was descended from a patrician family, which had been of some note in Italy during the middle ages; and one of his ancestors, the gonfaloniere Buonaparte of San Nicolo, had governed the republic of Florence about the middle of the thirteenth century. His father, Carlo Buonaparte, was an advocate of considerable reputation; and his mother, Letizia Ramolini, was eminent alike for personal beauty and uncommon strength of character. When the Corsicans under Paoli rose in arms to assert their liberty against the pretensions of France, Carlo Buonaparte espoused the popular side; and through all the toils and dangers of his mountain campaigns was attended by his lovely and high-spirited wife. Upon the termination of the war, the father of Napoleon meditated accompanying Paoli into exile; but his relations dissuaded him from taking this step; and being afterwards reconciled to the conquering party, he was pro-

Napoleon.

tected and patronized by the Comte de Marbœuf, the French governor of Corsica. Napoleon was the second child of his parents—Joseph, afterwards King of Spain, being the eldest born; but he had three younger brothers, Lucien, Louis, and Jerome; and three sisters, Eliza, Caroline, and Pauline. Five others appear to have died in infancy; and at the age of thirty Letizia became a widow by the death of her husband, who seems to have left his family but indifferently provided for.

In his early years Napoleon betrayed no marked singularity; and when his character began to be formed, its development was too profound and too essentially intellectual to attract the notice of ordinary observers. At the age of ten he was admitted to the Military School of Brienne, where he spent several years devoted to his studies, and afterwards removed to a similar institution at Paris, where he appears to have completed his education. That he laboured hard both at Brienne and at Paris, may be judged from the vast quantity of information which his strong memory ever placed at his disposal, and which, from the nature of his after life, must have been nearly, if not wholly, accumulated at this period. He succeeded in all that he undertook, because his will was resolute and his perseverance indomitable. He applied himself particularly to the study of mathematics, and made good progress in history and geography, but neglected Latin and the *belles lettres*. His intellectual faculties exerted themselves without any great effort on his part. He had a lively and prompt conception, a strong memory, and a cool and decided judgment. A foreigner, poor and proud, he kept aloof, for the most part, from the other boys, who were accustomed to taunt the distant young Corsican. He commonly sought for something to interest him; and this disposition placed him in a species of solitude, where he communed only with his own thoughts—a state which afterwards became habitual to him in all situations through life.

His birth having destined him for service, Napoleon had just completed his sixteenth year, when, in August 1785, after being examined by Laplace, he obtained his first commission as lieutenant of artillery in the regiment of *La Fère*. Never did he receive any title with so much pleasure as this. He was delighted beyond measure at his promotion; and the highest pitch to which his ambition then aspired was, that he might one day wear a couple of *epaulettes à bouillons*. A general of artillery seemed to him the *ne plus ultra* of human grandeur. He was already desirous of fame, however, and had conceived the idea of making himself a name by writing the history of the war in Corsica. He communicated his intention to Paoli, at the same time requesting that that officer would furnish him with the necessary information; but an historian of eighteen did not probably inspire any great confidence, and Paoli took no notice of his proposal. His advancement, however, indemnified him for this little mortification. In the year 1789 he obtained a company of artillery; and the Revolution, which broke out immediately afterwards, seemed to open up a new and more enlarged sphere of action. With this movement he soon foresaw that all his hopes and prospects were identified. "Had I been a general," said he, in the evening of his life, "I might have adhered to the King; but being a subaltern, I joined the patriots."

Happening to be in Paris in the year 1792, he witnessed the scene of the 20th June, when the revolutionary mob stormed the Tuileries, and placed the lives of the King and his family in the greatest jeopardy. He followed the crowd into the garden before the palace; and when Louis XVI. appeared on a balcony with the red cap on his head, he could no longer suppress his contempt and indignation. "Poor driveller," said Napoleon; "how could he suffer this rabble to enter? If he had swept away five or six hundred of them with his cannon, the rest would soon have disappeared." He was also a witness of the events of the 10th of August, when the throne was overturned, a provisional council established, the king confined in the Temple, the Republic proclaimed, and a national convention called to frame a charter. At this time he was without employment, and poor; wandering idly about Paris, living at the shops of restaurateurs, projecting a variety of schemes,—some of them wild enough,—and in a great measure dependent upon the scanty resources of his class-fellow Bourrienne. But the circumstances of the times were such that he was not suffered to remain long inactive. Being offered the command of a battalion of national volunteers destined to join the expedition to Sardinia, he readily accepted it; and upon the return of the expedition he re-entered the artillery with the rank of superior officer, or commandant. Till the siege of Toulon, however, he led an insignificant life. But this operation proved in some measure decisive of his fortunes. He saw that, from the situation which he held, as second in command of the artillery, he might have some influence on the result of the siege; and the event justified his anticipations.

Napoleon.

When, towards the close of August 1793, Toulon, the great port and arsenal of France on the Mediterranean, had, along with the fleet, been delivered into the hands of the allies, the situation of France was truly deplorable. Lyons had raised the standard of the Bourbons; civil war raged in Languedoc and Provence; the victorious Spanish army had passed the Pyrenees, and overrun Rousillon; and the Piedmontese army, having cleared the Alps, was at the gates of Chambery and Antibes. Terror, discord, and defection reigned within; whilst on the frontiers one reverse followed hard at the heels of another. But the allies were not sufficiently sensible of the importance of the acquisition which they had just made. About six weeks were passed in assembling the force and means necessary for the siege. On the 15th of October a council of war was assembled at Olioulles, where the conventional proconsul Gasparin presided; and on this occasion there was read to the council a memoir on the conduct of the siege of Toulon, which had been drawn up by the celebrated engineer D'Arcon, and approved by the committee of fortifications. Napoleon opposed the adoption of this plan, and proposed one much more simple. "Your object," said he, "is to make the English evacuate Toulon. Instead of attacking them in the town, which must involve a series of operations, and ruin the place, endeavour to establish batteries so as to sweep the harbour and roadstead. If you do this, the English ships must take their departure, and the English troops will certainly not remain behind them." He then pointed out a promontory nearly opposite the town, by establishing batteries on which the desired effect might be attained. "Gain La Grasse," said he, "and in two days Toulon will be yours." Had this suggestion been adopted in time the result would have been as Napoleon predicted; but the English had leisure allowed them to construct Fort Mulgrave, and to render it so strong that it went by the name of Little Gibraltar. Nevertheless, Napoleon's system prevailed. Instead of attacking the body of the place, the principal effort was directed against Fort Mulgrave; and in a month the desired end was obtained. On the 18th December the besiegers entered Toulon, but were able to save only the half of the squadron; the other half, the arsenal, and the dock-yards, having been consumed by the conflagration kindled by the English as they abandoned the place.[1]

[1] During the siege of Toulon, Napoleon, whilst constructing a battery under the enemy's fire, had occasion to prepare an order, and called for some one who could write with facility. A young serjeant stepped out, and, leaning on the breast-work, wrote as he dictated.

The recovery of Toulon was a service of the very first importance to the revolutionary government. It suppressed the insurrectionary spirit in the south of France, restored the credit of the republican arms, and rendered disposable the force which had been employed in the siege. But the man to whose genius alone success was due did not immediately obtain the credit of this important achievement. The truth, however, was too generally known to be effectually concealed. Napoleon was appointed general of brigade, and in the beginning of 1794 was sent to the army of Italy to command the artillery. The general-in-chief, Dumerbion, was old and incapable; the head of his staff, though a man of information, wanted talents; and, between them, war was carried on without art or skill in the Maritime Alps. Napoleon proposed a plan for turning the famous position of Saorgio. His suggestion was adopted; Saorgio, with all its stores, surrendered, and the French obtained possession of the Maritime Alps. He then proposed another, which had for its object to unite the army of the Alps and that of Italy under the walls of Coni—an operation which would have secured Piedmont, and enabled the combined force, without any great effort, to establish itself on the Po. It was found impossible, however, to come to an arrangement with the staff of the army of the Alps; but Napoleon indemnified himself by carrying the army of Italy as far as Savona, and to the gates of Ceva; by which means he disengaged Genoa, then threatened by the allies, and would have achieved more important results had not his progress been stopped by the approach of winter and the imperative orders of the committee. He was superseded on the 6th of August 1794, apparently in consequence of the labours of Aubry, who had reformed the organization of the army, in order to impart to it greater solidity.

Before the end of the year he went to Paris in order to solicit employment, but at first experienced a very cold reception, probably on account of his supposed connection with Robespierre, with whose younger brother he was known to have lived on terms of friendship. The re-action consequent on the downfall of that extraordinary personage was then at its height, and threatened France with evils not less terrible than those from which it had just escaped. Everything was in an unsettled state, and the monthly renewal of the Committee of Public Safety served only to increase the confusion. After a time, however, Napoleon was placed amongst the generals of infantry appointed to serve in La Vendée; but he refused to act in a situation which he considered as altogether unsuitable to him, and resolved to remain at Paris, where he might be more usefully employed. This proved a fortunate determination, and soon led to service of a more congenial kind. Kellermann had just allowed himself to be beaten in the Apennines. The committee were anxious to repair the disaster, and with this view attached Napoleon to the board of military operations, with orders to prepare such instructions as might seem calculated to bring back victory to the national standards. This afforded him an opportunity of making his talents known, and probably contributed not a little to the future advancement of his fortunes. Soon afterwards, he was appointed to command a brigade of artillery in Holland, where for some time the war had languished; but before he could avail himself of this appointment, his services were required upon a nearer and more important field of action.

During the contest between the Convention and the sections of Paris (of which details will be found in the article France) it was proposed to Napoleon to command, under Barras, the armed force destined to act against the Parisians. He consented, upon condition of being left free from all interference, and lost not a moment in sending to Meudon for the artillery. He had 5000 men and 40 pieces of cannon, a force more than sufficient to put down a riot, but not too much against a national guard well armed, and provided with artillery; and he was reinforced by 1500 patriots, organized in three battalions.

On the 13th of Vendemiaire (4th of October 1795), the sectionaries marched, nearly 30,000 strong, against the Convention. One of their columns, debouching in the Rue Saint-Honoré, advanced boldly to the attack; but it was instantly checked by the fire of the artillery, which swept the street with grapeshot, and soon afterwards it gave way in confusion. A number of the fugitives attempted to make a stand on the steps of the church of St Roche, where, owing to the narrowness of the street, they were in a great measure sheltered from the fire of the artillery. Napoleon, however, promptly brought a gun to bear upon them, and in a few minutes this crowd was dispersed, leaving behind them a number of dead. The column which debouched by the Port-Royal was not more fortunate. Exposed to the direct fire of the guns stationed below the Tuileries, and taken in flank by that of the other batteries by which the bridge was commanded, all its efforts to establish itself upon the quays of the Seine proved unavailing, and, after a very short struggle, it dispersed, and fled in all directions. In less than an hour the whole was ended, and the Convention victorious. This event, so trivial in itself, and which scarcely cost 200 men on each side, had important consequences. It prevented the revolution from retrograding; it enabled the Convention to disarm the sections; and, above all, it had a marked influence upon the future fortunes of Napoleon. The eminent service he had rendered was immediately rewarded with the rank of general of division; in five days he was named second in command of the army of the interior; and soon afterwards, on the resignation of Barras, he was advanced to the chief command. He had now passed into the order of marked and distinguished men. But the situation which he held was by no means suited to his views. He longed to make war upon a more extended theatre of action, and to profit by the advantages which fortune had thrown in his way.

It was at this time, when his residence in Paris had begun to appear insupportable to his active mind, that he became acquainted with the widow of General Beauharnais, whom he afterwards married. At the moment when the sections were disarmed, the sword of her husband, who had perished by the guillotine, a victim of the tyranny of Robespierre, had been taken from her; and she now sent her son Eugene, a boy of fifteen, to beg that it might be restored to her. Her request was at once complied with, and the boy shed tears as he received from the hands of Napoleon the sword of his unfortunate father. This scene touched Napoleon; and, having gone to give an account of it to the mother of Eugene, he was so enchanted with her elegance and grace, that he soon afterwards made her a tender of his hand, which was accepted. Such appears to be the simple truth in regard to the origin of his relations with Josephine, concerning which so many absurd and injurious stories have been circulated. Napoleon had little relish for the society of women, which accorded neither with his tastes nor his character, and in which he experienced constraint; but, being desirous to fix himself in life,

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The writing was just finished, when a shot struck the ground by the side of the volunteer secretary, scattering dust over him and everything near him. "Good," said the serjeant, laughing; "we shall this time have no need of sand." The cool gaiety of the remark pleased Napoleon; he kept his eye on the man; and Junot—for it was he—rose in the sequel to the rank of a marshal of France, and was created Duke of Abrantes.

Napoleon.

and finding in Josephine spirit and elegance united with celebrity, he resolved to make her his wife. The marriage took place on the 9th of March 1796, only a few days before he set out to assume the command of the army of Italy.

Tranquillity being now restored at Paris, the Directory had time to turn their attention to the state of affairs, particularly to that of the army of Italy, the condition of which was by no means satisfactory. It was determined to supersede Schérer, who had disappointed the expectations of the Directory, and to give it a new general; and as the chief command of the army of the interior naturally led to that of an active force, provided the individual holding it possessed the confidence of the government, Napoleon was consequently appointed general-in-chief of the army of Italy. To this command he had pre-eminent, and indeed exclusive claims. When serving under General Dumorbion, as commandant of artillery, he had turned the important position of Saorgio, and disengaged Genoa, then threatened by the allies; when employed at the board of military operations, he had digested a plan of campaign, the result of which was the signal victory gained at Loano, and the possession of the line of the Apennines, as far as Savona and the sources of the Bormida; and now, when brought into more direct contact with the government, he satisfied Carnot, to whom the direction of military operations was intrusted, that his plan in regard to Piedmont, which had been rejected by the Committee of Public Safety in 1794, might still be executed, with every prospect of success. These circumstances, independently of his services at Toulon, and also against the insurgent sections of Paris, naturally pointed him out as the person best qualified to obtain that success of which the Directory at this time stood so much in need, in order to support its credit and consolidate its power. That his talents were fully appreciated, and that he was solely indebted to his merits for this splendid command, admits of no doubt whatever. "Advance this young man," said Barras to one of his colleagues, "or he will advance himself without you." Napoleon quitted his wife ten days after their marriage, and, after a rapid journey, arrived at the head-quarters of the army at Nice. With that moment began the most brilliant scene of his entire career. "In three months," said he, "I shall be either at Milan or at Paris;" and before a year elapsed, he had grown old in victory.

The plan which he proposed for the campaign united all suffrages; for, though at once bold and original, it was in reality extremely simple. It had been agreed that he should manœuvre by his right, in order to descend by Montferrat upon Lombardy, directing all his efforts against the Austrians, in the hope of detaching Piedmont from the imperial alliance. The armies of Germany being re-organized, were to resume the offensive by the end of April, and to endeavour to pass the Rhine. Jourdan, who commanded 70,000 men on the Lower Rhine, was to blockade Mayence with 30,000, and to advance into Franconia with from 40,000 to 50,000. Moreau, who had nearly an equal number under him, was to mask Manheim, and advance in Suabia; and it was proposed that both should unite in the heart of Bavaria. As to Napoleon, he had no other task to perform than that of advancing on the Adige; provided he succeeded by his victories in detaching Piedmont from the coalition, or in dethroning the King of Sardinia if the latter should refuse to make peace. In a word, this plan was merely a copy of that which Napoleon had previously drawn up for the committee, and the execution of which that body had recklessly intrusted to the incapable Schérer. Its distinctive characteristic consisted in the mode by which it was proposed to gain access to the fertile regions of Italy. Former invaders had uniformly penetrated the Alps at some point or other of that mighty range of mountains. Napoleon judged that the same end might be more easily attained by turning them; that is, by advancing along the narrow gorge of comparatively level country which intervenes between these huge barriers and the Mediterranean, and by forcing a passage at that point where the last elevations of the Alps pass by gradual transition into the first and lowest of the Apennine range. The military advantages of operating in this direction will be immediately apparent.

Napoleon.

Napoleon arrived at Nice on the 27th of March, and there found the army in a very precarious as well as destitute condition. Perched upon the summits of the Appennines, from Savona to Ormea, it was too widely dispersed, and its communications with France, running along the coast in a parallel direction between the enemy's line and the sea, were everywhere exposed; whilst the soldiers were in rags, without shoes, and a prey to almost every species of misery. Napoleon lost not a moment in placing the army in more advantageous positions, and in announcing that he was about to assume the offensive, with a view to provide for its wants, at the same time that he consulted its glory. This announcement had the desired effect. The soldiers forgot their privations, and eagerly longed to signalize their courage and devotion under the young chief who had promised to lead them to victory. Having occupied the principal roads leading from Nice to Italy, particularly that which sweeps the north by Saorgio, and crosses the chain of the Alps at the Col di Tende, Napoleon demanded of the senate of Genoa a free passage by the city and the Bochetta, along the road leading from Genoa to Alexandria, promising, in return, to carry the theatre of war beyond its frontiers, and to insure it the alliance and protection of the French republic.

On the 10th of April the Austrian general Beaulieu descended from the Apennines by the Bochetta, at the head of his left wing, and having dislodged the advanced guard of the French from Voltri, carried two of their redoubts. On the 12th Napoleon defeated the Austrian centre under Argenteau, overcame the Piedmontese on the 13th, and on the day following compelled Provera to lay down his arms. After a few more decisive encounters, in which he carried all before him, the conqueror concluded a sort of armistice at Cherasco, by which the King of Sardinia engaged to deliver up Coni, Alexandria, and Ceva, to withdraw from the coalition, and to send the Count de Ravel to Paris to treat of a definitive accommodation.

Thus, in somewhat less than a month, Napoleon with an army destitute of everything, had gained six victories, taken twenty-one standards, fifty guns, and several strong places, conquered the richest part of Piedmont, made 15,000 prisoners, and killed or wounded 10,000 men. He had reduced the Austrians to inaction, destroyed the army of the King of Sardinia, detached him from the imperial alliance, wrested from his hands the keys of the Alps, and established a solid basis for his future operations. In a few days he had done more than the former army of Italy in four campaigns; he had displayed consummate genius in achieving victory, and proved that he combined with it the still rarer talent of turning it to profit, by promptly gathering up its fruits. But his hopes were not yet realized. To deliver Italy from the German yoke, and to falsify the proverb which regarded that country as the tomb of the French, was the task which he still reserved for himself, and which he hesitated the less to undertake, as the armistice had left him at liberty to direct his whole force against the isolated army of Beaulieu, now too much enfeebled to resist his attacks with any chance of success.

No commander ever appreciated more justly than Napoleon the value of time in military operations. The day after the signature of the treaty of Cherasco, he put his divisions in motion, and directed them upon Alexandria.

Partly by stratagem, and partly by dexterous movements, Napoleon succeeded in obliging Beaulieu to withdraw from his position at Valeggio, on the Ogogno, and to attempt concentrating his army towards Lodi. With the view of forcing the Austrians to retire from this position, Napoleon marched on Lodi, at the head of the grenadiers and the corps of Messena and Augereau, leaving before Pizzighetone a division to mask that place and cover his right, and taking measures for the safety of his left, by directing Serrurier upon Pavia. On the 10th he arrived before Lodi, where Beaulieu, having retired with the main body of his army to Crema, had left General Sebottendorf with 10,000 men to defend both sides of the Adda. By means of this strong rearguard the enemy had hoped to preserve the bridge of Lodi, which was defended by twenty pieces of cannon established on the left bank; but they soon found that they had reckoned without their host. A battalion and some squadrons which occupied the town of Lodi were, without much difficulty, dislodged, and the French reached the bridge before the enemy's workmen had time to cut it down. Napoleon instantly formed his grenadiers in close column, and rushed along the bridge. The troops advanced with loud shouts to the attack, but being assailed by a perfect storm of grape-shot, they hesitated for a moment, and began to waver. The generals, including Napoleon himself, hurried to the front, cheering and animating the men by their example. The effect was electric. The column dashed along the bridge in spite of the tempest of fire which thinned their ranks, overthrew all that opposed their progress, carried the enemy's batteries at the point of the bayonet, and dispersed his battalions.[1] Sebottendorf retreated upon Crema, with the loss of fifteen guns and 2000 men killed or wounded. This, though only an affair of the rearguard, was a daring feat of arms; and its immediate consequences were the occupation of Pizzighetone, the retreat of Beaulieu towards the Mincio, and the triumphal entry of Napoleon into Milan, where his presence had become absolutely necessary. As the French troops had been in continued motion for a month, it was judged expedient to allow them some days' rest; and hence Beaulieu was not pursued.

Having thus descended like a torrent from the Apennines, overthrown and dispersed all that opposed him, separated Piedmont from the coalition, received the submission of the Dukes of Parma and Modena, driven the Austrians behind the Mincio, and entered the capital of Lombardy in triumph, Napoleon immediately directed his attention to the internal administration of the country, prescribed the measures necessary for the reduction of the citadel of Milan, imposed contributions, and made arrangements for establishing the republican system in Italy. His career of victory had been one of unexampled rapidity, and he now sought to secure and consolidate the conquests he had made. The intelligence of his success, however, appears to have excited astonishment and suspicion in the minds of the French Directory, who perceived with alarm that their young general had already made himself master of Italy. Scarcely had he reached Milan, when he received orders to divide his army in two; to give up the command of that of Italy to Kellermann, who was to observe the Austrians on the Mincio; and with the remaining 25,000 men, forming an army of the south, to advance upon Rome, and even to act against Naples. But this division of force, at the moment when it was about to contend against all the resources of the House of Austria, was a great deal too absurd to be submitted to by a commander like Napoleon; he answered by resigning his command, and thus saved the army from inevitable destruction. Meanwhile, he resolved to drive Beaulieu into the Tyrol, and with this view he addressed to his soldiers one of the most remarkable proclamations that ever proceeded from his pen. He knew well the men with whom he had to deal; he knew that the French soldiery, full of fire and enthusiasm, would be transported by an appeal which awakened in their minds heroic sentiments; he knew that such an address would produce at Rome or at Naples the same effect as it had done at Turin; he knew also that in proportion as he exalted the courage of his troops he struck terror into those of the enemy, and at the same time bequeathed to posterity a monument of his talent for command. The revolt of Lombardy for a moment endangered the success of his plan. On the day when he quitted Milan to advance against the Austrians, the tocsin sounded in the rear of his army; the people flew to arms, and having seized upon Pavia, put the garrison to death. The least hesitation on his part would have rendered this rising general. Without stopping the march of the army, he proceeded in all haste to Pavia, followed by 300 horse and a battalion of grenadiers, at the head of which he forced the gates, penetrated into the city, which was delivered up to pillage, ordered the municipality to be shot, and thus, by one vigorous blow, extinguished the insurrection in its principal focus. At Benasco, Lannes acted with equal promptitude and severity; and at Lugo, where a squadron of French horse had been destroyed, a number of the male inhabitants were shot.

After the defeat of Lodi, Beaulieu had not ventured to halt behind the Oglio, nor even behind the Chiesa. He preferred the stronger line of the Mincio, flanked on the left by the fortress of Mantua, and on the right by the Lago di Garda and the mountains of the Tyrol. Behind this barrier he established his army, with his centre posted at Vallegio, his left at Goito, and his right at Peschiera, a small place belonging to the Venetians. As the wings thus rested upon two strong places, Napoleon resolved to force the centre; at the same time making demonstrations on the side of Peschiera, which covered the enemy's line of retreat to the Tyrol. On the 30th of May he arrived at Borghetto with the mass of his army, and immediately dislodged an advanced guard of the enemy stationed on the left of the Mincio. Having repaired the bridge of Borghetto, which the Austrians had partly destroyed in their retreat, he was preparing to force the passage of the river, when a column of grenadiers threw themselves into the stream, carrying their arms on their heads, as the water reached to their shoulders. The enemy, believing themselves about to be attacked by the redoubtable column of Lodi, gave way, and taking the road to the Tyrol, allowed the French to effect the passage without opposition. Beaulieu attempted to make a stand upon the heights between Villafranca and Vallegio; but having learned the movement of Augereau on Peschiera, he immediately retired beyond the Adige, and ascended the right bank by Dolce as far as Caliano. Part of his left ascending the Mincio to join him at Vallegio, came suddenly upon the French head-quarters, and nearly captured the general-in-chief, but was soon dispersed by the troops under Massena; and the remainder of this wing, being detached from Goito, entered Mantua, the garrison of which now exceeded 13,000 men. The investment of that fortress was immediately decided on by Napoleon; materials for the siege having previously been prepared at

[1] The success of this attack was facilitated by the very circumstance which seemed to entail instant failure. Whilst the troops hesitated under the storm of fire with which they were assailed on the bridge, some soldiers slid down by the piles into an island in the river, where they hoped to find some point of attack less exposed to the enemy's fire. Here they discovered that the second branch of the Adda was fordable, upon which a battalion immediately spread itself out *en tirailleurs*, in order to turn the Austrian line; and, thus favoured, the mass of grenadiers passed the bridge at the *pas de charge*.

Alexandria and Tortona, whence they were directed in all haste on Lombardy.

Meanwhile Napoleon took measures for strengthening himself upon the Adige, where his situation had become complicated, and in fact presented a variety of new combinations. The investment of Mantua required that he should be master of the course of the Adige; and the key of this river is Verona, the position of which forms the basis of every system upon that line of operations. He therefore took it upon him to summon the latter city, which was surrendered without resistance, on the 1st of June; and by this precious acquisition he procured three fine bridges on the Adige, and a strong central position, defended by bastions, and protected by two forts perched on the last slopes of the Tyrolese mountains, so as to shut up hermetically the valley of the Adige on the left bank of the river. He also placed garrisons in Crema, Peschiera, and other strong places belonging to the Venetians; and having concluded armistices with the King of Naples and the Pope, occupied Leghorn, where he seized a large amount of English property and merchandise. The investment of Mantua was now converted into a regular siege, the labours of which were intrusted to Serrurier's division, 10,000 strong, whilst the rest of the army remained in observation upon the Adige as far as the western bank of the Lago di Garda. The trenches were opened on the 18th of July; but a new act of the drama was about to commence.

The cabinet of Vienna, justly alarmed at the progress of Napoleon, had resolved to check his career by opposing to him a new army and a new general. Beaulieu was replaced by Wurmser, who, having set out from Manheim, reached Trent towards the end of July, at the head of an army of 60,000 men. At this time Napoleon had not more than 30,000 men under his immediate command, and 10,000 were engaged under Serrurier in the siege. The Austrians had therefore a superiority of force which seemed to insure them the victory. In the last days of July, Wurmser debouched from the Tyrol; Quasdanovich, with 25,000 men, moving by the left bank of the Lago di Garda upon Salo and Brescia; and the marshal, with the remaining 35,000, descending the Adige in three columns. Napoleon instantly resolved to attack Quasdanovich before he could form a junction with Wurmser on the Mincio. This was his only chance of success, and to secure it he quitted everything. The siege of Mantua was raised; 140 pieces of cannon were abandoned in the trenches; and by the evening of the 30th Napoleon had assembled between Peschiera and Goito the divisions of Massena and Augereau, with the reserve of Serrurier's division.

Next day he passed the Mincio to encounter Quasdanovich. The Austrian general, assailed by a superior force, was driven from Lonato, Brescia, and Salo, and compelled to fall back on Gavardo. On the 3d, Augereau's division, supported by the reserve, advanced upon Castiglione; that of Massena directed its march on Lonato; and Guyeux received orders to debouch on Salo, in order to induce Quasdanovich to continue his retreat by threatening his communications with the Tyrol. Napoleon conceived that he was directing his effort against Wurmser, but, on the contrary, it fell upon the left of Quasdanovich, who was now making another attempt to operate his junction by Lonato. As might be expected, the Austrian was again defeated, and being warmly pursued, was forced to direct his columns on their former position at Gavardo. The same day Augereau attacked and defeated the advanced guard of Wurmser at Castiglione. Napoleon had as yet obtained only partial successes; but they strengthened him in his central position, and gave him the means of dealing heavier blows. The first of these was directed against Quasdanovich, who, on the very next day, was surprised at Gavardo, threatened with an attack in reverse, and obliged to fall back in great disorder upon Riva; thus definitively ridding Napoleon of a corps formidable from its strength, as well as from the strategic direction which had been assigned to it.

But if fortune seconded Napoleon in this juncture, he was at the same instant exposed to the greatest danger in the midst of his very head-quarters. Massena's division had just quitted Lonato, where Napoleon remained with 1200 men, when all of a sudden an alarm was given that the place had been surrounded by an enemy's corps, and soon afterwards an Austrian officer came to summon him to surrender. Happily his presence of mind did not forsake him. He presumed that this could only be one of the detachments of Quasdanovich which had been separated from the main body in the recent affair of Lonato; and he resolved to extricate himself by audacity from a situation which must have been not a little embarrassing. Assuming a menacing tone, "What means this insolence?" said he. "Do you dare to beard the French general in the midst of his army?" The Austrian officer was confounded, and hearing the word "*fusillade*" significantly pronounced by Napoleon, he became so terrified that he consented to surrender. Two thousand men, provided with four pieces of cannon, then laid down their arms, and discovered, when it was too late, that if they had stood firm, the French general-in-chief and all his staff must have been their prisoners. This corps formed the advanced guard of Quasdanovich, which, in executing a reconnoissance with a view to a junction with Wurmser, had crossed on the march the columns of St Hilaire and Sauret, and had fallen upon the French head-quarters at the very moment when the camp of Gavardo was unexpectedly attacked by the French troops.

The combat which decided the final success of this operation took place on the 5th of August, near Castiglione. Wurmser, still infected with the mania of detachments, had pushed one in the direction of the Lower Po, and left another to blockade Peschiera, so that there remained under his immediate orders not more than 25,000 men. The divisions of Massena and Augereau, with the reserve, presented a force equal to that of the enemy, and the arrival of the division of Serrurier turned the balance decidedly in favour of the French. As soon as the latter came up, Napoleon attacked the enemy's left with his right and centre, defeated it, and forced him to repass the Mincio with the loss of twenty pieces of cannon. Massena instantly crossed the Mincio at Peschiera, and falling upon the enemy's right wing, established before that place, routed and put it to flight. Wurmser now perceived that a prompt retreat could alone save him, and, leaving in Mantua a garrison of 15,000 men, he fell back along the valley of the Adige, warmly pursued by the French as far as the entrance of the Tyrol, which he regained with a total loss of 12,000 men and fifty pieces of cannon.

The Austrians, however, had scarcely re-entered the Tyrol, when, being joined by considerable reinforcements, they once more found themselves stronger than their adversaries; and Wurmser having received positive orders to relieve Mantua, imagined that he could attain this end without fighting, by means of manœuvres alone. Davidowich was to cover the Tyrol with 20,000 men disseminated from the environs of Feldkirch as far as Roveredo; whilst Wurmser himself, with the remaining 26,000, should descend the valley of the Brenta, to debouch on Porto-Legnago and the rear of the French army. But the young chief of the French army was not the man to allow himself to be deceived by false demonstrations. At the moment when Wurmser was meditating this false movement, Napoleon received a reinforcement of 6000 men from the army of the Alps; and being thus strengthened, he resolved to penetrate into the heart of the Tyrol, and to

fall upon the right of Wurmser at the moment when he was draining the Tyrol in order to manœuvre by his left. On the 4th of September, Wukassowich, who commanded the advanced guard, was expelled from the camp at Mori, and driven back, first on Roveredo, and then on Calliano, where he formed a junction with the mass of the corps. The position of Calliano seemed inexpugnable; but Davidowich, being attacked by a greatly superior force, was compelled to abandon this redoubtable gorge, leaving in the hands of the assailants twenty-five guns and 2000 prisoners. The Austrians retreated in the greatest disorder, and next day the French entered Trent. Meanwhile Davidowich rallied the remains of his corps behind the Lavis; Napoleon, however, resolved to dislodge him; he was attacked by Vaubois, and having in vain attempted to defend the passage of the river, he was thrown back upon Salurn and Neumarck.

In the course of this victorious march, Napoleon learned the movement of Wurmser on the Brenta, and resolved to make the most of it. After a series of successful manœuvres, on the part of the French, Wurmser was attacked on the morning of the 8th of September, and driven back in disorder on Bassano. The French instantly pursued, and reaching the town close on the heels of the fugitives, carried it by main force. Not knowing where to make head, Wurmser, with the left of his *corps de bataille*, retired on Fonteriva, where he passed the Brenta, and took the direction of Vicenza; whilst Quasdanovich, with the right, finding it impossible to gain the Brenta, fell back upon Friuli. In this affair 2000 prisoners, thirty pieces of cannon, and an immense quantity of baggage, fell into the hands of the French. The situation of Wurmser seemed desperate; and he resolved to throw himself into Mantua, and there await the arrival of fresh succours from Austria. A mistake on the part of Sahaguet enabled him to accomplish this more easily than might have been expected.[1] He had flattered himself with appearing before that fortress at the head of 26,000 victorious troops; but in reality he threw himself into the place with no more than 12,000 men, discouraged by defeat, and, instead of raising the siege, about to be themselves invested. The entire garrison having sallied out to forage on the 15th, Napoleon attacked them with his whole force; penetrated as far as St George, which he carried at the point of the bayonet; and having compelled Wurmser to retire within the body of the place, completed the investment of the city and the fortress. The charge of the blockade was intrusted to General Kilmaine, with Serrurier's division, and the rest of the army were placed in observation before the Tyrol.

The position of Napoleon, however, was by no means without difficulty, to say nothing of danger. By the middle of October, Davidowich had received reinforcements which raised the force of his corps to 20,000 men, that of Quasdanovich now amounted to 25,000 combatants, and the Croats were permanently organized into regiments to facilitate the arrival of the levies drawn from the Tyrol, and the recruits raised in the interior. The supreme command was conferred on General Alvinzi, a veteran of high reputation, who, having joined the corps of Davidowich, resumed the offensive, directing that corps by Bassano on Verona, where he hoped to effect a junction with Davidowich, who had received orders to descend the Adige.

Napoleon could not advance to encounter Alvinzi without abandoning Verona, and consequently enabling Davidowich to overthrow Vaubois, unite with Wurmser under Mantua, and thus establish in his rear an army superior in number to all the troops he had been able to collect. Vaubois was too weak to defend the approach to Trent; but in ordering him to assume the offensive, Napoleon hoped to impose on Davidowich. In this, however, he was deceived. On the 3d of November Vaubois was forced to fall back on Calliano; on the 4th Davidowich entered Trent; and on the same day the army of Alvinzi arrived at Citadella and Bassano. At the approach of the enemy Massena fell back on Montebello. Davidowich now marched on Calliano, and Alvinzi prepared to move upon Verona by Vicenza. Napoleon now decided to repeat from right to left the manœuvre which had succeeded against Wurmser from left to right,—that is, after first trying to defeat Alvinzi, and drive him behind the Piave, he proposed to ascend the Brenta, in order to fall upon the rear of Davidowich. With the divisions of Augereau and Massena he advanced towards the Brenta, which the enemy had already passed, and on the 6th attacked their left under Provera at Carmagnano, and their right under Quasdanovich at Lenove, though with only partial success. Provera repassed the Brento, and Quasdanovich withdrew to Bassano without suffering any serious loss. Meanwhile Vaubois, being warmly pressed on the Adige, was, after two days' fighting, driven from the strong position of Calliano, and obliged to retreat on La Corona. Napoleon flew to this division, harangued the 39th and 85th regiments, which had given way at Calliano, and threatened to inscribe on their colours that they were no longer worthy to belong to the army of Italy. Moved with these reproaches, the soldiers shed tears, and swore to conquer or die when next led against the enemy. Napoleon, however, found it necessary to renounce his projects, and to retire on Verona, where he established the head-quarters of the army. The whole country between the Brenta and the Adige being now in the hands of the enemy, the French general began to be closely pressed, and, not choosing to be more so, resolved once more to fall upon Alvinzi. On the 11th he left Verona with the divisions of Massena and Augereau, and next day attacked the enemy, whom he found in position at Caldiero. But a violent tempest which beat in the faces of the troops, and the strong position of the enemy, rendered all his efforts unavailing; he was repulsed with loss, and forced to return to Verona, where his situation now became more critical than ever. He was everywhere too weak; and the fortune which had hitherto so signally befriended him seemed at length to abandon her favourite. Any other general, in his circumstances, would have thought only of repassing the Mincio, and would thus have lost Italy. But in war it often happens, that to gain all a general must risk all. Reduced to this predicament, Napoleon determined to pass the Adige below the left of Alvinzi, and thus to act on his rear. The project was hazardous in itself; but it was nevertheless wise, because it was the only one which still left him some chance of success.

Having recalled Kilmaine with two thousand men from the blockade of Mantua, Napoleon confided to him the defence of Verona, and on the night of the 14th November he set out from Verona for Ronco, where he threw a bridge over the Adige. On the 15th he passed the river, with the divisions of Massena and Augereau and the reserve of cavalry, forming in all about 20,000 men, and advanced by the three dikes which conduct to Arcole. A brigade of Croats, however, profiting by the advantages of the ground, repulsed the attack of Augereau, whose column had been directed on the bridge of Arcole, and afforded time to Alvinzi to come to their assistance. The latter also sent Provera with six battalions to attack Massena at Porcil, and with the mass of his army retrograded on St Bonifacio. But this unforeseen obstacle did not discourage Napoleon. Perceiving that if he could not attain Villa Nova by the

[1] Napoleon never forgave Sahaguet for this oversight, which deprived him of one of the fairest fruits of his victory of Bassano. His plan had been so ably formed, that, but for Sahaguet's blunder, the destruction of Wurmser would have been inevitable.

Napoleon.

left bank of the Alpon, he might act more directly by Porcil on Alvinzi's line of retreat; and sensible that, with this view, as well as to secure his right, and prevent himself from being taken in a *cul-de-sac*, it had became absolutely necessary to make himself master of the village and defile of Arcole, he made fresh efforts to carry the bridge. The greater part of his generals being wounded, he seized a standard, and urged his grenadiers once more to the charge. They advanced boldly amidst a tremendous fire; but the head of the column being shattered the troops gave way, and Napoleon being thrown into the marsh was in imminent danger of being taken. At this critical moment Belliard charged with a company of grenadiers, and rescued the general-in-chief when about to fall into the hands of the enemy. Nevertheless, towards evening, the Austrians abandoned Arcole, on the approach of a brigade which had passed the Adige at the ferry of Albaredo, and was advancing along the left bank of the Alpon. But it was now too late; and Napoleon, not choosing to run the risk of passing the night with his troops crowded in the marshes, in presence of the hostile army deployed between San Bonifacio and San Stephano, and fell back to Ronco, on the right bank of the Adige.

The combat of the second day proved not more decisive than that of the first. It was maintained with equal bravery on both sides; and in the evening Napoleon, from the same motives as before, repassed the Adige. But the third conflict proved decisive. At daybreak on the 17th the French troops resumed their march to the bridge, and drove back the Austrians on Porcil and Arcole. It was not against this point, however, that Napoleon had resolved to direct his principal efforts. Leaving Robert with a demi-brigade to keep the enemy in check, he therefore directed Massena with another demi-brigade on Porcil, whilst the rest of his division remained in reserve near the bridge; and he ordered Augereau to throw a bridge over the Alpon, near the embouchure of the rivulet, so as to be in a condition to act against the Austrian left, and thus take Arcole in reverse. As Napoleon had foreseen, the Austrians, reinforced at Arcole, assumed the offensive, and drove back Robert, whom they pursued with reckless impetuosity. Proud of this success, their deep column continued to advance, and suddenly came upon the main body of Massena's division, placed in ambuscade amongst some willows, who instantly assailed them in flank, cut off 3000 men, and forced the remainder to retire in disorder on Arcole. The decisive moment had now arrived. Augereau developed his attack, whilst some cavalry appeared on the enemy's flank; Massena debouched by Arcole and St Gregorio; the little garrison of Legnago threatened the enemy's rear; and the latter, unable to maintain themselves in ground favourable for acting on the defensive, were reduced to the alternative of either accepting battle in an open country or commencing a precipitate retreat. Alvinzi durst not risk the former, and on the 18th he retired on Montebello, leaving Napoleon at perfect liberty to turn upon Davidowich.

After a few more successful encounters, which will be found detailed in the article FRANCE, Napoleon had rendered abortive all the efforts of Austria. A fourth army had been baffled; and for two months after the last day of Arcole the French general remained undisputed master of Lombardy. To him this interval was of great importance, as it enabled him to take the necessary measures for consolidating his conquests, and also to procure reinforcements sufficient not only to put him in a condition to maintain himself, but also to insure the fall of Wurmser, and to strike a blow at the very heart of the Austrian monarchy.

All that Napoleon had yet done seemed like the web of Penelope; it was invariably undone by the constancy with which the cabinet of Vienna reinforced its army of Italy, and by the negligence of the Directory, which had so long delayed to afford him adequate support. In fact, he was treated by the government of France as Hannibal had been by the senate of Carthage. But public opinion forbade the sacrifice of a general and an army that had gained so many victories; and, as the battles of Arcole showed that both were within a hair's-breadth of being expelled from Italy, it was at length resolved to adopt decisive measures. Accordingly, the fine divisions of Bernadotte and Delmas, drawn from the armies of the Rhine, were, notwithstanding the winter, directed across the Alps, and, on joining the French army, would have made its total strength about 75,000 men. On the other hand, by the end of December, Alvinzi having under his orders upwards of 40,000 men, resolved to descend from the mountains, and make another effort for the relief of Mantua. For the fourth time, therefore, the possession of that important place was to be submitted to the arbitrement of arms.

Napoleon.

Whilst waiting the arrival of the reinforcements which he expected from the Rhine, Napoleon, apprized that Alvinzi had assumed the offensive, flew to the Adige, to watch the development of his attack. At this moment the division of Serrurier was before Mantua; that of Augereau occupied the line of the Adige from Verona to Legnago and beyond it; Massena was at Verona; and Joubert, with a fourth division, held the important positions of La Corona and Rivoli. Each of these divisions was about ten thousand strong; and Rey, with a reserve of four thousand, occupied Desenzano. The imperialists, as if determined to profit by no lesson, advanced at once on the centre and the two wings of the French army, by Roveredo, Vicenza, and Padua; but Napoleon, as he had not yet ascertained in which of these three directions Alvinzi was carrying the mass of his force, resolved to keep his positions until the Austrian general had developed his projects. On the 12th of January 1797, the column which advanced by Vicenza approached Verona, and drove in the advanced posts of Massena. But the division of that general having debouched on St Michel, the enemy was repulsed with loss; and Napoleon acquired the certainty that he was not in force upon that point. Having received intelligence that the principal corps was advancing by the valley of the Adige, Napoleon instantly set out from Verona with the greater part of Massena's division, leaving two thousand men to keep in check the column of Vicenza; and at the same time he sent orders to Rey to advance from Salo on Rivoli, and to Joubert to maintain himself, at any sacrifice, in advance of Rivoli until his arrival.

Soon after midnight Napoleon arrived. It was a fine clear moonlight, and by the enemy's watch-fires, which illuminated the white peaks of Montebaldo, he could easily distinguish five separate encampments. On the morning of the 14th he made his dispositions for battle, and commenced the attack by directing Joubert against the Austrian centre, whilst a demi-brigade was detached to keep in check Lusignan. The enemy sustained the shock with great firmness, and, becoming the assailant in his turn, forced Joubert to give way; Vial, who commanded the right, also retrograded, and the plateau seemed about to be carried. At this critical moment Napoleon, favoured by the vigorous stand made by one of his regiments in the centre, flew to the left, whither he directed the column of Massena, which had just arrived; the enemy were repulsed, and the French left established itself on the heights of Trombalora. The danger, however, was not yet passed. The right was warmly pursued by the Austrians, who had descended from the heights of San Marco; Quasdanovich, having forced the entrenchments of Osteria, was also beginning to ascend the plateau of Rivoli; and Lusignan was moving by Affi upon the rear of the French. Napoleon was in fact surrounded; but an instant's reflection convinced him, that if he could overpower Quasdanovich, he would have nothing to fear

from Lusignan, and that matters might easily be re-established on the right. This intuitive judgment decided the fortune of the day. As soon as the head of Quasdanovich's column appeared on the plateau it was assailed on both flanks by the infantry, and in front by the cavalry under Lasalle; and being forced back into the ravine, it was thrown into complete disorder by the explosion of an ammunition waggon in the midst of the troops when crowded together in the hollow. Confusion and terror reigned supreme; infantry, cavalry, artillery, fled pell-mell by Canale. Having thus got rid of Quasdanovich, Napoleon directed his efforts to support Vial, who was now in full retreat. The Austrians, pursuing with headlong impetuosity, had got into disorder, when a charge of two hundred horse completed the confusion; the panic communicated itself to the centre, which immediately disbanded; and it was only behind the Tasso that Alvinzi succeeded in rallying the fugitives. The fate of Lusignan was now sealed. Attacked by Massena in front and by Rey in the rear, his corps was destroyed, and he regained Montebaldo with only a few hundred men.

On the evening of the battle, however, Napoleon learned that Provera, having forced the centre of Augereau's division, scattered along the Adige, had succeeded in passing the river at Anghiari on the 13th, and was directing his march on Mantua. On the 14th the Austrian general was at Nogara, and on the 15th he arrived before Mantua, into which he hoped to make good his entrance by the suburb of St George. But finding it retrenched and occupied by the besiegers, he next day attacked the post of La Favorita, whilst Wurmser sallied out against that of San Antonio. Serrurier, however, succeeded in maintaining his ground; Wurmser retired into the body of the place; and Provera, assailed on all sides by the forces which Napoleon had promptly directed against him, was forced to lay down his arms. Meanwhile Joubert, acting with equal vigour, pursued Alvinzi without intermission, turned both his flanks, and getting upon his line of retreat, made 5000 prisoners. Having lost half his army, the Austrian general now withdrew the remainder behind the Piave, leaving only 8000 men for the defence of the Tyrol, and the French army resumed the positions which it had occupied before the combats of Arcole. Such, then, was the famous battle of Rivoli, in which Napoleon, with only thirty thousand men, made twenty thousand prisoners. But its most important result was the capitulation of Mantua, which surrendered on the 2d of February, thus rendering the French undisputed masters of Lombardy. The terms granted to Wurmser were much more favourable than he had any reason to expect, with a garrison reduced to the last extremity, and suffering from almost every species of privation and misery.

Whilst Napoleon was at blows with Alvinzi, the court of Rome, seduced by the instigations of Austria, had broken the armistice concluded in the month of June immediately preceding, and raised a considerable body of troops, the command of which was intrusted to General Colli, whom the cabinet of Vienna had sent for the purpose. Thinking it necessary to punish this hostile demonstration, partly as an example to others, and partly also to get rid of an enemy seldom dangerous but always inconvenient, Napoleon formed a division, which he placed under the command of Victor, and directed to march upon Imola in the Romagna, where it arrived on the 2d of February, the very day on which Mantua capitulated. The campaign was neither long nor bloody. A corps of 4000 papal troops, which attempted to defend the Senio, was totally routed; Faenza was carried at the point of the bayonet; and Colli, with about 3000 men, were made prisoners. On the 9th Victor arrived at Ancona, where he compelled 1200 men to lay down their arms; on the 10th his van-guard entered Loretto, and rifled the treasury of the Santa Casa; and by the 18th he had reached Tolentino, where his progress was stopped by the conclusion of peace. The terms were such as Napoleon thought fit to dictate. The pope confirmed the cession of Avignon, the Comtat, and the legations of Ferrara and Bologna; he also ceded the Romagna, obliged himself to pay a contribution of L.1,200,000, and agreed to execute, in the fullest manner, the provisions of Bologna respecting works of art.

The face of affairs being now completely changed, Napoleon hastened to carry the war into the hereditary dominions of Austria. With 55,000 men he resolved to advance against the enemy; and the Directory, with a view to second him, ordered Moreau to repass the Rhine at Kehl, whilst Hoche, after re-organizing the army of the Sambre and Meuse, should again advance upon the Meyn. The cabinet of Vienna had entertained the idea of carrying the theatre of the war into Italy; but it was not till after the capture of Kehl by the Archduke Charles, and the disaster of Alvinzi at Rivoli, that it was resolved to act upon this principle. Accordingly, about the middle of January, the archduke, who had just distinguished himself by a masterly campaign, set out with three divisions of chosen troops to traverse the Tyrol, and to oppose the conqueror of Italy. Meanwhile, as the divisions of Bernadotte and Delmas had actually joined the French army, whilst the Austrian reinforcements were as yet only traversing Bavaria, Napoleon, finding himself ready to take the field before the enemy, resolved to profit by this advantage, anticipate his adversary, and attack him *à outrance*, before his whole force should be assembled. Having arranged his plan of operations, and recalled Victor from Ancona to the Adige in order to cover his communications, he put his army in motion on the 10th of March, and with the mass of his force advanced towards the Tagliamento, whilst Massena was directed to move on Feltre, in order to push the brigade of Lusignan, left in observation on the Piave, and also to menace the right of the archduke. This secondary movement was immediately successful. Lusignan retired, ascending the Piave; but on the 13th, his rear-guard, being overtaken at Longaro, was overpowered, and the general himself made prisoner. Satisfied with having thrown the Austrian brigade on Cadore, Massena now directed his march on Spilimbergo and Gemona, in order more effectually to turn the Austrian right, and occupy the important route of Poteba, of which the enemy might take advantage in order to retire upon Villach. On the 16th Napoleon arrived at Valvasone, on the Tagliamento. The archduke had already commenced his retreat, leaving only a rear-guard on the Tagliamento. But the river being fordable, the French columns rushed into the stream, overthrew the enemy, and pursued them along the road leading to Palmanova. Prince Charles having now divided his army, he himself fell back on Goriza; one of his columns, commanded by Gontreuil and Bayalitsch, with the greater part of the *matériel*, moved by Cividale and the valley of Natisono upon Caporetto; and Ocksay, with the brigade of Lusignan, covered the road from Villach to Chiusa-Veneta. But the Isonzo, from its source as far as Goriza, flows between two chains of mountains which are nearly impassable on the side of Krainburg. Napoleon, therefore, manœuvred against the left flank of the archduke, with the view of throwing him back into the valley of the Isonzo, where his army would have found themselves in the Caudine Forks; and, for a moment, he entertained some hope of accomplishing his object. The left of the enemy was covered by the town of Gradisca, occupied by four battalions. On the 17th Bernadotte attacked the place in front; whilst Serrurier, passing the Isonzo between the city and Montefalcone, took it in reverse, and forced the garrison to capitulate. Directing Guyeux by Cividale on Caporetto, Napoleon now ascended the left bank of the Isonzo, for the

purpose of cutting off the enemy from the road of Czernita, or obliging him to plunge into the valley of the Isonzo by Canale. But as soon as the French general had developed his movement, the archduke fell back, in all haste, upon Laybach, taking the road by Czernita and Adelsberg, closely followed by Bernadotte. Disappointed in one object, Napoleon instantly turned his attention to another, and directed all his efforts against the column of Gontreuil and Bayalitsch, which, being headed by Massena at Tarvis, was thrown back into the gorges of Oberpreth, and being there surrounded, was forced to lay down its arms. On this occasion, 4000 prisoners, 25 pieces of cannon, and 400 baggage waggons, fell into the hands of the conquerors.

From Laybach the archduke had marched by Klagenfurth on St Veit, where he was joined by the first of the reinforcements sent from Germany; but not believing himself even yet in a condition to deliver battle, he fell back upon Neumarck, and on the 30th Napoleon arrived at St Veit. On the 2d of April Massena forced the gorges of Dirnstein, and at Neumarck and Hundsmarck defeated the enemy's rear-guard, consisting of the grenadiers who had just arrived from the Rhine. The archduke continued his retreat on Vienna, and on the 5th Napoleon arrived at Judenburg. But the contest had now reached its term. Two days afterwards, the Austrians, who had received instructions from Vienna touching a letter which Napoleon had addressed to Prince Charles from Klagenfurth, manifesting a desire of accommodation, demanded an armistice, with a view to treat of the preliminaries of peace. To this proposal Napoleon gladly consented. His position was in fact more brilliant than solid. In these circumstances the negotiations speedily advanced towards a favourable issue; and, on the 18th of April 1797, the preliminaries of peace were signed at Leoben, to which the French head-quarters had been transferred.

The conclusion of peace with Austria was almost immediately followed by the annihilation of the republic of Venice. The government of that state had done everything to call down the vengeance of the conqueror. Besides other offences, a repetition of the Sicilian Vespers had taken place at Verona, where every Frenchman found in the streets or houses was butchered in cold blood, and the commandant, General Balland, forced to retire into the castles with 3000 men. Napoleon now hastened to pour the full storm of his wrath on the devoted republic. The senate, in despair, made the most abject offers of submission; but it was too late. The price paid by the republic for its perfidy and cruelty was the surrender of large territories on the mainland, and five ships of war; the payment of three millions of francs in gold, and as much more in naval stores; and giving up twenty of the best pictures, along with five hundred manuscripts.

After the occupation of Venice, and the dissolution of its oligarchical government, Napoleon established his head-quarters at Passeriano, near Udine, where he awaited the arrival of the plenipotentiaries which the emperor was to send to treat of a definitive peace. In order to accelerate the progress of the negotiations, he had, on the 24th of May, signed a preliminary convention with the Duke de Gallo; but the cabinet of Vienna having refused to ratify this act, he repaired to Milan to hasten the organisation of the Cisalpine republic, by annexing to it Modena, Reggio, Brescia, Bergamo, Ferrara, and Bologna—the whole destined to constitute a single state, with about 3,000,000 of inhabitants. He also profited by his stay at Milan to direct the democratic revolution which overturned the oligarchy of Genoa, and placed all the friends of change in entire dependence on France; an event which was soon followed by the establishment of another mushroom state, under the name of the Ligurian republic.

By the treaty of Campo-Formio, concluded on the 3d of October 1797, Austria yielded to France Belgium and the boundaries of the Rhine and the Alps, recognised the Cisalpine republic, and received, as an indemnification for the loss of territory, Venice and her Italian provinces; whilst France assumed the sovereignty of Dalmatia and the Ionian Islands.

Napoleon having thus terminated the most wonderful series of campaigns recorded in the history of war, set out for Paris, where he arrived in the beginning of December. The reception which he met with, on this occasion, was such as would have elated the most modest, and encouraged the least ambitious. It was easy to see that he might aspire to everything in France. Nevertheless, the time had not yet arrived to profit by his fame, and take advantage of his popularity; it was necessary to wait until the Directory had completed its discredit with the country, and lost all hold of public opinion. France had indeed proclaimed him as its hero; but this was not enough, and to become the head of the state, it was necessary to be at the same time its deliverer and restorer.[1]

During the negotiations at Campo-Formio, Napoleon had suggested the idea of a descent upon Egypt, though he did not then think of undertaking it himself. The project had been relished by Talleyrand, who had replaced Charles Delacroix in the ministry of foreign affairs. Napoleon now offered to carry it into execution. Europe he considered as but a mole-hill in comparison of Asia, whence "all the great glories" had come. And from the view which he took of the state of India at the time, he conceived, that in undertaking to open a direct communication with that country he was taking the surest means to strike an effective blow at England. The expedition to Egypt had three objects: first, to establish on the Nile a French colony, which, without having recourse to the system of cultivation by slaves, should supply the produce of St Domingo and the sugar islands; secondly, to open new outlets for French manufactures in Africa, Arabia, and Syria, and to obtain, in return, all the productions of these countries; and, thirdly, setting out from Egypt as a base of operations, to carry an army of fifty thousand men to the Indus, and make common cause with the Mahrattas, the Hindus, the Mussulmans, and all the oppressed races of the Indian peninsula. The last was the grand and ultimate object aimed at.

Egypt, it is true, was then a tributary of the Porte, one of the most ancient allies of France; but as the Mamelukes

[1] On his return to Paris, Napoleon took up his residence in the same small and modest house which he had occupied before his departure for Italy, in the Rue Chantereine, where he resumed his favourite studies and pursuits; contented, apparently, with the society of his friends, and carefully avoiding any act which might seem intended or calculated to invite popular notice or distinction. His society was much courted in the highest circles, and he occasionally received company at home; but pride as well as policy led him to shun notoriety, and shrunk from being stared at in the streets or saloons as the wonder of the day. On one occasion, when greeted with some noisy demonstration of popular favour, "Bah," said he, "they would crowd as eagerly around me if I were on my way to the guillotine." At this period he was reserved and thoughtful, like one too much occupied with serious designs to take any pleasure in the elegant frivolities of fashionable conversation. Wherever he appeared he was the man of Lodi, of Arcole, and of Rivoli, disdaining to disguise his military bluntness in those brilliant circles where a man of an inferior stamp of character would have been ambitious to shine. Piqued by this haughty demeanour, Madame de Staël made various attempts to enlist him amongst the number of her votaries, but without success. "Whom," said she, one day addressing herself to the victorious soldier, "whom do you consider as the greatest of women?" Insinuating a compliment in expectation of an equivalent. "Her," replied Napoleon, drily, "who has borne the greatest number of children." This keen retort was not forgotten, and the daughter of Necker became his declared enemy.

Napoleon.

were the real masters of the country, and in open revolt against the Sultan, it was thought that the Divan, already occupied with the war against Paswan Oglou, pasha of Widin, and that against the Wahabees, and obliged, from weakness, to tolerate the independence of a number of refractory pashas, would not, for a mere shadow of sovereignty, throw itself blindly into the ranks of the enemy. The preparations were accordingly carried on with great activity, but with the utmost secrecy. All was under the direction of Napoleon, and his characteristic energy everywhere appeared. To draw the attention of England from the ports of the Mediterranean, he visited those of the Channel, and affected to occupy himself with the project of crossing it, when his thoughts were directed towards the invasion of Egypt. At length, all being ready, he repaired to Toulon on the 10th of May 1798, and, on the 19th, sailed from that port with thirteen ships of the line, six frigates, and a fleet of transports, having on board 25,000 men. He was joined at sea by the squadrons which had sailed from Bastia, Genoa, and Civita Vecchia, with from 7000 to 8000 men on board, destined to form part of the expedition; and on the 9th of June the whole arrived before Malta. The subsequent history of the expedition, until the return of Napoleon, is fully detailed under FRANCE; and in the article EGYPT will be found an account of the final conquest of that country by the British under Abercromby and Hutchinson. It is clear, indeed, that, after the destruction of the French fleet at Aboukir all the chances of success were changed. It is no doubt true that Napoleon might still hope to maintain himself in possession of the country, provided he succeeded in attaching the inhabitants to his cause. But two serious obstacles presented themselves to the attainment of this object; namely, the maritime blockade, which obstructed all exportation; and the peculiar nature of the Mohammedan religion, which forbids all obedience or submission to an infidel power. Nor were these difficulties lessened by the failure of the attack on St Jean D'Acre, which, in proving that the invaders were not invincible, encouraged resistance and invited hostility.[1] The truth of this was soon exemplified by the landing of a Turkish army of 15,000 men in the peninsula of Aboukir, the fort of which they immediately stormed and carried, putting the garrison to the sword. But they paid dear for this momentary success. On the 25th of July 1799, Napoleon pounced on them like an eagle on its prey, and annihilated them by a single blow.

The destruction of the Turkish army having consolidated the position of the French in Egypt, Napoleon decided on returning to France. Even when before St Jean D'Acre, he ascertained that a new coalition had been formed; and at a later period he received, through Sir Sidney Smith, several English journals, and the French gazette of Francfort, which informed him of the reverses sustained by the armies of Italy and the Rhine, as well as of the successive revolutions which had completed the disorganization and debasement of the Directory. The consummation which he had contemplated before leaving France seemed to have at length arrived; and no obstacle stood in the way to prevent his return to that country. Having left the chief command to Kléber, Napoleon sailed from Alexandria on the 24th of August 1799, with a small squadron of four ships, and, after a passage full of marvellous escapes, landed at Fréjus on the 6th of October. His presence excited the enthusiasm of the people, and was considered by them as the certain pledge of victory. His progress to the capital had all the appearance of a triumphal procession, and, upon reaching Paris, he found that everything was ripe for a great change in France.

Napoleon.

The circumstances attending the revolution of the 18th of Brumaire (9th of November) have been narrated in the article FRANCE. That event was not produced, but only accelerated by the return of Napoleon. The necessity of a change in the existing order of things had for some time been generally felt and acknowledged. The Directorial government having lost all hold on public opinion, and become equally feeble and contemptible, it seemed necessary to replace it by an imposing authority; and there is none so much so as that which is founded upon military glory. Napoleon perceived this in all its force. The Directory could only be replaced by him or by anarchy; and, in such a case, the choice of France could not for a moment be doubtful. Accordingly, all parties now ranged themselves under two distinct banners: on the one side were the republicans, who opposed his elevation; and on the other all France, which demanded it. A *coup d'état* was nevertheless necessary to produce the revolution of the 18th of Brumaire; and this was effected by the employment of the troops, although without spilling a drop of blood. Napoleon had for a moment hoped that the projected change would be carried by acclamation. He was disappointed. But, after a short and noisy struggle, the republic, born amidst anarchy, and baptized in blood, expired in clamour and uproar—Siéyes assisting in the demolition of his own work; and the Directory was replaced by a provisional consulate, with Napoleon at its head. The dissolution of the councils was followed by the appointment of a legislative commission, and to a committee of this body was assigned the task of preparing a new constitution, which was afterwards denominated that of the year VIII.

Great as had been the ability displayed by Napoleon in the field, few expected that he would evince equal talents and aptitude for government. At the very first meeting of the consuls, a lengthened discussion took place concerning the internal condition and foreign relations of France, and the measures not only of war, but of finance and diplomacy, which it either was or might be expedient to adopt. To the astonishment of Siéyes, Napoleon entered fully into all these subjects, showed perfect familiarity with them even in their minutest details, and suggested various resolutions, which it was impossible not to approve. "Gentlemen," said Siéyes, on reaching his house, where Talleyrand and others awaited his arrival, "I perceive that you have found a master; one who can do and will do every thing himself." The work of reform proceeded rapidly and surely: order was everywhere established, and vigour infused into all the departments of the state. The situation of France, however, occasioned him some disquietude; and, notwithstanding the chances of success in his favour, he resolved to sue for peace, which he could then do in good faith, because the misfortunes of the preceding campaigns were not his work. But Pitt turned a deaf ear to the application, and by this refusal obliged Napoleon to enter upon that course of

[1] There are two proceedings connected with this expedition for which Napoleon has been severely and justly censured. The one was the wholesale murder of the remains of the garrison of Jaffa, consisting of 2000 men, who had fallen into the hands of the French after the storming of that town. The ruthless conqueror, seeing no ready way of disposing of these unfortunate men, ordered them at once to be shot; and all who had escaped the terrors of the siege perished in consequence. The other point was the poisoning of those of his soldiers who had been seized by the plague during the siege of St Jean d'Acre. He had resolved to march for Egypt, and the 50 poor plague-smitten patients could not be conveniently removed, when their impatient and unscrupulous commander ordered them to be poisoned by opium. His humanity in other instances on this retreat was certainly highly praiseworthy, yet there can be no doubt that in these two cases he obeyed the spirit which, to a great extent, characterised his entire career. This was, to sacrifice anything, no matter how precious—whether truth, honour, or even human life—whenever it materially stood in his way.

Napoleon. victory and conquest which ultimately extended his empire over the greater part of the Continent.

War being thus inevitable, the First Consul issued a decree, dated the 7th of January 1800, ordaining the formation of an army of reserve, to consist partly of veterans, who were ordered to rejoin their respective corps, but principally of a new levy of 30,000 conscripts. He caused arms to be forged; appealed to the sentiment of national honour, and assembled an army, young, it is true, but full of enthusiasm. The miserable state of the army of Italy has already been noticed; but that of the Rhine, when united to the army of Italy, presented a fine and formidable body of men, the command of which Napoleon intrusted to Moreau, at the same time sending him the recruits necessary to complete his different corps, and to put him in a condition to assume the offensive. The remainder of his disposable troops was directed on Dijon, where he organized an army of reserve, amounting to 40,000 men, which, from that central point, might be ready to march into Suabia, Switzerland, or Italy, according as circumstances should require.

Finding that the attention of Melas was exclusively fixed on Genoa, into which Massena, with the remains of his force, had been obliged to throw himself; and being anxious, if possible, to relieve that place, which was closely invested; he resolved to give the preference to the shorter route of the Great St Bernard, leaving that of the St Gothard to be followed by the corps which were on their march from the Rhine. In the beginning of May Napoleon set out for Dijon, and on the 8th he arrived at Geneva, where he made the necessary dispositions for effecting the passage of the Alps. The operations which followed have been pretty fully detailed in the article FRANCE. By a series of well-combined manœuvres and demonstrations, Napoleon deceived Melas as to his movements, descended like a torrent from the Alps upon his line of communications, and, by a single march, conquered Italy. Genoa had indeed surrendered; but the battle of Marengo, fought on the 14th of June, repaired everything, and, by a victory snatched from the enemy, after he thought the fortune of the day decided, completed at one blow the conquest of Italy. Never as yet had Napoleon been in such imminent peril, not even at Arcole; never had genius and fortune more happily conspired to change the fate of battle. The victory was glorious, and its results were immense. A convention was entered into, by which Melas obtained permission to retire with his army behind the Mincio; and, in return, he consented to give up Coni, Alexandria, and Genoa, with the fort of Urbino, the citadels of Tortona, Milan, Turin, Pizzighetone, Piacenza, Ceva, and Savona, and the castle of Arona.

Meanwhile both parties continued their preparations for a renewal of the contest; and as all hopes of peace had entirely vanished, Napoleon resolved to put an end to the armistice in the middle of November, and, notwithstanding the severity of the season, to recommence hostilities. Moreau and Brune accordingly received orders to denounce the armistice, and between the 17th and the 27th all the French troops were put in motion. The fate of the contest was to be decided in Germany, where hostilities recommenced towards the end of November; and, in a few days afterwards, Moreau obtained a decisive victory at Hohenlinden. The battle was obstinate and bloody, but never for an instant doubtful; indeed it is one of the few instances to be met with in war where complete success was obtained by the literal execution of the plan previously devised by the general-in-chief. Moreau lost not a moment in taking measures to improve his success. The Austrians were forced to sue for an armistice, which was concluded at Steyer on the 23d of December; the cabinet of Vienna having consented to detach itself from England, and to treat for a separate peace. A definite treaty of peace was signed at Lunéville in 1801, by which France secured the boundaries of the Rhine and the Alps. This treaty, in fact, differed but little from that which, in 1797, Napoleon had concluded at Campo-Formio.

But amidst all these successes, the conspiracy of the 3d of Nivose (24th of December) convinced Napoleon that he was still upon a volcano. The plan was simple, for it consisted in obstructing the progress of Napoleon's carriage as it passed along the Rue St Nicaise, and in the same instant exploding a machine crammed with all sorts of combustibles, and hence called *the infernal machine*. Napoleon escaped by a miracle; and the assassins were tried, condemned, and executed, glorying in their design, and lamenting that it had not been successful.

The second coalition being now dissolved, England alone maintained an attitude of hostility to France; but the progress of events soon developed a prospect of an accommodation. Egypt and Malta were at first stumbling-blocks in the way of an arrangement; but the conquest of the one led to an adjustment respecting the other; and at length, after a tedious negotiation, preliminaries of peace were signed at London on the 1st of October 1801, and these were afterwards followed by a definite treaty, which was concluded at Amiens on the 27th of March 1802. But the peace of Amiens, like that of Campo-Formio, proved merely an armistice. It was signed in the midst of mutual suspicion; and, before the ink was dry, difficulties arose, and from day to day accumulated the elements of a speedy and inevitable rupture.

During this short cessation of arms, the attention of the First Consul was occupied with the re-establishment of religion, and the arrangement of a concordat with the pope. The churches were deserted and in ruins; and since the famous civil constitution of 1791, the clergy had been in a state of complete schism. His object was to restore the one and to reconcile the other, but without suffering them to acquire the power and influence they had formerly possessed. His next measure was the establishment of a system of national education; and this was followed by the commencement of the great and difficult but highly important task of providing France with a uniform code of laws. Of the various remarkable codes known generally under the collective designation of *Code Napoléon*, the *code civil des Français* is unquestionably the best. It has continued hitherto to be the law of France, and is perhaps the most valuable result of his extraordinary reign. It was his own proud anticipation that he would go down to posterity with the codes in his hand, and in this he was not mistaken. Innumerable works of public utility were likewise begun. Roads and bridges were planned; museums were founded; and the vain were gratified with rising monuments of magnificence, whilst the reflecting recognised in every such display the depth and forecast of a genius formed for empire. This was more fully evinced in the measures by which Napoleon sought to secure the prolongation of his power. The establishment of the consulate for life, which was decreed on the 2d of August 1802, proved a grand step towards the completion of his designs, and formed the primary base of the edifice which it yet remained for him to construct. This dignity had already been prorogated for ten years by a senatus-consultum of the 6th of May; but on referring the matter to the people, it was decided that the consulate should be conferred upon him for life. He was now virtually sovereign of France. His task was to terminate the Revolution by giving to it a legal character, that it might be recognised and legitimated by the public law of Europe. He instituted, likewise, a new order of chivalry, called the Legion of Honour, which, if it served to further his scheme of empire, did not militate with that equality which alone he sought to maintain.

The causes which so soon led to the rupture of the hollow truce of Amiens will be found recorded in the articles FRANCE and BRITAIN. On the 18th of May 1803 Great Britain declared war against France; and that fierce contest recommenced, which, after an unexampled career of victory on the part of Napoleon, was destined to terminate in his downfall. His first measures were, the occupation of Naples and of Hanover; and his next project was one of a far more daring and formidable character, namely, that of invading England, and thus striking a blow at the heart of his inveterate and implacable enemy. (See BRITAIN.)

The English ministry were not without serious apprehensions as to the result of the threatened invasion; and to cause a diversion, they are said to have countenanced the unwarrantable warfare of plots and conspiracies. The projects of Pichegru, Georges Cadoudal, and others of the same stamp, have already been described in the article FRANCE. That assassination was contemplated by some of them, appears from the evidence of Cadoudal; but the real designs of these men have never been brought clearly to the light. Finding himself exposed to the attempts of desperadoes who aimed at his life, Napoleon resolved to deal a decisive blow, which he considered as indispensable to strike terror into his enemies. A distinguished Bourbon was at the gates of Strasburg; the police pretended to have discovered evidence which implicated him in the designs of those who had plotted against the life of the First Consul; and under the first excitement produced by this information, the fatal command was issued to seize the prince and bring him to Paris. The order was promptly obeyed, and the Duc d'Enghien, having been seized at Ettenheim, in the territory of Baden, was carried to Paris, where on his arrival he was tried by a military commission, as an emigrant who had borne arms against France, condemned, and shot almost immediately after the sentence had been pronounced. This was the most unwarrantable occurrence in the life of Napoleon. That he was misled by the infamous reports of the secret police, and by the perfidious suggestions of those around him, may perhaps be true; indeed, there is good reason to believe that such was the case. He was likewise kept in ignorance of the afflicting circumstances which accompanied the catastrophe; and the appeal made to his clemency by the unfortunate prince was infamously withheld until after the sacrifice of the ill-fated victim had been consummated; but, with every allowance which can justly be made, it must nevertheless be admitted that, in commanding the seizure of the duke in a neutral territory, he became answerable for all the consequences which ensued, and that he had the double misfortune to incur the guilt of a public crime, and at the same time to commit a political error of the greatest magnitude.

The conspiracies intended to subvert the power of Napoleon, however, served only to confirm it; and the necessity of restoring to France an hereditary and stable government had now become equally obvious and urgent. A motion was accordingly made and carried in the Tribunate, that the imperial dignity should be conferred upon Napoleon; the legislative body without hesitation adopted the proposition; and a senatus-consultum appeared, in which he was declared Emperor of the French, with remainder to his male line, or, in the event of his having no children, to any son or grandson of his brothers whom he might choose to adopt as his heir. This decree was sent down to the departments, and on the 1st of December 1804, the prefects reported that between three and four millions of citizens had subscribed their assent to the proposed measure. By the army the elevation of Napoleon was hailed with enthusiasm; and when he visited the camp at Boulogne, he was received with an excess of military devotion. His coronation took place at Paris on the 2d of December, amidst all that was most splendid and illustrious in that capital. The ceremony was performed in the cathedral of Nôtre-Dame, where the Pope officiated on the occasion, and consecrated the diadems, which Napoleon placed on his own head, and on that of the Empress Josephine. In like manner, on the 25th of May 1805, he placed on his head the iron crown of the Lombard kings, in their ancient capital, and henceforth styled himself Emperor of the French and King of Italy; announcing, however, that the two crowns should not be held by the same person after his death.

The history of the wars of the empire belongs to that of France, Spain, Austria, Prussia, and Russia, to which the reader is accordingly referred. The Emperor Napoleon again made an offer of peace, which was rejected, and a third coalition was formed against France. The ostensible objects of this league were, to restore the independence of Holland and Switzerland, to free the north of Germany from the presence of the French troops, to deliver Piedmont, and to compel the evacuation of Italy; but its grand aim and design, in as far as concerned England, was to find employment for the French troops on the Continent, and to avert, for a time at least, the dangers of a threatened invasion. The hopes of the allies were, however, speedily crushed by the decisive victories of Ulm and Austerlitz; and Napoleon would soon have been at liberty to turn his arms against England, had it not been for two events, one of which served in a great measure to counterbalance his successes in Germany. We allude to the battle of Trafalgar, in which, on the 21st of October 1805, the very day after Mack surrendered at Ulm, the French grand fleet was annihilated by one mighty blow, and the means of effecting a descent on England completely destroyed. The other event above referred to was the declaration of war by Prussia, after Austria had been crippled and forced to receive the law from the conqueror, and whilst the Russian army was still behind the Vistula. This rash and headlong conduct was dearly expiated at Jena and Auerstadt, and the dismemberment of the Prussian monarchy formed a just retribution for the double perfidy and presumptuous confidence of the cabinet of Berlin. The campaign of 1807, after a prodigious effusion of blood, terminated with the battle of Friedland; and the peace of Tilsit, which followed, not only confirmed the humiliation of Prussia, but appeared to throw Russia into the arms of France. The French emperor had already made a gigantic stride towards the establishment of an European monarchy, and the effectual exclusion of English commerce from the ports of the Continent, by which means he vainly hoped eventually to reduce Great Britain to the necessity of listening to terms of accommodation.

In prosecution of this system, which ultimately proved the main instrument of his ruin, when, to all human appearance, it seemed about to be crowned with success, Napoleon commenced his aggressions on Portugal and Spain, and thus entangled himself in a struggle which became the proximate cause of his ultimate overthrow. In vain did he bring all his means to bear upon this unhappy contest; in vain did he drive the English under Sir John Moore out of Spain. The formation of a fourth coalition again called him away into Germany, where Austria was actively preparing to take up arms, in the hope of recovering what she had lost, and freeing herself from the yoke of France. The attempt, however, proved unsuccessful; and though accident gave her a temporary advantage at Aspern, the battle of Wagram placed her once more at the feet of the conqueror. At this moment the power of Napoleon seemed irresistible. No enemy opposed him on the Continent except the insurgents in Spain, aided by the English; and had he instantly directed his whole energies to terminate the war in the Peninsula, it is probable that his power would have remained unshaken by any reverse likely to

Napoleon.

befall him. But he judged otherwise; and, in seeking to attach Austria to his interests by a marriage with a princess of the imperial family, he became involved in a system of policy, the ultimate term of which was the abdication of 1814. From this moment his ascending movement was stopped; he had reached the culminating point of his greatness; and though his genius had as yet lost nothing of its vigour, his power began to decline.

The events of 1810 and 1811 belong chiefly to the history of Spain, where the genius of Wellington was gradually but steadily maturing a resistance which every day became more formidable. Those of 1812 were fraught with the destiny of Napoleon. He had long regarded a war with Russia as inevitable. The co-existence of two such empires as those of France and Russia seemed to him incompatible; and differences speedily arose which led to a terrible collision. The preparations on both sides were immense; the fate of Europe, or rather of the empire of the world, was about to be decided in a single campaign; but Napoleon contemplated the conflict without dread, because, in his view, it afforded the only means of terminating for ever the long struggle which had consumed his life. The result is well known. Amidst the frozen steppes of the Scythian wilderness perished those invincible legions which had carried the imperial eagles in triumph to Vienna, to Berlin, to Warsaw, and to Moscow. No such catastrophe had ever been witnessed in modern times; all preceding examples of suffering and disaster in war sank into nothing in comparison with it. Yet Napoleon, undismayed by the magnitude of the calamity, displayed the almost miraculous resources of his genius in repairing the losses he had sustained; and his appearance in Germany early in 1813, at the head of a powerful army, is perhaps the most astonishing circumstance in his extraordinary career. But fortune had now completely changed sides. Victorious at Lutzen, at Bautzen, and at Dresden, he was, through the treachery of his allies, and the faults of his lieutenants, defeated at Leipzig, and forced to retreat beyond the Rhine. Still he maintained the struggle with incomparable energy and perseverance; and never did his transcendent genius for war display itself more resplendently than in the astonishing campaign of 1814, when, by incredible efforts, he struggled, though in vain, to expel the invaders from the territory of France. But the battle of Montmatre, followed by the capitulation of Paris, decided the fate of the campaign, and with it that of Napoleon. The marshals were tired of war, the spirit of the nation had sunk under its misfortunes, the people demanded that a term should be put to their sufferings, and Napoleon himself shrunk from entailing upon France the still greater calamities of a civil war. In these circumstances, he resolved to abdicate, and, on the 18th of April, signed an instrument by which he renounced for himself and his heirs the thrones both of France and of Italy.

The allies having left Napoleon the choice of his retreat, he chose the island of Elba, near to his native Corsica, and set out, accompanied by four commissioners, one from each of the great allied powers. He was allowed to retain the title of Emperor, and to take along with him a small number of those veteran soldiers who had accompanied him in so many dangers, and whose attachment was not shaken by his misfortunes. In traversing France on his way to the place of his exile, he had occasion to observe the extreme divergence of opinion respecting himself; for in proportion as he was beloved and regretted in the environs of Paris and the provinces of the east, he was detested in those of the south, where even the respect due to misfortune was denied him; and he was more than once obliged to put himself under the protection of the strangers, to defend his life against the people who had been so often intoxicated with his triumphs. On the 4th of May he landed in Elba, wherein, being separated from his wife and son, and without any projects for the future, he seemed to regard himself as politically dead to Europe, with no other task remaining for him to perform but that of writing the history of the rise and fall of his power.

Napoleon anxiously watched the progress of events, which outran his expectations; he was also well informed as to what passed at the congress of Vienna; and having learned in time that the ministers of Louis XVIII. had proposed to the congress to remove him from Elba, in order to send him in exile to St Helena, he conceived a project which will appear audacious in history, but which, in reality, circumstances indicated as the only reasonable course to be followed. He resolved to return to France.

His preparations were not long; he brought nothing with him but arms, and trusted that France would provide the rest. After a passage of five days, he landed without opposition at Cannes, near the spot where, fifteen years before, he had disembarked on his return from Egypt. This memorable event took place on the 1st of March 1815. He had no determinate plan, because he wanted particular data as to the state of affairs; his intention was to be guided by events, making provision only for probable contingencies. Nor was he at all embarrassed as to the route he should take; for he required a point of support, and as Grenoble was the nearest fortress, he lost no time in directing his march on that place, which opened its gates to receive him. The enthusiasm of the troops knew no bounds, and the reception which he everywhere met with confirmed him in his project. In fact, his march to Paris was throughout a triumphal procession. In twenty days this new revolution was terminated without having cost a single drop of blood. Amidst the acclamations of all France, Napoleon was reinstated on the throne. The grandeur of his enterprise had effaced the recollection of his misfortunes; it had restored to him the confidence of the French people; and he was once more the man of their choice.

In a proclamation published by the Congress of Vienna to all Europe, it was declared that Napoleon, "by appearing again in France, had deprived himself of the protection of the law, and manifested to the world that there could neither be peace nor truce with him." Nothing remained, therefore, but to commit the future destiny of Europe to the arbitrement of arms. Various attempts were made to open a negotiation with the allies, but all proved abortive; and as Napoleon had no intention to await the onset of his enemies, he resolved to fall upon the Anglo-Prussians before the troops of Austria or Russia could be in a condition to take part in the conflict. By the end of May he had about 180,000 ready to take the field, and by the middle of July this number would have been increased to 300,000; but by transporting the seat of war into Belgium, he would save France from invasion, and perhaps take the enemy unprepared. These considerations decided him to become the assailant. On the 12th of June he set out from Paris, and on the 14th he established his head-quarters at Beaumont, where, in order to profit by the dissemination of the enemy, he judged it necessary to open the campaign without a moment's delay.

Accordingly, he passed the frontier of Belgium on the 15th, and on the following day advanced to Fleurus, where he discovered the Prussian army ranged in order of battle between St Amand and Sombref. Ney had received orders to push forward with 42,000 men by the Brussels road as far as Quatre Bras, an important point situated at the intersection of the roads leading to Brussels, Nivelles, Charleroi, and Namur, and there to keep the English in check, and prevent them from advancing to the aid of the Prussians, whom Napoleon proposed to attack with the 72,000 men that remained under his command. The battle of Ligny followed, in which the Prussians were defeated; and so

complete was the rout, that, of 70,000 men, their generals were never afterwards able to assemble more than about 30,000. A night pursuit would have annihilated them. But Ney had been much less fortunate at Quatre Bras, where he displayed great infirmity, neither bringing his whole force to bear on the English, nor throwing himself back on Bry to act on the rear of the Prussians. The Prussian army being thus defeated, Grouchy was detached in pursuit of it with 35,000 men, whilst Napoleon proceeded to turn his efforts against Wellington. It is not necessary here to detail the operations which followed, nor even to describe that fierce conflict which decided the fate of Napoleon, and with it that of Europe. (See FRANCE.) The result, more fatal to France than that of either Agincourt or Poictiers, is known to every one. By the timely arrival of the Prussians, who had given the slip to Grouchy, and their junction with the English, the French army was not only defeated, but totally dispersed.

Napoleon returned to Paris, in the hope that the national spirit might be roused, and that all good Frenchmen would unite in defending their country against another foreign invasion. But he soon found that he had deceived himself. Misfortune had deprived him of all consideration; he experienced opposition where he least expected it; the chambers rose in a state of insurrection against him; and, in a short time, he was compelled to sign a second abdication. He then decided to retire to America, and at first proposed to embark at Bordeaux, where his brother Joseph had hired a merchant-vessel for the purpose. But he afterwards changed his purpose, and set out for Rochefort, where he arrived on the 3d of July. Finding it impossible, however, to put to sea, and nearly equally perilous to return to the interior, he took the resolution of throwing himself upon the generosity of the prince regent of England; and, on the 15th, embarked on board of the Bellerophon, in Aix Roads. By a formal decision of the English government, he was sent as a prisoner of war to St Helena, where he pined away in hopeless exile, until death put an end to his misery on the 3d of May 1821. In his will he had expressed a desire that his body should be conveyed to France and buried on the banks of the Seine, "amongst the French people whom he had loved so well;" but this request could not, it seems, be complied with until 1840, when, at the request of the government of Louis Philippe, Britain permitted the removal of his remains to France. The body was accordingly deposited with unparalleled pomp and display in the Hôtel des Invalides, on the 15th December 1840. (J. B—E.)

(For particulars of Napoleon's residence in St Helena, and of his endless petty disputes with his keepers Cockburn and Lowe, see the work of Las Cases; and the *History of the Captivity of Napoleon at St Helena, from the Letters and Journals of the late Sir Hudson Lowe*, by W. Forsyth, 3 vols. 8vo, 1853.)

A few words remain to be said regarding the personal character of the man Napoleon. The materials for such an estimate still continue to increase. The memoirs dictated by himself to Count Montholon and General Gourgaud at St Helena possess great value and interest, notwithstanding the disingenuousness which they display, and the amount of misstatement and palpable untruth in which they abound. Facts and dates and characters are all deliberately sacrificed for the purposes apparently of stage effect and theatrical eclat. More satisfactory materials, however, have been recently accumulating for forming a correct judgment of his policy, motives, and general character. The *Letters and Journals* of Sir Hudson Lowe, already referred to, afford not only information respecting the character of the prisoner of war hopelessly chained to his rocky islet of St Helena, but enable the reader, from the striking conversations which they occasionally record, to obtain a true glimpse into his past history. Still more satisfactory materials, however, are to be met with in the *Confidential Correspondence of Napoleon Bonaparte with his brother Joseph, sometime King of Spain*, 2 vols., 1855, selected and translated from the *Memoires* of Du Casse, 1853–55. These letters extend over the period from 1795 to 1815, and refer both to his personal and family history, and to nearly all the remarkable events of his remarkable career. They possess the additional advantage, moreover, of presenting him somewhat in his every-day attire, and may be regarded as the most genuine, because the most unconscious and accidental, disclosure of his character which posterity can now read. They indicate in unmistakeable characters the strange blending of grandeur and meanness, of gigantic power and heartless selfishness, which reigned supreme in his nature. Success was his ruling motive, and to that everything had to succumb. He shed blood like water to make his projects float over all obstacles; and when an object was once set steadily before him, he hewed his way pitilessly on until he reached it. He shot down his prisoners by thousands when they proved an incumbrance, and ordered his own soldiers to be poisoned when they were smitten by the plague. "Sire, General Clarke cannot combine with General Junot, for the dreadful fire of the Austrian battery." "Let him carry the battery," called the chief. "Sire, every regiment that approaches the heavy artillery is sacrificed; Sire, what orders?"—"Forward, forward!" was the reply. "My lads you must not fear death," he said to a regiment of chasseurs before the battle of Jena; "when soldiers brave death they drive him into the enemies' ranks." When the Russian army was making its retreat over a frozen lake after the battle of Austerlitz, the emperor came riding at full speed, shouting to the artillery, "You are losing time: fire upon those masses: they must be engulphed: fire upon the ice!" It is needless to add that the ice was fired upon, and that thousands of Russians and Austrians were buried under the waters of the lake. If the Alps were pronounced impassable; "There shall be no Alps," was made the order of the day. Napoleon can hardly be called cruel or bloodthirsty, but he was as remorseless as fate, and seemed never to have known pity. He would risk everything to gain his end—money, troops, and even himself; but his movements were never reckless, and without due deliberation and insight. "He never blundered into victory," says Emerson, "but won his battles in his head before he won them on the field." "My hand of iron," he said, "was not at the extremity of my arm; it was immediately connected with my head." Embarrassments of conscience and scruples of sentiment and affection were unknown to him. If he had a work to do, nothing could stand in its way. "They charge me," he said, "with the commission of great crimes; men of my stamp do not commit crimes:" such was his justification of himself. While fond of regarding himself, however, as the "Child of Destiny," no man ever more thoroughly understood his business. Nothing was effected by magic; the calmest penetration was brought to bear upon everything; and he knew the value to a grain—of gold, iron, ships, and men, in all their possible combinations. If the enemy had three men for his one, he made the contest a matter of simple calculation; and strained all his superhuman genius for manœuvring and evolution, to attack their forces at an angle, and destroy in piecemeal what he could not crush in the mass. "On any point of resistance he concentrated squadron on squadron in overwhelming numbers, until it was swept out of existence." His troops almost worshipped him: their devotion is best indicated in the order of the day at the battle of Austerlitz, when Napoleon, unlike ordinary generals, promised his troops that he would keep out of reach of fire. With his officers, his freedom and companionship was never so great as with his ordinary troops. "When

soldiers have been baptized," he remarked, "in the fire of a battle-field, they have all one rank in my eyes." He accordingly made merit and personal valour the passports to distinction. The cross of the Legion of Honour was the reward of bravery; and he raised seventeen men from the rank of common soldiers to that of king, marshal, duke, and general. He was nevertheless unjust to his generals when his boundless egotism came in the way; and we find him meanly appropriating the fame due to Kellerman and Bernadotte. Junot, who was true to him through all hazards, he intrigued to ruin, because his manners were too familiar for the taste of the emperor. Here is a glimpse into his relation to men:—"There are two levers for moving men, interest and fear. Love is a silly infatuation, depend upon it. Friendship is but a name. I love nobody. I do not even love my brothers; perhaps Joseph a little from habit, and because he is my elder; and Duroc, I love him too; but why? Because his character pleases me; he is stern and resolute, and I believe the fellow never shed a tear. For my part I know very well that I have no true friends. As long as I continue to be what I am, I may have as many pretended friends as I please. Leave sensibility to women; but men should be firm in heart and in purpose, or they should have nothing to do with war and government." He fought sixty battles, and felt that he must go on fighting or it was all over with him. "My power would fall were I not to support it by new achievements. Conquest has made me what I am, and conquest must maintain me." France both thought and fought with him for a time, but got tired of the game of fighting with her neighbours and impoverishing herself, and in 1814 joined all Europe in crying *assez de Bonaparte*. His absorbing ambition and boundless egotism blighted with death, like the upas-tree, everything that came within his sphere. Millions alike of men and money sacrificed and squandered could, on his principle, produce no permanent result. The world never witnessed a grander attempt to succeed without a conscience. The intellect, the will, the resources of the man seemed often superhuman; but he was destitute of moral principle, and laughed at rectitude. He broke friendship with truth, and thereby exposed himself to that terrible retribution which sooner or later overtakes all insincerity and wrong-doing.

NARANJOS, a cluster of small islands amongst the Philippines, 12 miles N.E. of Masbate. Long. 123. 54. E., Lat. 12. 29. N.

NARBO MARTIUS. (See NARBONNE.)

NARBONNE, a town of France in the department of Aude, pleasantly situated on a branch of the Aude, in a plain surrounded by small hills, about 8 miles from the sea, and 33 E. of Carcassonne. It is surrounded by walls, and entered by four gates. The streets are narrow, crooked, and dirty, and the houses ill built. There are several public walks in the town, the principal being *L'Allée des Soupirs*, which has a very fine appearance. The cathedral of St Just is the principal building in the town; it is a fine Gothic edifice of the thirteenth century, and is remarkable for the height of its roof, which exceeds 130 feet. The high altar and many of the monuments are of marble; but all the statues have been mutilated by the republicans during the revolution. The choir is the only part of this church which has been finished. The church of St Paul, which was also built in the thirteenth century, is in the Romanesque style. The archbishop's palace is a castellated building with an ancient square tower attached to it. Narbonne contains three hospitals, barracks, a theatre, public library, &c.; and has manufactures of verdigris, leather, linen, and bonnets, besides potteries, brickworks, dyeworks, and distilleries. The honey of the vicinity is highly esteemed; and this, as well as corn, wine, oil, brandy, wax, saltpetre, &c., form the principal articles of commerce. The modern town of Narbonne occupies the site of the ancient *Narbo Martius*, a Roman colony founded in 118 B.C. None of the ancient buildings now remain, though the sites of some may still be traced. The old materials were largely used in the construction of the walls by Louis XII. and Francis I.; but many sculptures, inscriptions, &c., have been collected in a museum, which is one of the richest in collections of the sort in France. After the first colonisation of Narbo, many of the soldiers of Cæsar's Tenth Legion were settled here, from whom the town derived the name of *Decumanorum Colonia*. It was taken by the Visigoths in 462, by the Burgundians in 508, by the Franks in 531, and by the Moors in 779. Charles Martel defeated the Moors under its walls, but the town held out until it was taken by Pepin in 759. In the middle ages it was one of the most important commercial towns in this part of France; but afterwards it fell into obscurity, and is now chiefly distinguished for its manufacturing industry. Narbonne was the birthplace of the Latin poet Varro Atacinus, and of the Emperor Aurelius Carus. A court of first instance and one of commerce is held here. Pop. (1856) 12,7[illegible].

NARBOROUGH, SIR JOHN, a British naval commander, was sprung from an old Norfolk family, and became lieutenant of the "Portland" in 1664. His first engagement was in the contest of June 1666, between Prince Rupert and Monk on the one side, and the Dutch admirals Van Tromp and De Ruyter on the other. His conduct in this hotly-contested action was the cause of his rapid promotion. Before two years had passed he was captain of the "Assurance," and in 1669 he was appointed to command an expedition of discovery to the South Seas. Two years were spent in this voyage. In the following year his courage and ability were again conspicuous at the naval battle of Solebay, and recommended him to the notice of the government. He was soon afterwards promoted to the rank of rear-admiral, and dignified with a knighthood. The great honour of his life, however, was his appointment to the command of the fleet sent in 1675 to suppress the Tripoline piracies. After routing several corsairs, and chasing others into their ports, he arrived before Tripoli at the beginning of 1676. Lieutenant Cloudesley Shovel was despatched to negotiate with the Dey, and at the same time to make observations on the harbour. The attempt at negotiation failed, but the position of the shipping was ascertained. Accordingly, at midnight on the 4th March, the boats of the British fleet entered the harbour, burnt the Tripolitan ships, and returned without the loss of a single man. This bold stroke frightened the Dey into agreeing to a treaty. Scarcely had Sir John Narborough returned home, than he was sent with a squadron on a similar expedition against the Algerines. He committed great havoc among these incorrigible pirates, turned his guns against their capital, and forced them to come to an agreement. No sooner, however, had the admiral sailed out of sight, than the Deys of Tripoli and Algiers both returned to their old piratical practices. Soon after his return to England, Sir John was appointed a commissioner of the navy, a post which he held till his death in 1688. (Allen's *Battles of the British Navy*.)

NARCISSUS, a freedman of the Emperor Claudius, became the secretary of his master, and rose to have great influence in the empire. His unscrupulous cunning, and his power over the mind of the emperor, rendered him a useful tool in the hands of Messalina, the profligate wife of Claudius. To gratify her revenge, he accomplished the destruction of Appius Silanus. For the same end he seized the occasion when Scribonianus was condemned for treason, to implicate many innocent persons in the conspiracy. At length the league between these two wily associates was dissolved, and they directed their deadly arts against each other. The wary prudence of Narcissus soon

Nardo | Narses.

gave him the advantage. Hearing that Messalina, in her headlong career of debauchery, had married C. Silius, he hastened to carry the information to the emperor at Ostia. He returned to Rome with the entire command over the person and mind of the facile Claudius, and ordered Messalina to be immediately put to death. For his prompt conduct on this occasion he was raised to the dignity of the prætorship. It was in opposition to the wishes and influence of Narcissus that Agrippina was elevated to the place of Messalina in A.D. 49. A life-struggle arose in consequence between him and the new empress. He continued to retain the favour of the emperor. But the ruthless and ambitious Agrippina framed and executed a plot which ruined both the emperor and his favourite. In 54 A.D. Narcissus was persuaded to visit the warm baths of Campania for his health, and during his absence his master was poisoned, to make room for Nero. His own death was then accomplished without any difficulty.

NARDO (anc. *Neritum*), a town of Naples, province of Otranto, in a well-cultivated district, 9 miles N.N.E. of Gallipoli. It is well built, and has a cathedral, several other churches, and an hospital. Olives are extensively grown in the neighbourhood, cottons and snuff are manufactured, and a considerable trade is carried on in these articles. In the marshes between Nardo and the sea will-o'-wisps are frequently seen, and have given rise to many local superstitions. Nardo, together with Gallipoli, forms the see of a bishop. Pop. 9000.

NARO, a town of Sicily, province of Girgenti, on a river of the same name, 13 miles E. of the town of Girgenti. It stands on a height which is surrounded by fertile and picturesque valleys; and it contains a royal college and a house of refuge. In the neighbourhood large quantities of sulphur are found, in which, as well as in oil and wine, a considerable trade is carried on. Many ancient remains have been found at Naro. Pop. 10,740.

NARSES, a great general who rose, about the beginning of the sixth century, from the humble position of a slave and eunuch in the household of the Emperor Justinian at Constantinople. Possessing the body of a boy and the voice of a woman, he had yet the soul of a hero, and the large mind and persuasive tongue of a statesman. From a menial office in the palace he rose, in course of time, to be chamberlain and treasurer to the Emperor. His talents were next employed in several embassies. To all these duties he proved himself equal. He was therefore fixed upon by his master as the proper person to counteract the influence which Belisarius was gaining over the army in Italy by his successes against the Goths. Setting out for the scene of war in 538 at the head of 7000 men, he joined Belisarius at Firmium. The purpose of his visit was executed with a vigour and thoroughness that endangered the Roman cause. The army was forthwith divided into two jealous factions. Belisarius found himself hampered and thwarted on all sides both in the council and in the field. In vain he asserted, that he had the imperial authority for exacting absolute obedience. Narses pointed out to him in the commission of the emperor the saving clause, "that the officers should obey him in everything compatible with the welfare of the empire." In vain he drew up his army before the walls of Urbino. Narses decamped with a great part of the soldiers during the night. Meanwhile the Goths, released from every check, had burst forth with fresh vigour, laid Milan in ruins, and inundated the northern provinces of Italy. Justinian then saw that it was time to recall his over-efficient servant.

During the twelve years that followed 539, Narses continued to conduct himself with unfailing tact amid the intrigues and jealousies of the court, and steadily to rise in the estimation of Justinian. In 551 he was chosen to recover those parts of Italy which had been wrested by the Goths after the departure of Belisarius. The empire was astonished at the choice. But the despised eunuch accepted the high office, and began to manifest all the spirit and ability of one born to command. Prevailing upon Justinian to surrender into his power the imperial treasury, he used the money with no niggardly hand in purchasing equipments, conciliating the soldiers, hiring mercenaries, and bribing enemies. In the spring of 552, a completely-accoutred army of 100,000 men was ready to follow him to Italy. He set out from Philippopolis, and reached Salona. He then marched along the shore of the Adriatic, attended by his fleet, until he arrived at Ravenna. Nine days were spent in that city in refreshing his soldiers, and in collecting the fragments of the Italian army. Then hastening by forced marches to meet the enemy, he passed under the walls of Rimini, bent his course over the hills of Urbino, and entered on the Flaminian Way. On an evening of July, the Goths under their valiant King Totila appeared in sight near the town of Taginæ. On the following day the battle began; the Romans were completely victorious, and the Goths left their king and 6000 men dead upon the field. The conquerors then took Rome, and proceeded to receive the submission of the neighbouring fortresses. They were still engaged in reducing Southern Italy in 553, when Teias the successor of Totila, setting out from the foot of the Alps, crossed the Po, eluded those who had been sent to intercept his progress, and confronted Narses on the banks of the Sarnus near Naples. Sixty days were spent in skirmishing between the two armies. At length the Goths were compelled by famine to come to an engagement. The battle raged for two days, until King Teias, his bravest chiefs, and the greater part of his army had fallen, and the remainder of the Goths were obliged to surrender. Narses had now given the death-blow to the Gothic power in Italy, and he supposed that the reduction of several towns throughout the country was the only arduous task that now remained. He was mistaken. Before half a year had passed, a horde of 75,000 Franks and Alemanni, under the command of two brothers, the Dukes Leutharis and Buccellinus, poured down from the Rhætian Alps into the plains of Italy. The vanguard of the Roman army under Fulcaris was overwhelmed before them at Parma. Narses himself retired into the fortress of Rimini, and allowed the living deluge to sweep on towards the south. But he immediately set himself to prepare for taking the field, and the winter was spent in exercising his soldiers in all the evolutions of military discipline. In the spring of 554 he mustered an army of 18,000 in the neighbourhood of Rome. By this time a part of the barbarian invaders under Leutharis had returned northward, and had been destroyed by a pestilence on the banks of Lake Benacus. The rest under Buccellinus were advancing from Lucania towards Capua. They took up a strong position on the banks of the Vulturnus, and there they met the approach of Narses. That general, depriving them by a series of skilful manœuvres of the advantage of their ground, attacked them, and almost annihilated their entire army. The Gothic cause in Italy was thus ruined for ever.

Narses was now installed in Ravenna as the exarch of Italy; and for the next fifteen years he ruled with a rod of iron. The licentious soldiery were curbed by a severe discipline; several insurrections were crushed with a merciless rigour; and heavy taxes were wrung from the people to satisfy the avarice of the governor. The Romans, groaning under this tyranny, did not dare to complain during the reign of Justinian. But soon after Justin had ascended the throne in 565, they procured the deposition of Narses. The disgraced eunuch retired to Naples, vowing revenge, and, according to the ordinary account, invited the Lombards to invade Italy. The Romans in their hour of danger remembered their old general, and through the mediation

of the Pope, induced him to take up his abode in the capital. But before he could take any measures to save them from the invaders, he died of extreme old age in 568.

NARUSZEWICZ, ADAM STANISLAUS, an eminent Polish historian and poet, was born in Lithuania in 1733. He entered the society of the Jesuits at the age of fifteen; and his talents soon raised him to distinction among his order. After travelling through Germany, France, and Italy, he became a professor in the college of the nobles at Warsaw. His order was suppressed by an edict of the Pope in 1773. But the king Stanislaus Augustus, taking notice of him, presented him to the bishopric of Smolensk, and encouraged him in his literary pursuits. In 1772, Naruszewicz had exhibited an aptitude for historical writing by a happy translation of Tacitus. He was now employed by his royal patron to produce a history of Poland. This production was published in 6 vols. 1780–86, and speedily took its place among standard historical works. An introductory volume on the early and obscure periods of the country's annals was also projected; and materials to the amount of 360 folio volumes were collected. But the historian never began it. The close of Naruszewicz's life was saddened by the disasters of his country. He was promoted to the bishopric of Lukow in 1790. But he was past enjoying the dignity, and died in 1796. Among his other works are a collection of poems, consisting of odes, satires, epistles, and translations from Horace and Anacreon, a description of Taurida, and a Life of the Lithuanian general Chodkiewicz. The works of Naruszewicz form part of the collection of select Polish authors, published by Motowski in 26 vols. 8vo, Warsaw, 1803–5.

NARVA, a town of European Russia, in the government of St Petersburg, is situated on the Narova, about 9 miles from its mouth, and 80 miles S.W. of St Petersburg. It consists of an old and a new town; the latter of which is built of stone, and inhabited principally by Germans. Narva has a castle, two churches, a town-house, an exchange, and an old castle. Nails are manufactured here; and there are several large sawmills. Narva was formerly one of the Hanse towns; and had an extensive trade; but since the foundation of St Petersburg, it has much declined in importance. It is memorable for the battle fought here in 1700, when the Russians were defeated by the Swedes under Charles XII. Pop. (1849) 4051.

NASEBY, a village of England, county of Northampton, and situated at the sources of the Nene and Avon, 3 miles E.S.E. of Welford. It stands on the watershed between the German and Atlantic Oceans, to the former of which flows the Nene, to the latter the Avon. It is chiefly remarkable as the scene of a decisive battle, fought in 1645, when the army of Charles I. was defeated by Cromwell and Fairfax. Pop. 898.

NASH, JOHN, an architect, of Welsh descent, was born in London in 1752. After studying architecture with unwearied perseverance under Sir Robert Taylor, he became a measuring surveyor and speculative builder. In course of time he retired to a small property at Caermarthen. In 1790, however, misfortune induced him to resort to architecture for a livelihood; and in 1792 he took up his abode in London. He soon acquired extensive business; and in 1797 he is found receiving a patent for a new mode of using hollow iron boxes in the construction of the arches and piers of bridges. In 1812 he was employed to plan the laying out of Regent's Park, of which he afterwards designed all the terraces, except Cornwall Terrace. A more successful undertaking was the planning of Regent Street in 1813. In carrying out this plan, he endeavoured to give a picturesque effect by uniting several houses into one façade, and covering the bare brick walls with the newly-introduced Roman cement. In 1815, through royal favour, he was appointed architect, valuer, and agent for letting land, to the Board of Woods and Forests. In this capacity he laid out the routes and designed the architecture of several streets. He also assisted Repton in altering and enlarging the Opera House in 1816-18, built the Haymarket Theatre in 1820-21, commenced Buckingham Palace in 1826, and superintended the improvements in St James's Park in 1827-29. The large fortune which Nash had acquired from these and other enterprises enabled him to retire in 1834. His death took place in May of the following year at East Cowes Castle.

NASH, *Richard*, better known as "Beau Nash," a famous master of the ceremonies at Bath, was the son of a gentleman of limited means, and was born at Swansea in 1674. From Caermarthen School he was sent to Jesus College, Oxford, to prepare himself for ultimately studying law. But that thoughtless love of amusement which afterwards became his ruling passion soon began to influence him. At the age of seventeen, he entered into a matrimonial engagement, which caused his expulsion from the university. A commission in the army was then bought for him. But even the barrack life of a soldier was too serious an employment; and so, under the guise of studying law at the Middle Temple, he devoted his life to pleasure. A fairly acquired success at the gaming-table supplied him with money. His fine clothes, his imperturbable effrontery, and especially his scrupulous attention to all the ceremonies of polite life, introduced him in a short time to the leaders of fashion. So eminent a master did he become in the science of gentility, that the members of the Temple appointed him to conduct the pageants with which, in accordance with an old custom, they entertained King William. This difficult duty was performed with a masterly tact, and would have been rewarded with a knighthood had not the uncertain income of the "beau" been inadequate to maintain such a dignity. The notoriety of Nash, however, did not commence until he repaired to Bath in 1704. That city was then a paltry watering-place, where a few visitors sought for health and pleasure in comfortless lodging-houses, ill-regulated entertainments, and assembly-rooms perfumed with tobacco-smoke. With his usual forwardness of spirit, Nash got himself appointed master of the ceremonies, and inaugurated his rule by a thorough reformation. By his exertions a handsome assembly-hall was erected, the streets and houses were improved and ornamented, and Bath began to assume the appearance of a city consecrated to pleasure. Good breeding was installed as the ruling principle of the balls and entertainments, and was guarded by a code of laws rigorously enforced upon all. He constituted himself umpire of all quarrels, and prevented appeal from his decisions by forbidding swords to be worn. He also endeavoured, gambler though he was, to keep the thoughtless young of both sexes from the clutch of designing villains. At the same time, his exertions for the improvement of the city, his native vivacity, and his free though sometimes misdirected benevolence, made him popular with the people of the town. In his old age, however, the act of Parliament against gambling deprived him of the means of subsistence. The absurd pomp with which, in his character of "King of Bath," he was wont to secure the respect of the frivolous and the vulgar, could no longer be maintained. The glory of the old beau faded simultaneously with the gaudy trappings that decked his ungainly person. Yet with tottering steps he continued to pursue those vanities which no longer afforded him any enjoyment. He died in February 1761, and was honoured with a public funeral. A *Life of Richard Nash*, by Goldsmith, was published anonymously, in 8vo, London, 1762, and has been reprinted in the edition of Goldsmith's works by Peter Cunningham, in 4 vols. 8vo, London, 1854.

NASH, *Thomas*, the most brilliant pamphleteer of the Elizabethan age, was born about 1564, at Lowestoft in Suf-

Nashua.

folk. He became a student of St John's College, Cambridge, and in 1584 took the degree of B.A. With this honour, however, his university career closed. His satirical faculty began to try its edge upon the college authorities; and he was in consequence expelled. The next few years seem to have been spent in visiting the Continent, and moving about without any settled employment. At length, in 1589, he took up his abode in London as a literary adventurer. His pugnacious propensity hurried him at once into the contest with the Puritans. He attacked them with their own favourite weapons of ridicule and invective, and proved more than a match for them. ***Pap with a Hatchet***, ***An Almond for a Parrot***, and ***A Countercuffe to Martin Junior***, following each other in rapid succession, overwhelmed his opponents with a shower of humorous sallies and cutting jibes. Such a clever satirist could scarcely fail to attract notice. Accordingly he soon became a reigning wit at supper-tables, and a choice boon companion among literary men of pleasure. He was also employed in 1590 to assist Kit Marlowe in composing ***The Tragedy of Dido***; and in 1592 a comedy of his, entitled ***Summer's Last Will and Testament***, was played before Queen Elizabeth. But the wit and the fancy that were so active and lively amid the din of controversy were dull and spiritless in the calm region of the drama. This failure in writing for the stage cut off Nash from almost the only source from which the professional authors of that day derived a tolerable pittance. It is no wonder, then, that we find him in 1592 in the midst of bare poverty, writing ***Pierce Penilesse, his Supplication to the Divell***; and, with the graphic strokes of one who was representing a stern reality, describing himself as "sitting up late and rising early, contending with the cold, and conversing with scarcitie," cursing the day of his birth, and scarcely restraining himself from ending his misery with his own hand. His ***Christes Tears over Jerusalem***, published in 1593, is written in the same strain. But this melancholy was soon shaken off, when about this time he got once more into the congenial region of satire, and began to attack Dr Gabriel Harvey. That worthy individual, the friend of Spenser and Sir Philip Sidney, was then the common butt of some of the most mischievous wits about town. But "that restless buffoon Tom Nash," as old Anthony Wood calls him, used him worst of all. He twisted the many foibles of the pedantic doctor into the most ludicrous and grotesque shapes, and exposed them to ridicule. He raked up every family scandal, and cast it in his teeth. He even sketched the appearance of the lank and shrivelled old scholar with all the vivid fidelity of a portrait-painter, and held it up before the original to make him mad. In vain the learned doctor most manfully wielded his stately invective and cynical humour. These cumbrous weapons were no guard against the keen and light shafts that came pouring in upon him. The most pungent of Nash's pamphlets in this memorable contest were, ***Strange Newes of the Intercepting certaine Letters and a Convoy of Verses***, 1592, and ***Have with You to Saffron Walden***, 1596. At length, in 1597, the battle waxed so hot that the Archbishop of Canterbury interfered, and issued an order that all the books of both the combatants should be seized. In the same year Nash was again employed to write for the stage, and, conscious probably that the faculty of ridicule was the only power of his that could achieve success, he produced a satirical play called ***The Isle of Dogs***. The lash, however, had been plied too vigorously. Scarcely had the drama been performed, when the author was lodged in the Fleet prison. He seems to have lain there for several days. This play is his last work on record. His death took place in 1600 or 1601. (See Disraeli's *Calamities of Authors*; and Collier's *History of English Dramatic Poetry*.)

NASHUA, a town of the United States, North America, in New Hampshire, situated at the confluence of the Nashua and Merrimack rivers, 31 miles S. by E. of Concord, and 40 N.N.W. of Boston. It has seven churches, three newspaper offices, and a bank. The River Nashua affords a great amount of water-power for machinery; it has a fall of 65 feet in 2 miles, and at the driest season discharges a volume of 180 cubic feet per second. Its waters are connected with those of the Merrimack by means of a canal. Nashua is remarkable for its manufacturing industry. The total value of the capital invested in various manufactures is about L.800,000, and the number of hands employed 2300. Cotton is the principal article produced. Machinery, iron, &c., are also manufactured here. The town is connected by railways with the principal towns of New England. Pop. 5820.

Nashville
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Nasmith.

NASHVILLE, a town of the United States, North America, capital of the state of Tennessee, is situated on the left bank of the Cumberland River, 230 miles E.N.E. of Memphis, and 206 S.W. of Lexington. It is built on a limestone hill, in the midst of a rich and fertile country; and contains many splendid houses and public buildings. There is a fine square, in which stand the court-house, market-house, and other edifices. The capitol, which was built in 1845, stands on a height called Capitol Hill, 175 feet above the river, and is one of the finest buildings in the States. It is built of limestone, and is 240 feet in length, by 135 in breadth. It contains halls for the state legislature and government offices, and is calculated to have cost L.200,000. The court-house is also a very fine building, with a dome, and a colonnade in the Ionic style. The town has also numerous churches, many of which are very handsome buildings; a university, founded 1806, which had in 1856, 7 professors, about 75 students, and a library of 10,207 volumes; a medical college in connection with the university; several schools; a penitentiary; and a lunatic asylum. Nashville has several manufactories of different kinds, and is the centre of an extensive trade. The River Cumberland is navigable up to this place; and the amount of tonnage belonging to the town in 1852 was 4083, entirely employed in steam navigation. The town is rapidly increasing in wealth and prosperity; and is the centre of several railways, completed or in progress. The assessed value of taxable property in 1857 was L.2,726,327. Pop. (1850) 17,502; (1853) about 20,000.

NASMITH, DAVID, the founder of city missions, was born in Glasgow in 1799, and was early placed in a mercantile house. From the age of fourteen onwards, his life was devoted to the welfare of his fellow-men. He began his philanthropic career by imparting religious instruction to prisoners, and exerting himself to establish schools and Bible associations. The next undertaking that engaged his attention was the establishment of young men's societies. So successfully did he execute this project, that between 1823 and 1826 he had been the means of instituting seventy of these associations in Great Britain, France, and America. He then addressed himself to the great work of his life, the converting of the irreligious of large towns. The Glasgow city mission, established in 1826, was the first result of his zeal. Stimulated by this success, he resolved in 1828 to devote himself entirely to his great enterprise, and accordingly resigned his situation of clerk to the Institution House in his native town, an office which he had held for seven years. On a scanty pittance, supplied by some friends, Nasmith travelled through Ireland, the United States, and Canada, founding missions in all the large towns which he visited. The British capital was the next great field of his labour. Taking up his abode there in 1835, the unwearied philanthropist was engaged for the remainder of his life in establishing the London city missions. Meanwhile the rest of the country was frequently visited, and similar institutions were founded in the large towns of England, and in Edinburgh and the other principal towns

of Scotland. He was abroad on his great errand when he died at Guildford in November 1839. Memoirs of Nasmith, by Dr John Campbell, were published in 8vo, London, 1844.

NASMYTH, ALEXANDER, a popular Scottish artist, was born in Edinburgh in 1758. His first lessons in art were received in London under Allan Ramsay, and he completed his studies in historical, landscape, and portrait painting during a residence of several years at Rome. Then returning to his native country, he settled down in Edinburgh as a portrait-painter. Among other likenesses, he executed the well-known portrait of Robert Burns. In course of time, however, his strong taste for sketching landscapes led him to concentrate his attention exclusively on this kind of painting. The pictures he began to produce were not characterised by vigorous pencilling or life-like colouring; yet their tasteful simplicity and careful finish rendered them popular among his countrymen. At the same time, he was rising into notice as a teacher of his art. His services in this vocation continued to be more and more appreciated, until he had acquired, in his later years, both ample practice and large emoluments. He died at Edinburgh in 1840. His eldest son and his five daughters inherited their father's artistic skill.

NASMYTH, *Patrick*, an eminent artist, was the eldest son of the preceding, and was born in Edinburgh in 1786. Like several others of his gifted family, he took to the pencil instinctively at a very early age. His right hand was shortly afterwards damaged by an accident. But its cunning was soon acquired by the left. The almost exclusive attention which he bestowed upon his art speedily rendered him a proficient. Fixing his abode in London at the age of twenty, he plied his pencil in landscape-painting with great vigour and success. The style of his father, which he had adopted, was much improved by the greater warmth of his colouring. His subjects were sometimes Scottish scenery, but he was more successful in representing the placid brooks and rich meadow-landscapes of England. The careful minuteness of detail in some of his pictures was especially admired, and acquired for him the surname of "the English Hobbema." Stimulated by growing popularity, Nasmyth prosecuted his art as enthusiastically as ever. With a reckless ardour he continued to pursue his studies in the open country, under the most inclement weather, until he fell into a decline. As he lay dying in his lodgings in South Lambeth, on the 17th August 1831, a terrific thunder-storm passed over the city. He desired to be raised in bed that he might look on it. Before the thunder had rolled away he had expired.

NASO, a town of Sicily, in the province of Messina, is situated on a hill near the coast, in a richly-wooded country, 43 miles W.S.W. of Messina. It is surrounded by walls, and contains several good buildings. Some trade is carried on at Naso. In the vicinity there are mineral springs. Pop. 8000.

NASSAU, DUCHY OF, a small state of Germany, bounded on the N. by Rhenish Prussia, W. by the same and the River Rhine, S. by Hesse-Darmstadt, and E. by the Prussian Frankfort district, Hesse-Darmstadt, and the Prussian district of Wetzlar; between N. Lat. 49. 56. and 50. 48., and E. Long. 7. 30. and 8. 35. There are besides two detached portions, the one in Hesse-Darmstadt, the other in Hesse-Cassel; and including these, the entire territory has an area of 1810 square miles. The surface of the country is hilly, and in many parts highly picturesque. A range of hills, called the Taunus, in the S., between the rivers Lahn and Main, attain the height of from 2600 to 2800 feet; while another range in the northern part of the duchy, called the Westerwald, rises to the height of about 2000 feet. The Rheingau or Rhine district, noted for its fruitfulness and mild climate, is situated between the Main and the Rhine, to the S. of the Taunus Hills. The chief rivers are, the Rhine, forming the west boundary, and here about 2500 feet wide; and its tributaries the Lahn and Main. The former traverses the centre portion of the duchy, and the latter constitutes its southern frontier for part of its course. Several small lakes occupy the more level parts of the country; while as many as 153 mineral wells are known to exist here. Agriculture and mining are the chief branches of industry carried on. In some parts, especially on the Westerwald, the soil is mostly devoted to pasturage. Rye is the chief crop in the higher districts; while excellent wheat is grown in the lower situations, especially on the banks of the Lahn and Aar. Spelt is produced to a considerable extent, and barley is found almost everywhere, excepting on the Westerwald. The other products are oats and buckwheat, potatoes, rapeseed, flax, succory, tobacco, garden fruits, and grapes. The last form one of the staples of the duchy, which possesses the most famous vine district on the Rhine. It includes, among others, the vineyards of Johannisberg, Rudesheim, Markebrunn, and Gesenheim, and that of Hochheim on the Main. The entire state usually produces wine to the amount of 1,020,000 gallons, of which about three-fourths are from the Rhine district alone.

Of a total area of 1,158,143 acres in Nassau, 493,421 are under forests, 433,684 under tillage, 121,136 meadows, 66,051 pasture, 9598 vines, 4612 gardens, 4041 domains, 769 lakes, and 24,831 waste land, roads, &c. In 1852 the crops were 691,072 qrs. potatoes, 148,982 qrs. rye and buckwheat, and 91,144 qrs. wheat and spelt; and in 1865 there were 195,541 cattle, 136,487 sheep, 44,780 swine, 26,794 goats, 12,090 horses, and 15,097 bee-hives.

Mining is the next most important branch of industry in Nassau. The minerals found include silver, iron, lead, copper, and manganese; but of these, iron is by far the most abundant. It is worked in the valleys of the Lahn and Dill, and the amount produced is, of raw iron, about 12,500 tons annually; of cast iron, about 3500 tons; and of bar iron 3500 tons. The lead mines produce about 1700 tons, the copper about 150 tons, and the silver 11,000 oz. annually. With the exception of those connected with metals, the manufactures of Nassau are unimportant. They consist of linen and woollen goods, leather, earthenware, and paper; besides tobacco, oil, spirits, beer, and potash. The trade of the duchy is carried on by means of the rivers Rhine, Main, and Lahn; and by the Frankfort, Castel, and Wiesbaden Railway. The imports include, among other articles, colonial products, salt, cotton and fancy goods; and the exports, wine, fruit, minerals, cattle, paper, and mineral water. The duchy is a member of the Germanic confederation, to which it sends two representatives, and belongs to the *Zollverein*, or trade union. The government is a limited monarchy, in the hands of the duke, assisted by two chambers of administration. The upper chamber consists of an unlimited number of members belonging to the royal family, nobility, and upper classes, while the lower house is formed of twenty-four members returned from a like number of electoral districts.

All religions are tolerated in Nassau, but the full rights of citizenship are only accorded to evangelical Protestants and Roman Catholics. The former denomination is under the Bishop of Wiesbaden, and the latter under the Bishop of Limburg. The military force amounts to [illegible] men, of whom 4542 form the contingent to the Germanic confederation.

Education is imparted to the people by means of elementary and *real* schools. There were in 1854, 708 of the former, with 902 teachers, and 10 of the latter. In Wiesbaden, the capital, a *realgymnasium* has also been established in connection with the preparatory and middle burgh schools, but no university has as yet been founded in the

duchy. There are several normal schools and seminaries of Evangelical and Catholic theology, and a military academy. The public library of Wiesbaden contains from 50,000 to 60,000 volumes; and there is a museum in the same town devoted to antiquities. Two literary associations have been established, one for history and antiquities, the other for natural philosophy. There is also a *stadt* theatre in the town. In 1849 thirteen newspapers were published in Nassau.

The budget for 1857 estimates the revenue of the state at L.288,397, and the expenditure at L.376,043. The national debt amounts to L.651,000. Of the revenue, about L.6800 is raised from the duty on mineral water, and L.8900 from that on the baths, which are very numerous here. The mineral wells are chiefly in the possession of the duke, and form a valuable property. In 1856 the total population numbered 432,039 persons, of whom 225,681 were Protestants, 198,960 Catholics, 6927 Jews, 341 German Catholics, and 130 Mennonites. Wiesbaden, the capital, contains 16,000 inhabitants. The duchy derives its name from the castle of Nassau, built by the counts of Laurenburg in the beginning of the twelfth century. In 1255 Walram IV. and Otho, the sons of Henry the Rich, divided the territory between them. The former took the earldoms of Nassau, Idstein, and Weilburg, and became the founder of the present family of Nassau. The descendants of Otho, on the other hand, became the earls of Dillenburg and Siegen, and the founders of the House of Nassau-Orange, to which William III. of England belonged. The counts of the older line soon made considerable additions to their territory by acquiring, among others, the lordships of Mehrenberg and Gleiberg. In 1605, after repeated changes, Lewis II., a member of the Nassau-Weilburg family, became sole master of all the lands in the possession of the Walram line. At his death, however, in 1625, the family was divided into the three branches of—1*st*, Saarbruck, divided in the next generation into two branches, called Saarbruck-Sarbruck and Sarbruck-Usingen, both of which were again united in 1735, but became extinct in 1797, and the land devolved on the present line; 2*d*, Idstein, which became extinct in 1721; and 3*d*, Weilburg, on which all the states devolved, and since 1816 have formed but one principality. During the French revolution the city of Saarbruck, with its territory upon the left bank of the Rhine, was seized by the republicans. It then comprehended 430 square miles of land, with 53,000 inhabitants; for which, at the pacification in 1803, it received an indemnification of 750 square miles and 93,000 inhabitants, which were added to the earldom of Usingen. The Count of Weilburg had lost on the left bank of the Rhine 170 square miles and 19,000 inhabitants, for which he received on the other side of that stream a territory of 330 square miles, with 37,000 inhabitants. At the period when Napoleon instituted the confederation of the Rhine in 1806, the whole of these families had been united in the person of the existing prince, who then received, in addition to the former territories which he possessed, a tract of land of 650 square miles, with 84,500 inhabitants, and at the same time the title of Duke was conferred upon the reigning prince.

NASSICK, a town of Hindustan, in the British collectorate of Ahmednuggur, within the presidency of Bombay, situated on the Bombay and Agra trunk road, and regarded by Brahmins as the peculiar seat of piety and learning. It contains a great number of ancient Brahminical temples and establishments, very flourishing under the peishwa's sway, and still enjoying great privileges under British rule; although the government has entirely withdrawn from interference with the affairs of the native religious institutions. The population of the town is estimated at 25,000. Distance from Bombay, N.E., 100 miles. N. Lat. 20., E. Long. 73. 47.

NATAL.

NATAL, a country on the S.E. coast of Africa, about 300 miles N.E. of British Kaffraria, from which it is separated by a thinly-inhabited country called Kaffraria Proper. It lies nearly between 28. and 31. S. Lat., and 29. and 31. E. Long.; and is bounded on the N. and N.E. by the rivers Tugela and Umzimyati, which separate it from the kingdom of the Zulu Kafirs; on the S.E. by the Indian Ocean; on the S. and S.W. by the River Umzimkulu, which divides it from Kaffraria Proper; while on the W. and N.W. the Kahlamba or Drakenberg Mountains wall it off from the territory of the Orange River republic. Its length is about 200 miles, and its breadth from the sea to the Kahlamba Mountains about 100 miles; area about 17,000 square miles.

The country rises from the sea-coast in a series of terraces to an elevation of several thousand feet, and presents a rare variety of scenery, soil, and climate. A sufficiently clear and practical view of the country, however, may be given by representing it as consisting of three general divisions,—1*st*. Along the Indian Ocean is a belt of land about 15 miles in breadth, the greater part of the surface of which rises and falls in a succession of round swelling hills and small valleys, carpeted with long grass, over which are scattered clumps of trees, chiefly of mimosa and euphorbia. In some places the uniformity of the scenery is relieved by forests and dense jungle, in others by vast masses of lofty and abrupt hills and deep ravines. This lovely region favours the vegetation both of the tropics and of southern Europe. Sugar, coffee, indigo, and almost every other tropical plant, flourish, along with the mulberry, olive, and vine. Nor is it unfavourable to some of the productions of a cooler climate; for oats, beans, and potatoes thrive well, especially the first two; maize or Indian corn grows luxuriantly in this as in every part of the country.

2*d*. Having crossed this belt, we ascend into a country where the hills take a longer sweep, something like the downs of Sussex. They are still covered with long grass, but the wood has disappeared, except in small patches in the hollows and on the banks of the streams. The character of the vegetation has changed; we no longer see that of the tropics. Good crops of wheat, oats, potatoes, and other productions of a temperate climate, are produced; and the district is admirably suited for horses and horned cattle. Many fruits also flourish in this part, among which are the orange, pomegranate, peach, apricot, and granadilla.

3*d*. Proceeding still farther, and ascending another terrace, we find the hills more massive, with a still longer and bolder sweep, covered with grass, but generally bare of wood. They are frequently flat-topped, and sometimes expand into table-land. At intervals on the crests of the hills we meet with stony ridges, composed of large boulders, stretching across the country like huge dykes. In the distance farther inland we see rugged hills cut by deep ravines, and beyond them the Kahlamba mountain-range rising abruptly like a huge wall 8000 feet above the sea, and nearly 4000 above the country at its base, with here and there buttresses thrown out like towers and battlements,—in summer casting a dark, rugged outline against the deep-blue sky, and in winter radiant in a mantle of snow. Sweeping round to the N.W., the range sinks into lower hills, presenting a softer outline, with passes winding over them.

Natal.

The long coarse grass of the lower country is here exchanged for a shorter and finer kind; and everything about him tells the traveller that he has now reached a land admirably adapted both for horned cattle and for sheep. He finds, too, that the country produces abundant crops of wheat, oats, and other cereals of England; while he is refreshed by the taste of excellent peaches, apricots, nectarines, apples, pears, walnuts, and other fruits of a temperate climate. Scattered at intervals over the whole face of the country are vast clusters of hills, varying in area from 10 to 20 by 15 to 30 miles. These localities seem to have been subject to some violent convulsions of nature; for the hills, or rather mountains, rear their rugged or scarped sides in every fantastic form, overhanging deep and gloomy glens, the channels of rushing rivers or foaming torrents. Some of these romantic regions are almost surrounded by the comparatively tame scenery of long sweeping hills or table-land.

Rivers.

Throughout his journey from the coast upwards, the traveller crosses innumerable streams and several considerable rivers. He scarcely descends into a valley which he does not find traversed by a brook of clear fresh water. Numerous rivers intersect the country, flowing generally S.E. into the Indian Ocean. The largest of them, as the Tugela, the Bushmans, the Mooi, and Umkomanzi, have their sources in the Kahlamba Mountains; while the others, as the Umgeni, the Umlazi, and the Umvoti, spring from the lower ranges of hills. None of the rivers are navigable. Their sparkling waters flow with great rapidity, now between banks fringed with brushwood, now past the scarped sides of mountains which rise abruptly from their stream. Some of them have fine cataracts, as the Umgeni, near Pietermaritzburg, the sheer fall of which is 280 feet. All the rivers partake of the character of mountain streams,—low in the dry season, filling in a few hours in the rainy weather, and rushing down like torrents.

Geology, soil, &c.

The land on the sea-coast is composed of rounded downs of sand, interrupted by strata of sandstone and shale, traversed by masses of erupted rocks. The latter in some places run out into the sea in the form of dark reefs. Farther in the interior the high lands are composed of stratified sandstone, almost horizontal, and deficient in organic remains. A huge vein of granite seems to run from N.E. to S.W. among these high lands. The Kahlamba Mountains were considered by the late Dr Stanger as divided in regard to geological structure into two parts; one part, forming the W. boundary of the colony—the bold, rugged outline of which we have described—he supposed to consist of granite; for it is so precipitous, and so guarded by rugged hills and ravines at its base, as to be almost inaccessible. The part of the range forming the N.W. limit of the colony exhibits a softer and rounder outline, and is composed of sandstone, with beds of shale traversed by basalt and other volcanic rocks. The soil near the coast seems to be a sandy loam; much of it is formed by the blending of sandstone, shale, and erupted rocks. Farther inland it mostly consists of friable loam, red or brown, resting on clay, ferruginous rocks, or granite. In parts from which wood has been cleared, the soil is a rich vegetable mould. Alluvial soil is not abundant; but at the mouths of some rivers, as well as on parts of their course, level plains occur several hundreds of acres in extent. Iron is found in abundance, and said to be of good quality. Copper has lately been discovered in small quantities. Coal exists in several places, but most of it is rather deficient in bituminous matter, though well adapted for furnaces. In the most remote and perhaps the coldest part of the country, however, there is coal fit for burning in a common fire-place; but none has yet been found sufficiently near the sea to be useful for steam navigation. There are in the upper part of the country some valuable mineral waters, the chief ingredients of which are carbonic acid; carbonate, sulphate, and muriate of lime; and sulphate of magnesia. Their temperature is 125° Fahr.

Natal. Botany.

The flora of the country has been but imperfectly investigated, but it seems to be remarkably rich and varied. It differs from that of the Cape of Good Hope in several respects. Geraniums, heaths, and proteads, so varied and abundant in that country, are here represented by few species, and by no means in large numbers. On the other hand, it has many plants which are either not found, or are but sparingly distributed at the Cape. The tribes chiefly worthy of notice are, the Acanthads; the Amaryllids, having among them the beautiful Natal lily; the Solanads; the Scrophulariads; the Euphorbiads, or spurges; the Papilionaceæ, which are very abundant; and the Asclepiads. Grapes are far more abundant than at the Cape. Ferns are also abundant in some parts. Many indigenous plants grow within the belt of land along the sea, which are hardly ever found elsewhere out of the tropics. Among them may be named three kinds of mangrove, indigo, and the ground-nut.

Climate.

The spring commences in September, and the autumn about March. These transition seasons are, however, short; so that the period from September to March may be considered as summer; that from March to September as winter. The hottest weather is in December and January; the coldest in June and July. In summer rain falls almost daily, accompanied occasionally by thunder-storms. In winter there is but little rain, and the sky is clear and cloudless. In the lower belt of country the average temperature in the summer is 77° to 85°. In winter it ranges from 58° to 70°. In the second division of country, at Pietermaritzburg, the capital, the range of the thermometer in the summer is from 64° to 75°, and in winter from 48° to 60°. The climate, especially for persons taking much outdoor exercise, may be considered as one of the healthiest in the world. Travelling in this country, especially in the early morning, is extremely delightful. The light, elastic, and transparent atmosphere gives an indescribable freshness and vigour to mind and body.

History.

This country was discovered by the Portuguese on Christmas-day 1498, and named Natal in honour of the day. They found it inhabited by a portion of the Kafir race, divided into small tribes, not unfrequently at war with one another, but kind and hospitable to strangers. The Dutch who, after their settlement at the Cape in the seventeenth century, sometimes visited this country, gave a nearly similar account of its condition. Little more is known of it till 1810, when a remarkable man arose in the neighbouring country of the Zulu-Kafirs. This was Chaka, originally the chief of an inconsiderable tribe of Kafirs called Zulus, but who became the chief of another more powerful tribe. The united tribes under his rule became a great nation, and conquered and destroyed other tribes of Kafirs far and wide. Nearly the whole population of Natal was swept away, being either annihilated or incorporated with the conquerors. Of the few who escaped, some fled into the country beyond the Kahlamba Mountains, and others to the Cape frontier, where, under the name of Fingoes, they became the serfs of the Amakosa Kafirs. In 1824, during the reign of Chaka, Lieutenant Farewell and a small party of British emigrants, chiefly from the Cape, settled in Natal, which they found almost depopulated. Chaka received them kindly, and ceded to them a considerable part of the country. In 1828 Chaka was murdered at the instigation of his brother Dingaan, who assumed the sovereignty. In 1837 a party of the Dutch boers, who, as mentioned in our article CAPE OF GOOD HOPE, had emigrated from that colony, arrived in Natal; they were welcomed by the British settlers and Retief their leader proceeded to the residence of Dingaan to obtain from him a cession of some part of the country. That chief consented to comply with his wish, upon condition of his recovering for him a large number of cattle stolen from him by a neighbouring tribe. The cattle were recovered; and Retief, accompanied by 60 Boers, proceeded to the residence of the Zulu chief, by whom he was received with apparent cordiality. With the aid of an English missionary, the Rev. Mr Owen, who resided near, a treaty was drawn up by which the whole of Natal was ceded to the Boers. Retief was, however, warned by Mr Owen's servants that the king meditated treachery, but he treated their warnings with indiffer-

Natal.

ence; and so completely did the wily chief, by marks of friendship and hospitality, succeed in disarming the suspicion of his guests, that as they were on the point of leaving him, he induced them to present themselves without their fire-arms, before himself and an array of his most trusted warriors, whom he had ordered to be drawn up to do honour to them on their departure. The warriors chanted the war-song in honour of their guests. In a short time the chief himself intoned a song, in the course of which he uttered the terrible words "Kill the wizards!" In an instant the lines of savage warriors closed in on the Boers, and butchered them to a man in cold blood. Dingaan then despatched a large force to attack the rest of the Boers, scattered in small encampments over the country. Some of them were surprised, and men, women, and children were murdered; others, who had time for defence, repulsed their assailants. A deadly war ensued between the Boers and the Zulus, in the course of which was fought a battle memorable in the annals of border warfare. A handful of Boers, not 400 strong, were encamped in a bend of a small river with precipitous banks, and protected on the outer sides by a barricade formed, in their usual manner, by their waggons lashed together. In this position they were, one Sunday morning in 1838, attacked by Dingaan's forces, upwards of 12,000 strong. A terrible conflict ensued. The Zulu warriors marched up in dense columns, and hour after hour strove in vain to storm the camp. Their close battalions were one after another shattered to pieces by the terrible fire of its brave defenders. At length, towards the afternoon, the attacks of the Zulus became fainter, and their whole army was observed to waver; then the Boers mounted their horses, opened their barricade, and charged their assailants, who broke and fled. The Boers pursued them for many a mile, shooting them down without mercy. The victors lost but two or three men; while the loss of the Zulus is said to have exceeded 2000. After this the war continued with varied success. In the meantime the governor of the Cape, in consequence, as he stated, "of the disturbed state of the natives, arising from the unwarranted occupation of the country by certain emigrants being her Majesty's subjects," sent to Natal a small detachment of troops to prevent further bloodshed, for which purpose it was utterly useless, and was not long afterwards recalled. Towards the close of 1839, a brother of Dingaan, named Panda, whom he had for some cause resolved to put to death, went over to the Boers, carrying with him 4000 men. The combined forces then took the field, but as the Boers did not fully trust their new allies, they kept during the march some miles apart from them. Panda fell in with Dingaan's army and totally routed it, chiefly owing to several of its regiments going over to him during the battle. Dingaan fled from the field with a few followers, and sought refuge with a tribe near Delagoa Bay, by whom he was murdered. The Boers then proclaimed Panda king of the Zulus, and declared their own paramount sovereignty to extend not only over Natal, but over the Zulu country.

They, however, only occupied Natal, where they established a republican form of government. That country at this period seems not to have contained more than 12,000 to 15,000 natives, the broken remnants of tribes who, by hiding in the mountains and forests, had escaped destruction from the Zulu armies. In a short time, however, a considerable number of Panda's subjects flocked in to put themselves under the protection of the Boers. Alarmed by this large accumulation of natives in Natal, the Boers resolved to remove a part of them to a country farther to the south. This project, and also an attack made by the Boers on a tribe in that quarter, represented probably with exaggeration to the governor of the Cape, caused him to resolve to take military possession of Natal. A detachment of troops under Captain Smith accordingly arrived at the port, and encamped in the neighbourhood. The Boers refused to recognise the authority of this officer, annoyed his force in every way, and demanded that he should quit the country. Upon this Captain Smith made a night attack on their camp, situated at the upper end of the harbour of Port Natal. He was repulsed with severe loss, and forced to shut himself up in his camp, which for several weeks he and his little force defended with great gallantry, being compelled to kill their horses for food. In the meantime a Mr King, one of the British settlers mentioned above, started on horseback overland to inform the authorities at the Cape of the position of the troops; and on the 26th June 1842, Colonel Cloete, despatched by the governor of the Cape, arrived at the Port with a detachment of troops on board her Majesty's ship Southampton. To this force the Boers made a feeble resistance, the port was taken, and the gallant little band under Captain Smith relieved. Finding further resistance hopeless, the Boers entered into a negotiation with Colonel Cloete. With few exceptions, a general amnesty was granted to them, and protection promised them against the natives. Their private rights to their lands were guaranteed to them, but the special terms by which they were to hold them was reserved for the decision of the government. Shortly after this, Colonel Cloete left Natal, and the command again devolved on Captain Smith. On the military occupation of Natal by government, the natives from the Zulu country poured into it in crowds, and it was then that probably the great bulk of Kafir population settled in it. In 1843 the government signified its decision in regard to the property in land, by causing the governor of the Cape to issue a proclamation declaring that lands were to be held by payment of a small annual quit-rent, and providing for the recognition of claims to particular farms, but confirming such recognition to the cases of persons who had occupied their farms claimed for a year next previous to the arrival of a commissioner to be appointed to register such claims. The commissioner, Mr Cloete, was at the same time sent to Natal. This limitation was scarcely in accordance with the terms of the convention, and was manifestly unfair, as pointed out by Mr Cloete. In the disturbed state of Natal during the preceding year, in a great measure the result of the arrival of her Majesty's troops, which gave courage to the natives to harass the Boers in every direction, it was absolutely necessary for the latter to throw themselves together into camps for their protection, and it was thus impossible for them, in the majority of cases, to occupy their farms. Mr Cloete seems to have done as well as he could under the circumstances. He registered a number of claims as coming strictly under the terms of the proclamation, and a number of others as entitled to favourable consideration. The government, on reference home, would only confirm claims of the first kind; and unfortunately even these claims, or rather rights, were not long afterwards interfered with in several ways. This, added to the previous dislike of the Boers to British rule, caused a large part of them to emigrate from Natal to countries beyond, where, under their leader Pretorius, they again measured their strength with her Majesty's troops. Several attempts have since been made to conciliate them by further and liberal grants of land, but with only partial success; their confidence once destroyed, could not be restored. The errors of the government with regard to them in this respect arose from its attaching too great a value to the grazing land mostly occupied by the Dutch, and its failing to see that Natal, with the large Kafir population within and around it, could not be held by the handful of troops it had there without the presence of the Boers; for, even if British immigrants could have been at once poured in, they could not have supplied the place of men inured to the native warfare. These errors were perceived by Sir Harry Smith, when governor of the Cape in 1848, and the measures devised by him, and carried out by the late lieutenant-governor, by retaining a remnant of the Boers in Natal, contributed largely to the tranquillity of the country, which has enabled it to assume its present satisfactory position. In 1845 Natal was constituted a part of the Cape Colony, and the Roman-Dutch law introduced. But in the same year it was again made a separate government, to be administered by a lieutenant-governor, under the general control of the governor of the Cape.

Government.

On the establishment of the colony, the executive functions of government were committed to a lieutenant-governor, assisted by an executive council composed of four chief officials. The legislature consisted of the lieutenant-governor and a council of only three principal officers; so the government remained until 1856, when the crown granted representative institutions. The legislature now consists of the lieutenant-governor and a council composed of four chief officers, who are ex officio members, and of twelve members elected by the people of the several counties and towns of the colony. The qualification for voters is the possession of freehold property worth L.50, or the occupation of property at an annual rental of L.10; all voters are eligible as members. The executive council is still composed exclusively of permanent officers of the government. By the new constitution Natal is made wholly independent of the Cape.

Each of the counties is presided over by an officer, called the resident magistrate, possessing limited judicial and executive authority. By a law passed in 1854, each county is entitled to a local council, consisting of the resident magistrate, the clerk of the peace, and of persons elected by the inhabitants. The qualifications of electors and members are the same as those for the general council. This system, owing to circumstances, has not hitherto worked well; but we see with regret that proposals are made to abolish it. It probably requires change, but to do away with it seems a step backwards; we are convinced that the prosperity of colonies greatly depends upon such local institutions.

The towns possessing 1000 inhabitants, or upwards, are also entitled to local self-government in the form of corporations. The governing body consists of councillors elected by the people, and a mayor chosen from their number. This system is in operation in the two towns, and works well.

The Roman-Dutch law is the common law of the colony, constituted by ordinances of the local legislature. Trial by jury, both

Natal.

in criminal and civil cases, has been introduced. The courts of law are,—1st, The supreme court, presided over by a single judge, styled the Recorder; 2d, The courts of the resident magistrates of counties, whose criminal jurisdiction extends to cases not punishable with death or transportation. They can only punish by indicting three months' imprisonment and 25 lashes on an offender, and they can only fine to the extent of L.10. In civil cases their jurisdiction only reaches cases when the amount in dispute does not exceed L.15, with the exception of that of the magistrate of Port D'Urban, which extends to cases involving L.100. From all these courts there lies an appeal to the supreme court. Owing to the uncivilised and peculiar state of the natives in the colony, they are in some respects placed under a different system of government from that applicable to the white inhabitants.

For some time after the establishment of the colonial government the natives were in practice governed by their own laws, administered by Mr Shepstone, under the title of diplomatic agent; a gentleman who, by his tact, ability, and perfect knowledge of their language, had acquired considerable influence over them. This peculiar jurisdiction was legalised in 1848; for Lord Grey, then at the head of the Colonial Office, clearly seeing that it would be impracticable and dangerous to attempt to rule men in a state of barbarism by laws framed for a highly-civilised society, advised Her Majesty to issue letters-patent, retaining and confirming, as to the natives of the colony, their own laws, except so far as they might be repugnant to the general principles of humanity as recognised throughout the civilised world. The lieutenant-governor is armed, as to the natives, with all the powers of a supreme or paramount chief, and with the right to delegate his authority to subordinate officers. In this capacity he is assisted by Mr Shepstone, under whom are magistrates distributed over the colony charged with the administration of native law. These magistrates, for the sake of convenience, are the same persons as the resident magistrates mentioned above; but their jurisdiction is in this respect distinct, and in native cases an appeal lies from them to the governor, and not to the supreme court. It is considered that native law is applicable to cases civil and criminal between natives, and also between the government and natives. In cases of murder and some other crimes, the supreme court has co-ordinate jurisdiction. The crime of cattle-stealing by natives, however, which, if not promptly checked, leads to war and bloodshed, has been placed under the exclusive cognisance of native law, which is far better fitted to deal with it than more civilized codes. Cases of this kind are tried before two magistrates and the chief of the tribe to which the accused belongs.

The system of native government, in spite of some defects and some local difficulties, has worked well, and been one of the chief means of preserving peace in the colony, even when other parts of our South-African possessions were involved in war. The main object of the system is to control the natives by laws suited to their present condition, to modify and alter those laws from time to time as the people advance in civilisation, and so gradually and silently to assimilate, or rather to identify them with the laws by which their more enlightened fellow-subjects are ruled.

Population.

The total population is about 125,000 persons, of whom about 8000 are white, the rest natives. The white population is made up of Dutch Boers, settlers from the Cape, immigrants from the United Kingdom and their children, and a few Germans. The Boers—about a third of the white population—are the remnant of the people whose struggles we have described, the bulk of whom have emigrated beyond our boundaries. The colonists from the Cape, mostly of British origin, settled in the country before, or soon after, its occupation by the government; the colonists from the United Kingdom almost all arrived since 1849. The natives are of the Kafir race, for the most part refugees from the Zulu country.

Divisions.

The colony N. of the River Umkomanzi is divided into the following six counties:—D'Urban comprises the country about the Port, and the town of the same name; to the N.E. of this, Victoria stretches along the sea-coast to the Tugela. Above D'Urban, on the higher land, is Pietermaritzburg, containing the capital of the colony of the same name; N. and N.E. of which lie the counties of Umvoti, Weenen, and Klip River, chiefly inhabited by Boers. The country S. of the Umkomanzi, being only inhabited by natives, has not been divided into counties. There are two towns, Pietermaritzburg, the capital, and D'Urban, the port-town; and there are also a number of villages scattered over the colony. Pietermaritzburg contains about 500 houses, with a white population of about 1600. D'Urban has about 450 houses, and a white population of about 1200. This town stands on the north shore of Port Natal, a large and nearly circular basin communicating with the sea by a narrow channel. In this basin vessels drawing from 20 to 25 feet may be moored at all tides. Its mouth is obstructed by a sandy bar, the average depth of which was formerly not more than from 8 to 10 feet; but in consequence of works which have of late years been carried on, its depth has been increased to from 15 to 20 feet; and there is no doubt that it is capable of being rendered one of the safest and best harbours in this part of Africa.

Education.

In each of the two towns there is a public school supported by government. The government also assists other schools, under certain regulations, by granting to each a sum equal to that raised by private means. The several missionary bodies have schools in various parts of the colony; and there are some excellent schools established under the auspices of the bishop, both for Europeans and natives. By the new charter L.5000 has been specially reserved out of the revenue for the education of the natives. Public libraries and mechanics' institutions have been founded in Pietermaritzburg and D'Urban.

Religion.

The Church of England body, scattered over the colony, is presided over by a bishop, having under him a considerable number of clergymen. A handsome cathedral has been erected at the capital, and a very commodious church at D'Urban. In other places, churches are either built or in the course of erection. The Dutch Reformed Church embraces nearly all the Dutch part of the population. They have a church at Pietermaritzburg, and several in the upper country inhabited by the Boers. The Presbyterian Church, though embracing members of the several sections of the church at home, may be regarded as the representative of the Church of Scotland. It has a very commodious stone church at the capital, and small churches at one or two other places. The Wesleyans have several ministers, two chapels in each of the two towns, one for the natives, the other for Europeans, and other chapels in various parts of the district. The Independents have small congregations at the capital and the Port. The Roman Catholics have a bishop and several clergymen. They have small chapels at each of the two towns. The American mission is composed of ministers of several denominations, chiefly, however, Presbyterian and Independent. Their object being to convert the natives, they agree to drop all minor differences, especially as to church discipline, and to present to the native mind none but the great points of belief to which most Christians assent. They have upwards of ten stations scattered over the country along the sea-coast.

Revenue and expenditure.

The revenue is chiefly derived—1st, From customs duties; 2d, From licenses to carry on certain trades, stamps, auction duties, and spirit licenses; 3d, From a tax of 7s. per annum on every native hut; 4th, From fees of courts, fines, postage, &c.; 5th, From quit-rents on land.

The revenue and expenditure in several years were as follows:—

	Revenue.	Expenditure.
1846	L.[illegible]	L.6,[illegible]
1848	9,968	10,101
1850	28,410	21,774
1852	25,600	25,232
1854	31,397	31,474
1855	34,050	33,603

The hut-tax was imposed in 1849, and has yielded an annual revenue of upwards of L.8000 per annum. At the same period the expenditure was largely increased in providing the requisite machinery for the government of the natives, as noticed above.

Commerce.

The subjoined table shows the progress of the commerce of the colony:—

Natal § National Education.

Years.	Imports.	Exports of Colonial Produce.
1846	L.41,958	L.15,409
1848	46,204	10,683
1850	111,016	13,613
1852	103,701	20,164
1854	124,722	37,039
1856	102,513	53,931

In 1853 the value of the chief imports were,—cotton and other dry goods, L.40,000; food, stores, &c., L.30,000; spirits, wine, and beer, L.7800; machinery and iron, L.6600.

The exports in 1853 chiefly consisted of,—grain, flour, &c., L.2832; butter, L.5805; bacon and hams, L.1453; ivory, L.11,065; sheep's wool, L.3556; wood and planks, L.1888. In 1855 the export of wool had risen to upwards of L.8000; that of ivory to more than L.14,000. The exports of some other articles have sprung up or been developed since 1853. In 1856 beef and pork, hides, tallow, and arrow-root became prominent articles of export. The export of sugar commenced in 1856; and its value was stated at L.483.

Natchez § National Education.

Agriculture.

Agriculture is steadily advancing. In the upper and cooler parts of the country the cultivation of wheat, oats, and other grains is rapidly increasing; the breeding of cattle and sheep is also making good progress. The manufacture of sugar is progressing very satisfactorily; several mills have been imported and are in operation; and at the beginning of 1856 it was considered that there were nearly 1000 acres of cane under cultivation. There seems, too, no doubt that its production will be highly remunerative. Land is not a tenth of the price it brings in the West Indies and Mauritius, while labour is cheaper. Natal, moreover, has a great advantage over these islands in so far as a European can labour out of doors without danger to health. The cultivation of indigo has been attempted with success. Cotton will grow admirably on the coast lands. (R. C. P.)

NATAL, a town of Brazil, capital of the province of Rio-Grande-do-Norte, on the River Grande, about 4 miles from its mouth, and 170 miles N. by W. of Pernambuco. The houses are for the most part built only of earth, and the streets are narrow, crooked, and unpaved. The harbour, which might be made one of the best in Brazil, is at present so filled with mud as to be inaccessible to large vessels. The trade is considerable. Pop. (1851) 12,000.

NATCHEZ, a town of the United States, North America, state of Mississippi, on the left bank of the Mississippi River, 279 miles above New Orleans. It is well and regularly built; and most of the houses are of wood, having gardens and shrubberies attached to them. It has a court-house, jail, hospital, orphan asylum, theatre, and masonic hall. There are several oil-mills; and an extensive trade in cotton is carried on. Pop. (1850) 5229.

NATIONAL EDUCATION.

Meaning of the word Education.

THE word *education* is derived from *e*, out, and *duco*, to lead or draw, and is ordinarily employed to express the whole of the process by which we draw forth the powers and capacities of the human mind into free and full activity.

National education signifies the application of this process to any particular country, so that the mass of the people, in their relative stations, may possess the mental development suitable for performing the duties and carrying on the occupations of civilized life.

In treating of the entire subject of national education there are three inquiries which have to be instituted:—1*st*, What education, individually and nationally considered, is? 2*d*, Who is responsible for it? 3*d*, How is it to be carried on? The first of these questions is *theoretical*, and requires of us to explain *what* any one must be taught before he can be considered, properly speaking, an educated man. The second and third of the above questions are *practical*, and have to point out, the one the proper *agencies*, the other the proper *methods* of national education.

I. EDUCATION THEORETICALLY CONSIDERED.

The meaning of the word education, as above explained, conveys in the main the correct idea of the thing itself. It indicates the fact, that the educating process is not intended so much to pour a given amount of the *material* of knowledge into the mind, as to draw forth and develop its powers and capacities, so that they can act vigorously and intelligently upon any kind of intellectual material that may be offered. Man is placed, according to the constitution of Providence, in the midst of an infinite series of natural agencies, which act upon him through all the five senses. The powers of the mind are so framed, and so adapted to the world in which we are placed, that the phenomena presented to it from without are met by a corresponding series of intellectual activities from within, which receive, mould, adapt, and, if we may so say, *intellectualize* the material thus offered. In this way it is converted into knowledge and experience; the world without having supplied the *matter*, the mind itself having then impressed upon it the given intellectual *form*.

The influences of nature, however, and the powers of mind which grasp and interpret them, stand in a very varied relation to each other. In the infantile state of humanity nature has the preponderance over mind. Surrounding circumstances almost wholly mould the man; because the intellectual power which stands opposed to the phenomena presented, and re-acts upon it, is crude and undeveloped. Hence human life rises very little above the direct attempt at supplying physical wants; and those mental developments which go to form the whole complex idea of civilization hardly come into notice, or even existence.

On the other hand, in a more advanced state of humanity the relative preponderance of mind and nature tends more and more towards the supremacy of the *former*. Nature is gradually combated and subdued; she becomes a servant to human wants instead of a governor; and the arrangements of human life all bear the stamp of a wide-spread intellectual activity, in place of mere human instinct, seeking to supply the most primitive and most pressing of human necessities.

Now the whole difference between these two conditions of human life is due to *education*, in the most extended sense of the word. It is in proportion as the inward and originally slumbering powers of the human mind are drawn out, that man rises above the sphere of a mere physical existence, and comes to be guided by his reason, his conscience, and his better feelings.

Spontaneous education.

A large portion of human education, thus viewed, must evidently be purely *spontaneous*. A tribe of people obtaining a fixed settlement in some favourable quarter of the globe, starts, we will suppose, upon its progress towards civilization. The habit of living by plunder or by the chase is first of all exchanged for some settled kind of industry of a pastoral or an agricultural character. Industry gives rise sooner or later to property, and property requires law and government in some form to assure and protect it. With the establishment of fixed principles of government, giving security to life and property, exchange and commerce soon begin to spring up, wealth is produced, and leisure is in this way afforded to some to cultivate further the arts of

National Education.

life. But when once the rudiments of human knowledge, science, and literature, are brought into existence, in however elementary a form, they soon become nurtured and stimulated, it may be by the desire of gain, or by the sense of the beautiful, or by the impulse to celebrate in verse the praises of the good or the great. Parallel with these various steps of human progress, the religious feelings also become developed, and rise from the gropings of idolatry to the intelligent worship of a supreme being.

All this indicates the process of what we may term the *spontaneous education* of a nation,—an education which, under favourable circumstances, will always be going onwards, and to which a very large portion of the progress of every nation must ever be due. History, in fact, is the record of the spontaneous education of nations, together with the outward events which accompany it; and the philosophy of history is simply an attempt to comprehend the universal laws of human development, so far as they may be gathered from the phenomena of past ages.

Technical education.

It is not our object, however, at present to give any disquisition on the spontaneous education of nations, as seen in their history, nor to trace the laws of national growth, as shown in the *philosophy* of history. By education, in the more restricted sense of the term, we mean that process of instruction purposely and consciously adapted to the individual, by which his faculties are drawn forth into full activity, and his mind duly developed and informed. Education, viewed in this light, will of course be greatly modified by the position which each man holds in the process of human development generally. The answer accordingly to the question, Whether any given individual be educated or not? must depend in a great measure upon the age and the country in which he lives. In other words, his *technical* education presupposes and must spring out of the *kind* and *amount* of *spontaneous* education to which he is naturally and necessarily subjected in the course of human life.

Persian education.

A glance at the history of education in different periods of the world, and amongst different nations, will make this abundantly evident. Perhaps the earliest historical records which we have of the methods and details of education are those which relate to the ancient Persians. Amongst them the entire education of the youth, from their fifth to their twentieth year, was confined to three things,—riding, shooting with the bow, and speaking the truth.[1] The two former of these points do not indicate anything but what might exist in a state of barbarism; but the third presents to us the clear indications of an incipient civilization, just beginning to rise beyond the sphere of mere physical activity, and to regard the mental as well as the corporeal qualities of the pupil. Moral education, in this case, is seen to have preceded intellectual, which in fact does not appear to have existed at all amongst the Persians, with the exception of some slight instruction given to the priestly order in the laws and institutions of their religion.

The description which Xenophon gives of the education of Cyrus is not in contradiction to this account, although it is evident that the *Cyropædia* is rather intended as a type of what the education of such a prince *ought to be*, than any faithful delineation of what it actually was. How far this model education, as described by Xenophon, would fall short of what we now consider necessary even for the very rudiments of mental culture, it is not necessary for us to insist upon. And yet, no doubt, the ideal Cyrus must have been regarded as exhibiting *at* THAT TIME *the highest type of an educated man.*

Greek education.

No sooner do we pass from the oriental world into the active scene of Greek civilization, than we feel at once that the whole atmosphere of human existence is changed. The great drama of human history has commenced a new act, and the elements which form the chief interest in it are now of an entirely new character. In the Greek we no longer see humanity under the influence of the senses, nor guided merely by the feelings; the elements of self-consciousness there appear from the very first. The Greek *knows* that he has a soul and an intellect within him; he can place himself in bold contrast with nature; he can look *within* as well as *without*; detect the secret workings of his own mind; analyze the inward phenomena of his being, and strip away the fleeting impressions of the moment from the permanent elements of his more fixed ideas. In a word, he can not only form within himself ideal representations of nature, but he knows that they *are* ideal, and is fully conscious of the part which his own mind has had in constructing them.

In the Greek, accordingly, a higher range of mental faculties comes into play than was seen in the early oriental world. The ideas which these faculties create are vivid and exuberant; the memory is inexhaustible; the imagination fertile almost beyond conception; and the power of expression utters itself in a tongue the most harmonious, the most plastic, and the most versatile which mankind has ever produced. This exuberant power of *representation*, however, not only manifested itself in their life and language,—it not only poured itself forth in poetry and song,—it became, still further, the parent of *art*. The Greek was not content with forming ideals *in his own mind*; he felt impelled to express them *externally*. He must paint them out upon the canvas, hew them into wondrous reality from the solid marble, and erect them aloft in the form of massive temples.

With regard to his mode of life, the Greek was essentially a *social being*—social not from any sense of authority due to a superior, but social from the desire of realizing the utmost degree of elegance and ideal culture in his political existence. He has no great reverence for humanity as such; he will enslave others if he can, so long as he remains free himself; nay, all the world may remain either slaves or barbarians to him so long as his own joyous Greek life can blossom in all the hues of its native beauty.

The main idea of education, therefore, among the Greeks was *to fit men to be brilliant citizens*; to develop their physical energies; instruct them in music, poetry, and rhetoric; give them power to impel, to persuade, or to vanquish, and thus turn them out Greek *politicians* in the highest sense of the word.

"Just as the child," says Cramer,[2] "when he has made only a few steps, rejoices in his knowledge, looks down upon all other, even *his own* former sports, and begins already to fix the measure of culture; so also did the Greek. Culture, in the broadest sense of the word, bodily as well as mental, formed the distinction between himself and the barbarians,—separated the freeman from the slave, distinguished the instructed man from the manual labourer (βαναυσους), the rich from the poor, and, finally, the Athenian from the other Greeks." It is in accordance with this whole idea that Plato, in his ideal republic, points out the different classes which must exist in the state—the men of valour, the men of business, and the men of thought; and shows that the state should take up every child, as something belonging to itself, and *cultivate* him for his future functions, whatever they might be, in the body politic.

This self-conscious power which the Greeks possessed was sure eventually to lead them beyond the mere creations of poetry and art. In the person of Socrates it created *Ethics*, as the practical science of life; while in Plato

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[1] Herod. i. 136; Strabo, xv.

[2] *Geschichte der Erziehung im Alterthume, Erster Band*, p. 148.

National Education.

and Aristotle the whole of the latent elements of Greek culture were developed fully out into the form of pure philosophic Idea.

But here the genuine Greek life was already on the wane. As long as they found free scope for their *imagination*, they presented to the world the most wonderful spectacle of æsthetic life and culture which has ever been realized. Their mission on the great arena of human history had to do primarily with *the beautiful*, and then (so far as the fancy could picture them as ideals) with the *good* and the *true*. But it was not a part of their national character to develop any great and striking manifestation of the practical understanding. Another great nation was already formed, and, as it were, set apart for this mission—a nation which, alike devoid of all high exercise of the imagination on the one hand, and the speculative reason on the other, was already giving a perfect embodiment of a solid practical intelligence, and exhibiting all that strength of purpose, firmness of character, and accumulation of *power* over mankind, which such a mental temperament naturally and necessarily superinduces. It need hardly be said that the *Roman* nationality is here referred to.

Roman education.

The practical sense of the Romans gave a character to the education of their youth altogether different from what we see amongst the Greeks. In Greece everything was regarded in reference to *the culture of the individual*, and estimated according as it tended to realize some ideal of excellence and beauty. In Rome, on the contrary, UTILITY was the main object of all education. The Greek, for example, studied mathematics, but he did so mainly as a means of mental refinement; while the Roman studied mathematics and arithmetic solely for practical purposes in warfare or commerce. Physical education among the Greeks was intended to give elegance to the person; amongst the Romans it was intended to give strength and endurance for labour. In Rome the chief subjects of instruction accordingly were, as with us, *reading*, *writing*, and *reckoning*, to which some knowledge of geography and Roman history was added; for these were the pursuits which fitted men for their actual duties in human life.

Another thing, too, which caused the Roman education to approach nearer our own than the Greek did, was the fact of their having to look for their models of literary excellence to a foreign language and literature. The Romans studied Greek much in the same way as we do Latin, as being the best basis for a high mental cultivation. The necessity of doing this gave rise to the *science of grammar*, of which the Greeks, being always confined to one language, had no developed idea. The study of grammar in this way became, under the Roman empire, one of the chief pursuits in the schools of learning, and was considered *indispensable* to a liberal education. Thus, although the æsthetic culture of the Roman was far inferior to that of the Greek, yet in practical vigour of understanding, in the sense of personal right, in all the elements of social morality, and in everything which goes to make up the citizen of a great and a free state, the Roman showed himself far superior. What would have passed for high cultivation amongst the former people would have been regarded as virtually *useless* amongst the latter; whilst the Greek would have scoffed at the barbarism of the Latin, from his want of elegance, genius, and æsthetic development in general. In answer to the question, therefore, What is to be understood by an educated man? the Greek would have pointed to a man of high physical and mental *refinement*, while the Roman would have pointed rather to the man of *great practical efficiency* in all the affairs of human life.

The idea has been widely entertained, that the rise and spread of Christianity throughout Europe made, as it were, a clean sweep of the old-world civilization, and built up another state of society, based altogether upon new ideas. This, however, was *in fact* far from being the case. That Christianity introduced *a* new element into the West, and one of surpassing worth and moral grandeur, every Christian man can testify; but there were many other elements which mingled with it before it formed a new state of society, a new civilization, a new world. The Greek intellect was still busily at work in Christian times, as we find abundantly evinced by the controversies of the early church. The Roman practical understanding was at work also, and aided in the reconstruction of society upon the family as the *social*, and the Roman law as the *political* basis of the whole. The Christian youth, indeed, we know attended the schools of the grammarians and philosophers, even though many of them were yet heathens; and thus, in their very education, the culture of the old world was blended with the advancing Christian ideas of the new.

Middle age education.

If we come down step by step to the middle ages, we find all along precisely the same phenomena. The Greek ideas continued to exist there, for Aristotle reigned almost supreme in the region of the intellect; and the Roman sense of personal right and civil privilege was there also, for absolutism could gain no sure footing in Europe during the whole of the feudal times. And yet, with all this, society sank down into a condition bordering well nigh upon barbarism. This barbarism, however, was more *apparent* than *real*; for although the culture of the middle ages fell so immeasurably behind that of the classic periods of human history, yet there were *new* elements at work within it, which contained the germs of a still higher moral and intellectual life than had ever before existed. The truth is, the whole of the middle ages present to us an immense transition period; the elements of mental refinement, which had cast a radiance upon the old world, were passing away as the basis of a social state, and the sublime spirituality of the Christian life was struggling to realise itself against a thousand opposing difficulties. It was only when both these elements had become fully blended that the light of modern civilization dawned upon us in its full lustre.

Looking, therefore, at the state of education in the middle ages, it is necessary to make a distinction between the spontaneous and the technical education of that period. The spontaneous education, though not marked by a state of any refinement, yet contained in it elements of unspeakable value. To be a true gentleman in the age of chivalry implied valour, honour, gentleness and respect towards the fair sex, truth, humility, and piety; though it implied no scholastic learning whatever, not even the faculty to read or write. The technical education of the middle ages, on the other hand, was poor enough. It was divided into two branches, called respectively the *Trivium* and the *Quadrivium*. The Trivium included grammar, rhetoric, and dialectics; the Quadrivium comprehended music, arithmetic, geometry, and astronomy. The former was supposed to exhaust the study of *language*, the latter to exhaust the study of *science*; and the man who was master of the whole was considered to have fairly earned the title of possessing *universal knowledge*.

Moreover, poor as was this curriculum, there were very few, in comparison to the whole population, who attempted to master even the Trivium alone; while the man who mastered the Quadrivium also was looked upon as a wonder of the age, as was the case with Albertus Magnus, of whom it is recorded to his undying honour, that he taught the Quadrivium, and knew all that was to be known,—

"Quadrivium docuit, et totum scibile scivit."

The revival of letters in Europe was due proximately to the influence of classical literature, which was brought into the West by the scholars of Constantinople when that city fell a prey to the conquering power of the Turks. To this were added, in rapid succession, the invention of printing,

National Education.

Influence of the Reformation on education.

the discovery of America, and, lastly, the Reformation. With the Reformation a new era commences in the educational history of Europe. The controversies to which it gave rise brought to light the great principle so long forgotten,—that all human truth must depend ultimately upon the acknowledged validity of the faculties of the human mind, and that the responsibility of every man's faith and practice must rest in the end upon his own individual judgment. Hitherto men had been quietly led by *authority*,—now they were to be guided by their own convictions; and consequently it was a matter of supreme moment that those convictions should be rightly and wisely formed. With the spread of the Reformation, accordingly, the fact dawned upon the mind, that the universal exercise of private judgment must be accompanied by the universal education of those who were to employ it. Without this it was seen the work of reformation would be wholly incomplete; for of what use would be the appeal to individual convictions so long as the people were too benighted to have any? Of what avail the right of private judgment, so long as the masses of mind around them had no judgment at all? With the Reformation, then, *the imperative necessity of educating the whole mass of society, from the highest to the lowest, first grew into a clear conviction.* All the great efforts for accomplishing that end date their origin from this period. In Germany, the cradle of the Reformation, Luther proclaimed the education of the people as the crying want of his times, and wrote a circular letter to the councillors of all the towns in the country, pressing the subject upon their attention. In England, private effort set earnestly about the same business; and if all the funds which were left for educational purposes by our forefathers of this era were properly administered and employed, they would even now go far to place the great majority of our population beyond the reach of ignorance and shameful neglect. In Scotland the parochial system of education in the same way dates its rise from the efforts of John Knox and his coadjutors, who determined that every parish in the kingdom should be supplied with a school sufficient for the whole population, as well as with a church for divine worship.

The Reformation, then, we may set down as a great era,—nay, as *the* great era,—in the history of human education. It was the age in which the necessity of developing the whole of the human faculties became apparent; and of doing this, too, through *all classes* of the community. The only question was, *How* was this great end to be accomplished? In what way was human nature to be more and more perfected? What course should the educator follow in order to bring about the highest results? This has been the real problem of modern civilization, *and it is a problem not yet fully solved.*

Educational Reformers.

For some time great trust, as was natural, was put in *ancient* methods. All teaching was to be done by *words*; the old masters were still to be the guides; grammar, logic, and rhetoric were to be the great instruments of human culture; nay, even the practical sciences were to derive their light from the relics of the old world—from Galen, or Celsus, or Aristotle himself. When the Baconian philosophy, however, became once established, a great change was introduced into the whole idea of scientific teaching. Men, it was seen, were no longer to learn from *books* only, but from things themselves. They were no longer to trust to old-established propositions, but to draw the milk of truth at first hand from the bosom of Nature. Here, accordingly, the old system of logical *verbalism* began to give way to a system of scientific *realism*, in which the perceptions and the observing powers were to mingle their results with the generalizations of the understanding.

Bacon.

Locke.

One of the chief reformers in the department of popular education was John Locke. In a work which he wrote on the principles and methods of education, he condemned the exclusive Latin training of the age, and showed how important it was that a due regard to positive science should be joined to the more direct culture of the understanding, through the medium of *language*; and how necessary it was, also, that practical efficiency should ever be kept in view, if the future man was to become a really useful member of society.

Rousseau.

The work, however, which had perhaps the most extensive influence during the last century was Rousseau's *Emile*. Rousseau's fundamental principle was, that human nature is essentially *good*, tending alike towards truth and virtue; and that all the evils, sins, and miseries, which afflict it arise from the anomalies and imperfections of human society. He pictures, accordingly, an ideal case, in which an infant is brought up from the very first according to the principles he has laid down; shows how he is to be shielded from the corruptions of society; how he is to be left open to the influences of nature and conscience; how the mind, free from the trammels of conventionalism, is to be allowed to expand; how the faculties thus become enlightened, the will strengthened, the passions repressed, until he grows up a perfect specimen of what a man *ought to be* in his intellectual, social, and moral relations.

This work of Rousseau, though by no means very deep in its philosophy, nor very profound in its analysis of the human faculties, yet produced a marked effect upon European society. It was written just to meet the spirit of the age. Denouncing, on the one side, the materialistic principles of the French philosophy, which made man merely the creature of habit; but yet, starting from a purely psychological and antitheologic basis on the other, it just supplied the wants of those who were looking out for a safe path between the merest naturalism on the one hand and the old-fashioned methods of verbal authority on the other.

German Illuminati.

Germany especially felt the effects. A number of men, who received the name of *Illuminati*, entered into a bond of philanthropy to reform the evils of society, and educate its children on rational and moral principles. And much was such a reformation needed. The old grammar-school methods were miserable enough,—mechanical reading, learning by rote, and a half Latin jargon, which went by the name of *grammar*, were driven into the scholars with all due severity. Everything conspired to make the whole process dull, uninteresting, and repulsive. Against all this, then, the philanthropists protested; and although they ran into some extremes on the other side, yet, by nurturing a kindly spirit towards the young, by studying their wants and aspirations as well as their duties, and by introducing a variety of useful topics hitherto excluded from the very atmosphere of the school-room, they did much to break down old abuses and prepare the way for a better system of things.

Pestalozzi.

The most remarkable results of this whole movement were finally concentrated in the life and labours of Pestalozzi. The great merit of Pestalozzi, that for which the world owes him a lasting debt of gratitude, was his clear demonstration of the hollowness and futility of mere verbal teaching, unless it is based upon real mental experiences, *previously acquired*. Nurtured in the material philosophy of the age, Pestalozzi held that all human knowledge is based upon the senses; that the perceptive powers, therefore, must be cultivated in the first instance; and that whatever is afterwards taught by words must be brought back to the testimony of the senses for its verification. This philosophy led him both into a truth and an error. The truth into which it led him was, as I have said, the hollowness of mere verbal instruction. It showed him that words have no *essential* force at all; that the knowledge of a proposition, therefore, does not at all involve the knowledge of the *thing itself* of which it speaks; and that unless the intuitive powers are first

enriched, all your subsequent teaching will be unavailing, because there is as yet nothing in the mind answering to the terms you make use of.

On the other hand, Pestalozzi's philosophy was undoubtedly imperfect; it laid too much stress upon the senses as the foundation of human knowledge, and too little on the intuitions. His method thus became a constant oscillation between *sense* and *reasoning*. Every principle in arithmetic was to be proved by an appeal to the ball-frame; every proposition in geometry demonstrated by presenting the fact involved in it to the eye; every mechanical power explained by showing its actual effect in nature. He did not seem to comprehend that you may present all these things to the senses as facts, individually, and yet that the intellect may thoroughly fail to grasp the *principles* as matters of pure reason. Thus he left the minds of his scholars with a vast multiplicity of isolated facts, verified *as facts* by the senses, but drew forth very little of that superior power by which the mind comprehends truth in its unity, and groups individual phenomena under the universal conceptions of science.

Since the days of Pestalozzi very little has been done towards developing any well-grounded theory of education. The practical work of popular instruction, indeed, has been going on rapidly in nearly every country in Europe, particularly during the last twenty years; but we are still waiting for some master intellect which shall combine all the scattered elements of pedagogic science, and unite them into one broad generalization. In the meantime, the subject almost naturally divides itself into certain main branches, which are treated often in an isolated manner, but which, nevertheless, have drawn forth a large amount of useful observation and remark on the nature and methods of education generally.

Various kinds of education.

The most obvious classification, perhaps, which can at present be adopted is that which divides the entire subject of education into,—1. Physical; 2. Intellectual; 3. Moral; 4. Political; and 5. Religious Training. We mean by this, that education has to contemplate the future man in all these five different points of view, and must aim at drawing forth and confirming those special capacities and aptitudes which will lead to the efficient performance of the work and duty of life in all these several respects.

Physical education.

1. With regard to *physical* education, this has hitherto been left far too much to nature and chance; and we owe it mainly to the improved condition of medical science that public attention has been called to the deficiency. It includes, *first* of all, *the essential conditions of health*, such as cleanliness, fresh air, exercise, diet, alternate periods of labour and recreation; *secondly*, the strengthening and proper development of the bodily powers by means of drilling, marching, and gymnastic exercises; *thirdly*, the formation of certain useful habits, which after a time become almost instinctive. Hand-writing is a habit of this kind, which can be impressed once and for ever on the nervous system; the power of rapid performance on musical instruments is another faculty dependent on the same kind of physical training. Easy and graceful deportment, again, is a trained habit; so also is a clear and correct verbal articulation. In fact, wherever physical action is required, of such a nature that it may be transferred by habit from a *voluntary* act to a *reflex* one, there the use of physical education becomes evident; for every good habit which is thus formed and fixed by early training, whether it be a useful accomplishment, or a graceful deportment, or a facility of correct expression, or any kind of manual dexterity, is just so much power actually treasured up in the nervous system, which can be brought forth and applied at any moment, as if it were a kind of living machinery, and that, too, without any trouble or any sense of fatigue to the possessor.

Intellectual education.

2. With regard to *intellectual* education, the pathway is longer, and the process more complicated. The following, however, appears to be in the main the order in which the intellectual powers naturally develop, and is consequently the *direction* which the educator ought to follow in applying the means of intellectual training. The first of the faculties which comes into full activity after the senses and physical powers have become duly developed, is that of *perception*. By perception we mean the instinctive interpretation the mind makes of all the phenomena which come to it directly through the senses. It was once remarked by a man celebrated for his great learning and ability, that he had learned more in the first three years of his existence than in all the rest of his life put together. And when we take a child of three or four years old, and see what it has already attained,—how it has learned all its first lessons in time and space,—to how perfect a *use* of the senses it has arrived,—how accurately it can measure the relations of form, of size, and of distance,—how it has advanced in the knowledge of *men* as well as *things*,—how readily it judges of character, reads the human countenance, sides with the good and gentle, and rejoices in all that is genuine and beautiful,—we feel that there is almost a literal truth in the assertion. This faculty of the child, then, by which it learns all these indispensable elements of human knowledge, without effort, without instruction, without the aid of schools or lessons, without anything but *nature* and *life* around it, we call *perception*. The earliest teaching, accordingly, should be in accordance with the method which nature herself points out,—namely, *perceptive teaching*. Everything should be done to fructify and enrich the primary intuitions; for it is only when a store of perceptive knowledge is laid up in the mind that verbal lessons can prove of any avail.

The next great step in the unfolding of our intellectual life is the power of *reproducing* the impressions which have been made by means of perception upon the mind; of *representing* them to ourselves internally, and of occupying our minds not merely with things themselves, but with those inward representations of them. Every impression made on the mind through the nervous system leaves an indelible trace behind it. Of course these impressions are not for a time consciously reproduced; but there arrives a period in the course of our mental development in which we not only reproduce our primary mental impressions, but become conscious of that reproduction, and are fully able to connect the actual perception of a thing with the after representation of it. When the power of mental reproduction arrives at this stage, it is called *memory*. Again, if we employ images within the mind merely *as images*, without any further reference to their external source,—if we combine and expand them, and put them into new forms,—then we term it *imagination*; and lastly, if we attempt to trace the principles of order and arrangement, by which the constant flow of images through the consciousness is regulated, we term these the laws of association. All this group of phenomena, then, we include under one head, and call it *the representative faculty*. The triumph of the representative faculty is seen at length in the creation of *language*; for here not only are our perceptions internally represented and reproduced, but these very inward representations are projected out of ourselves, and embodied in external signs; so that by means of language the mind can place its own work before it, as the object of its own contemplation.

Now, observation shows us, that the period of boyhood is chiefly remarkable for the intense activity of the representative powers. The memory at this time of life is remarkably active; the power of seizing vivid ideas of things, of recalling them again and again, of combining them, associating them, and connecting them with the appropriate words or signs, is in the highest state of intensity. This is seen in the wonderful facility with which languages are acquired through the ear at this early period,—a facility

National Education.

which gradually dies away as the reasoning faculties become more advanced and mature. Nature herself, therefore, again dictates, that in education our principal aim at this time of life should be to furnish nutriment for the growth and expansion of the powers of inward representation; that is, for strengthening the memory, training and regulating the imagination, giving full play to the laws of association, and producing the capacity of expressing ideas in clear, luminous, correct, and copious language. All these habits of mind can generally be acquired with great facility at this time of life; but if neglected *now*, so difficult does the process of their education afterwards become, that it is a thousand chances to one whether they will ever be acquired to any degree of perfection at all.

The formation of signs for our ideas, and the construction of them into a complete language, paves the way for that higher exercise of mind which we call *thought*, and which is mainly concerned with abstract and generalized conceptions. This faculty, which deals with the general and the abstract, which separates our knowledge into definite parts, arranges it, classifies it, embodies it in accurate terms, expands it into formal propositions, and draws conclusions from one proposition to another, we term *the understanding*. The importance of training the mind to accurate logical thinking can hardly be over-estimated; for although the logical faculty is not the *highest* faculty of our nature, yet it is of all others the most practical, and that which has the closest bearing upon the occupations and duties of life. The illogical mind may be deep, reflective, and suggestive of many new ideas, but its knowledge is held loosely together, the connection between one idea and another is hardly perceived, and there is no system or order in the way in which truth is apprehended and retained. The main portion of our intellectual education, as the mental powers become somewhat mature, should accordingly be directed to the regulation and the development of the understanding; and this, according to universal experience, is best done by means of linguistic studies on the one hand, and mathematical and scientific studies on the other.

The goal and summit of our intellectual life is at length attained in the full and free development of the *reason*. By reason we mean that power which is concerned in the formation of our last and deepest convictions,—it is that image of the Divine thought which descends to the very basis of human truth, calls all earthly authority before its bar, and judges the right and the true, subject to no power, and amenable to no laws, but those of the infinite and eternal reason itself, of which it is an emanation. By means of the reason, knowledge is not only arranged, but traced upwards to its highest and most general conclusions; the laws by which the worlds, both of nature and mind, are governed, are laid bare, and in the midst of the immense and bewildering multiplicity of phenomena around us, a hidden unity is grasped that connects the whole as the work of one great Author, and as conspiring to one beneficent end. To nurture up this power of insight into full vigour is the highest problem of education, intellectually considered, and the result, when attained, is what we term scientific and philosophic genius.

Moral education.

3. We come next to *moral* education, which all resolves itself into *training the will to act firmly in accordance with the dictates of conscience*. Just as the intellect, commencing with mere sensation and perception, rises through a series of stages up to the highest exercise of reason, so also the will, commencing with a mere instinctive tendency to action, rises up step by step to perfect freedom and self-control; and just as intellectual training aims at perfecting the powers of reason, so does moral training aim at perfecting the self-control of the will. The child in the perceptive age requires especial care in relation to the regulation of the will. The rise and development of self-consciousness in the child is always accompanied with a sense of *inward power* in relation to the world without. The meaning of *play* at this early period is the instinctive exercise of this new-found power in our nature; and its real value lies in the nurturing of our self-consciousness, and the realization of our nascent ability to conquer the material world around us, and bend it to our service. The very same tendency leads to the desire of tyrannizing over others. The young child is *naturally* a tyrant, and will reduce all around him, if possible, to be the slaves of his desires. The problem of moral education, accordingly, here is to reduce this lawlessness with which self rises up to assert its power into a willing obedience to order and discipline,—an obedience which shall not arise from the crushing effects of sternness and severity, but from the feeling, steadily inspired, of the *absolute power of a command*. Willing obedience to a categorical imperative is the first great lesson in our whole moral life, and unmurmuring deference to the will of a parent or teacher is the natural preparation for our subsequent unwavering deference to the moral law of God.

As the mind grows, the tone of *authority* in the teacher must gradually *relax*, and justify itself by an appeal to the intelligence and moral sense of the pupil. In this way the respect for authority is increased by associating it with what is reasonable and just. Moreover, when the understanding becomes mature, even then a great deal must still be inculcated on the authority of the teacher, inasmuch as the logical faculty does not give us the power of penetrating into the grounds of human conviction. But respect must now be paid to the personality of the pupil, so far that the self-consistency of truth must always be made apparent, and nothing inculcated that could in any way militate against the moral intuitions. By this process the habit of self-control may be nurtured into a fixed principle; the power of acting according to established maxims of right may be strengthened; so that when the man becomes mature, and is thrown entirely upon his own guidance, the will responds to the moral convictions which have been formed, and expresses in outward action what the conscience inwardly affirms to be *good*. This self-control of the will becomes, of course, so much the greater in proportion as the convictions of conscience are shown to rest on a Divine and infallible foundation; and it is just here that moral education connects itself with religious training, which is indispensable as giving a firm and immovable basis to the whole. We have now glanced at the three main branches of human education—the physical, intellectual, and moral. There are yet two other branches, which grow out of those already treated of, and which regard the man not so much in relation to the development of his inward powers, as in relation to the circumstances by which he is surrounded and the destiny to which he is tending.

Political education.

4. The first of these is what we have already noted as *political* education. Much of the political education of a people is of course *spontaneous*. It is only *gradually*, and by the training of long experience, that nations acquire the power of self-government, and that the individual finds his own position, politically speaking, in the community. There are, however, many things of great importance to the citizen of a free country which *can* and *ought* to be taught,—the want of which, moreover, is fraught with serious evils both to the individual and the state. These are, the nature and functions of government, the obligation every man is under to yield a portion of his personal liberty to the public good, the duty of obeying all the just laws of the community, the nature and rights of property, the relation of capital to labour and of the employer to the employed, the laws of the production of wealth, and the ethics of commerce. The want of some elementary knowledge on these matters naturally gives rise to sedition, conspiracy, and revolution on the one hand, or to misery, pauperism, and

National Education.

consequent vice and degeneracy, on the other. Every child, therefore, should be trained to know and act upon the fundamental ideas of social economy and the primary duties of citizenship.

Religious education.

5. Lastly, *religious* education must give the crown and glory to the whole,—its great object being to supply a Divine sanction to all the dictates and requirements of our moral nature. Religious education, properly so called, begins in the development of the sense of the Infinite and the Divine,—deepening the consciousness of an ever-present and an almighty Being, who sees, rules, and guides all, and takes cognisance of human actions, whether they be good or evil. It next goes on to explain what means we have of knowing the will of God, whether manifested in nature, or, more directly, in revelation. And, finally, it should sum up the whole of the truths or principles thus elicited into a compendium of religious faith and practice which may serve the purpose of a succinct system of theology. The first of these processes is adapted to the child, the second to the youth, the third to the human mind in its full maturity. To teach the Catechism *to a child* is beginning at the wrong end, and holding up the truths of theology to him in their most abstract form before the power of abstract thinking is at all consolidated. Religion must be inculcated first in the intuitions and feelings; then it must occupy the memory and imagination; and, lastly, it must live in the understanding and the reason.

Regarding the present state of European society, it can hardly be affirmed that any individual is regarded as an educated man who has not experienced some amount of training in each of the departments above described. Every educated man must at least have gone through so much physical training, either consciously or unconsciously, as to give him a deportment proper to society, and a power of articulation sufficient to express his thoughts with intelligence and propriety. He must have had his perceptive powers so far cultivated as to observe what passes around him intelligently. He must have acquired some strength of memory, some power of conception, and the correct use of his native language, whether in writing or speaking. Further, the *understanding* must have been so far developed that the mind can generalize to some extent,—see the relation of one truth with another, and draw correct conclusions wherever the data are plain and obvious. With regard to *moral* training, the will of every educated man must be under some control, so that it can hold in check the lower passions and propensities; for the want of this is one of the chief features of barbarism. Politically speaking, education must enable every man to fill his place honestly and creditably in the station which he occupies in society, whether it be higher or lower. And, finally, it must have made him so far acquainted with the ideas, sanctions, and duties of religion, that he knows and appreciates its obligations as they are held and enforced in that particular community to which he may chance to belong.

This, perhaps, we may regard as the *minimum* of what is requisite to form *an education* in the present sense of the word. It may seem, perhaps, to include a great deal, especially when we consider how much actual instruction must be employed in order to bring the mind even into a moderate state of discipline upon all these points; and yet a decided failure in any one would inevitably cause any man among us to sink below the level of what are termed the educated classes of society. No system of national education, accordingly, could possibly contemplate less than we have now stated as essential to the present idea of an educated man. Every citizen, at least, in a free country, should have the means of mental development *so far* put into his hands. The expansion of the idea of education into its higher aims and purposes belongs, of course, to the higher spheres of instruction, and will always be determined in its amount and its character by the progress of knowledge and civilization through every succeeding era of human history.

We come now to the more practical aspects of the subject, and have to inquire,—

II. WHO ARE THE PERSONS AND WHAT THE AGENCIES BY WHICH NATIONAL EDUCATION IS TO BE CARRIED ON?

There are a thousand agencies that really bear upon the education of a people, which cannot be distinctly enumerated or calculated. Human life itself is an educating process, and much more so in some countries than in others. The active life of commercial towns has a more stimulating effect upon the minds of the people at large than the quiet routine of agricultural pursuits. In countries, too, which possess free institutions like those of England or America, the intercourse of daily life presents far more to stimulate the energies and educate the whole man than the monotonous political atmosphere of absolute governments. Hence we sometimes find that a country with very complete educational institutions does not produce nearly as much mental vigour, practical energy, and bold enterprise as another country where the actual institutions are perhaps far less complete, but where the stimulus of daily life is much greater.

Theories of educational agency.

(1.) The question which we have now to discuss, however, does not relate at all to this spontaneous education, which lies, in fact, beyond the direct control of human agencies. What we mean by the problem now before our consideration is, who is to frame, superintend, and carry on the actual educational institutions of a country? On this point various theories have been propounded, the principal of which must be now briefly considered.

Supply and demand system.

1. It is urged that education should be left to its own natural development; that the demand for teaching will of itself create a supply; and that the result of this natural supply will, in the end, be superior to any kind of education which is more artificially constructed.

Now, there can of course be no doubt but that, amongst many different peoples, education will make considerable advancement when left to its own natural course of development; but it would be taking a very narrow view of the laws of human progress to elevate this into a principle which could not be deviated from without danger and detriment. In all the different spheres of human activity the impulse afforded from time to time by some great master-mind appears to be one of the most natural and universal agencies by which human progress is secured. And this is not only true respecting the advancement of science, literature, or philosophy; it is equally true in regard to political development and social reformation. Take the case of Alfred the Great in our own country. Here is an enlightened sovereign, with knowledge and foresight far beyond his times, who is called to rule over a people only just emerging from semi-barbarism. Applying his superior abilities to the wants of his people, he not only makes wise laws, and lays the basis of useful institutions, but seeks to promote education by founding colleges and schools of learning similar to those of which he had himself had experience on the continent of Europe. It certainly could not be said that this was of no benefit to the country; that the people should have been left to find their own way out of the surrounding ignorance; and that everything done for them by the legislator, except what related to physical order and security, was an error and a mistake. Or take the case of Peter the Great, when he had the design of raising Russia into the sphere of civilized nations. To have affirmed in this case the principle, that because Peter was emperor, and invested with governmental authority, therefore he should not, on principle, interfere with the ignorance of his people, or move a single step in the pathway of their education, would assuredly be narrowing down the functions of great rulers and great

National Education.

legislators to a very subordinate degree of importance in the march of human progress,—a degree not at all corresponding with their natural and providential position as great reformers. If these and similar instances, then, be admitted as cases in which the interference of legislators in the educational institutions of their country was good, useful, and even necessary, then the principle of supply and demand, as a universal law, breaks down in its application. Many nations, as we see at this moment, left to the working of this principle, have failed to elevate themselves at all out of the ranks of barbarism or semi-barbarism; the *demand* for education in their case never appears, and thus there is a total lack of the *supply*. If there be any truth in history, an enlightened governor or government can assuredly do much to bring some useful agency to bear upon a people living or vegetating in this unsatisfactory and undeveloped condition.

Suppose, however, that a nation has already been raised into a civilized state, the question is, can we not then safely leave its further educational progress to the principle of supply and demand? The term civilization, it may be replied, is a relative one. It is difficult to say when a nation, viewed as a whole, is really civilized, and consequently difficult to draw the line where educational progress can be safely and properly left, if at all, to self-development. Civilization does not equally pervade all ranks of the community; and we find universally, that even in the bosom of the most advanced countries there is a large class of semi-barbarians who prey upon all the rest. Here, then, we have a case in which the *demand* for education is least where the *want* is the greatest. The principle of supply and demand does nothing therefore directly to elevate them; and the question comes, whether society is to wait patiently, and bear all the social ills resulting from these seething beds of ignorance and vice, uncertain whether the desire of reformation will ever manifest itself, or whether a wise form of legislation may not do much for their reformation, and thus aid in preserving others from the moral contamination. Whatever principle be adopted, government cannot hold itself disconnected from these lower strata of society. It is obliged to watch them, to intimidate them, to repress them, often to imprison, prosecute, and punish them; and the idea naturally suggests itself, whether in such a case it would not be wiser and better, as well as cheaper, to attempt some educational means of reformation, than to be ever engaged in a perpetually renewed struggle of force against force. Of all the countries of Europe and of the world, Great Britain can lay, perhaps, as valid a claim as any to the merit of being in a state of civilization. But no one can deny, that education, so long as it was left to the principle of supply and demand, continued in England to be in a lamentably weak, insufficient, and unsatisfactory state. The first extended efforts to amend this state of things, moreover, did not arise from any outcry or demand from the people themselves, but from the philanthropic efforts of individuals and societies; and these efforts, further, only began to rise into large proportions, or to meet any considerable amount of the acknowledged want, when they were seconded and upheld by governmental agency.

Scotland, again, which has always maintained a superior standing in respect to popular education, owes this superiority mainly to legislative enactments at the time of the Reformation (followed up by the Act of William III.) which provided the means for keeping up one school at least in every parish throughout the country; while Ireland, where no such enactments were made, has remained in a state of ignorance, and almost barbarism, which is only now being broken down by the active co-operation of government in the education of the people. And what is true of the lower is equally true of the higher education of these countries. Universities in these, as in most other countries of Europe, have not sprung up, or if they have done so, have never attained any large proportions, when left to the natural operation of supply and demand. For although many of them rest on private foundations, yet it is only when they attain the character of national institutions that they seem to combine the advantages requisite to produce seats of learning, in which leisure and opportunity are afforded for the due cultivation of the higher walks of literature and science. Individuals of course there will always be, whose genius breaks through every obstacle, and urges them forward to eminence, even from the very lowest ranks of the people. But the higher culture of a country could not be left to depend upon the irrepressible genius of the favoured few. What is wanted to make it tell upon the progress and welfare of the whole community is a steady maintenance of institutions in which learning may be cherished on a large scale, and its influence then diffused throughout the whole community. In this point of view national universities, even though often fraught with abuses, have played the most important part in the history and development of every country in Europe. With these facts before us, we conclude that it can hardly be the course of wisdom and prudence to leave the social evils arising from ignorance untouched, and trust to a mere theory, that at some distant period society will right itself, and education become spontaneous.

Education by the state.

2. This leads us to a second theory, namely, that the state should hold the education of the entire community in its own hands, as being the natural guardian of the welfare of the community. This theory may be regarded as the opposite extreme to the former one; and if that is open to objections, this in its turn is no less open to them also. First of all, it may reasonably be objected, that when education is wholly in the hands of the government, it may be employed for state purposes, instead of being adapted solely to the benefit of the community. This objection is not a mere speculation, but is one which may be largely borne out by facts. If we take any of the more despotic countries of Europe as examples, it is hardly to be denied that the public instruction of the people is so arranged, or so limited in its material, as to favour the interests of the monarchy rather than the free development of the mind of the people. The Metternich policy in Austria may be quoted as a well-known and universally-acknowledged example of this. Everything was done during its prevalence to enhance the material comfort of the people, and to nurse them in the lap of physical enjoyment, while the most rigid care was taken to exclude the entrance of progressive ideas, and to prevent the popular mind from ranging beyond the wants and enjoyments of the hour. In countries like Prussia, where the force of public opinion is strong enough to control the acts of the government, education naturally attains more freedom and strength; but even here it is conformed pretty closely to the state policy of the time being, and scarcely attains the elasticity which it would do under a more popular system. This is especially visible in the middle and higher education of the country. In spite of all the admirable organization which the Prussian educational system affords, from the people's schools up to the university, yet the fact of all the places being virtually in the hands of the crown, which thus holds in its keeping the destiny of the entire mass of gymnasial teachers and university professors, exercises insensibly an influence upon the minds and opinions of the great body of the learned men of the country, and biases them towards the views and the general policy of the government. Even the current systems of philosophy are not a little determined by the direction in which the sunshine of court favour falls upon the processes of human thought.

It might, however, be a question how far this objection against a purely governmental system of national education is obviated by the fact of a government becoming popular,

National Education. constitutional, and free. This introduces, no doubt, another phase into the whole aspect of the subject, but does not altogether render it free from the same difficulty. In a country like England society is divided into various large communities, distinguished from each other by their religious peculiarities, or by their social habits, or by their political sympathies. All these will have their own special views respecting the nature and machinery of popular or other education, and will exercise a pressure upon the government upon this as well as upon all other questions. Now, a constitutional government, we well know, can only maintain its position at the head of affairs by enjoying a certain amount of popular sympathy and support. Hence, instead of taking up the question of education simply as a question of national advancement, it is inevitably regarded also as an element in the state policy. To go contrary to the views of this or that large community might endanger the majority at the next election; and so a course must be steered between conflicting objections which shall satisfy the largest number and give the least offence. Thus a question like national education, which ought to rest simply and solely on the higher ground of the good of the people, irrespective of all political tendencies, when once it is centralized in the hands even of a constitutional government, becomes inevitably mixed up more or less with party struggles, and is treated with a view to majorities and minorities like any other question of state polity. Whether, therefore, we regard education as centralized in the power of the crown, as in the case of a despotic country, or as centralized in the bureau of a government, as in the case of a free and constitutional country, in both cases alike there are obstacles which stand in the way of a purely beneficent system, altogether removed from political or party interests. Of course the evils may be greater in one place and less in another; but, theoretically speaking, the centralization of all education in the hands of a government, whether constitutional or not, can hardly be separated from a certain amount of concomitant evil or imperfection.

Education by the church. 3. A third theory of national education is, that the church should educate the people. This is one of those theories which is rarely taken up upon universal grounds either of right or expediency, but is usually advocated by those whose views and sympathies are confined to some peculiar form of religion or of church polity. Moreover, those who advocate it as regards themselves would very rarely admit the soundness of the principle as applied to countries of a different faith and practice. In some Catholic countries, where there is nearly an entire uniformity of faith amongst the mass of the people, the principle that the church is the proper educator of the community has been oft-times affirmed, and to a large extent acted upon, under the sanction of the governments. But in other countries where a Protestant church establishment exists, the Catholics are very far from admitting the principle that this said Protestant established church should be entrusted with the whole work of national education whenever it becomes predominant. Neither do the Protestants, in their turn, who advocate the principle of church education in regard to themselves, show any greater disposition to carry out the principle when it would throw all education into the hands of hostile communities. The idea, therefore, that the dominant church should be the sole educator of the people, however simple it may appear as a theory, yet entirely breaks down in practice. There was no doubt a time in the history of Europe in which this theory might have been actualized—the time, I mean, when there was one complete uniformity of faith, when the church stood virtually on a level with the state, when the whole of society was based as much upon ecclesiastical institutions as upon civil government, when the see of Rome affirmed for itself a universal spiritual sovereignty over the human mind, and the clergy were the only depositaries of knowledge, small as it then was. But these times have long passed away; and it is only the lingering memory of such a state of things in the minds of those who live more in sympathy with the past than in the realities of the present, that could possibly keep up the illusion that this principle is in the slightest degree applicable to the time in which we now live. In the present day learning and science have become quite independent of religion, or at least of religious institutions. Each sphere of human activity, the religious and the secular, pursues its own way and reaches after its own results. Society, too, has at the same time become removed from an ecclesiastical to a secular and politico-economic basis. However faithfully the individual may cultivate his religious life, society as a whole is bound together by civil law and social customs, and can only act as one personality upon these general principles. Hence to speak of society as placing its own education in the hands of the church, would be simply giving up to those who represent the religious principle a function from which that principle is already virtually divorced. The church is not in any way scientific in its basis; it does not represent the learning, the science, the philosophy, the progressive ideas of the age. The general tendency of it in this point of view is frequently retrogressive rather than not; it has to be urged on by the spirit of the age more frequently than to guide and correct it; and whenever it has the control of educational establishments, it is not unfrequently engaged in a struggle to keep them to their ancient forms and spirit; while the age is equally struggling to develop them into new and more progressive institutions.

Hence the church is, *in fact*, educated by the people far more than the people by the church; so that to affirm the principle of church education uninfluenced, except permissively, by the state, would simply be to put one series of institutions and agencies in constant conflict with another. The church has its own sphere. It represents the religious interests of mankind; it has to keep alive our faith in the spiritual and eternal amidst the hurry and bustle of human life; it has to bring the aids, the motives, the consolations, the impulses of religion to the mind of a people too much immersed in secular concerns; but it can no longer seat itself on the throne of learning, or science, or of popular education; for the whole tendencies of the age are to make the separation of these things, already sufficiently wide, more and more absolute. The term church, however, is indefinite. In no countries where any amount of independent thinking has sprung up, does the religious life assume one uniform aspect. In England, according to the last census, fully one-half of the whole church-going population of the country was found to attend places of worship belonging to the various unestablished religious denominations; and in Scotland and Ireland the established churches are both greatly in the minority. Under such circumstances, of course, the theory that the church should educate the people could only be for a moment entertained in the broader sense, that the education of the country should be left in the hands of the religious bodies, to carry it on by their own voluntary activity. That a certain amount of healthy philanthropic effort may and does develop itself in connection with religious bodies in relation to the education of the people, facts abundantly prove; but it is one thing to allow this activity its free scope, and another to leave to it the entire education of the community. As far as our present experience goes, the voluntary efforts of religious communities, though they have effected much good in their own immediate circle, yet have totally failed, when left to themselves, to assume anything approaching national proportions. The very nature, too, of voluntary effort in matters of this kind is fluctuating and spasmodic. It can do much under sudden

National Education.

excitement; but it always diminishes and grows feeble when excitement dies away. Thus in matters which require one steady unwavering flow of support, quite independent of any kind of public incentive, voluntary effort always shows itself incompetent. Such incompetence may be of little moment in some branches of philanthropy; but when we consider the vastness of the scale on which national education must be carried on in order to be effective; when we consider the immense amount both of money and machinery which is requisite to keep it going steadily forward, reaching all the farthest recesses of the country; when we consider, moreover, the tremendous stake which a country must always run in deciding the manner in which the masses of the people are enlightened and trained in early youth, it cannot assuredly be wise to leave the whole to what have hitherto proved, in every country in the world, uncertain, fluctuating, and wholly incompetent resources.

Moreover, religious bodies are themselves exposed to revolutions. New ideas spring up, new forms of doctrine appear, wide-spread disputes prevail, vast schisms and disruptions disturb from time to time the working even of those bodies which are apparently the most firm and unmovable, and draw away public attention and public effort from all the details of denominational life. In the midst of all this, however, the people, with its wants, its ignorance, its need of proper training and enlightenment, whether in the purlieus of the city or the remotest nooks of the country village, is a standing fact, which cannot be abandoned with any security to the mercy of these fluctuations. So far, then, there is an objection to the principle we are now considering in point of *fact*, but there is also an objection in point of *theory*. It will hardly be maintained by any one that the rivalry and social separations of contending sects is a *benefit* to the community. Even when confined to religious differences, it produces ill-will, unhappy feeling, bad neighbourhood, and want of unity amongst citizens in carrying out social changes or much-needed reformations. Should the education of the country, however, be left entirely in the hands of the religious denominations, this separation, which was before confined to acts and forms of public worship, must gradually sink down lower into the core and heart of society. Denominational distinctions would begin with the child in the school; his sympathies would be confined to his sect from his youth up; and the whole country, as far as it was educated at all, would grow up stamped with certain *intellectual* types, which would add tenfold intensity to the *religious* ones. To sum up, then, in a few words, the objections to the whole theory, we should say that it must, first of all, fail in reaching the far-spreading wants of what we mean by national education; secondly, that it must prove defective in yielding steady unfluctuating support; and thirdly, that, so far as it does extend, it has the undesirable effect of perpetuating and intensifying the spirit of sect throughout the country.

Education by church and state conjointly.

4. A fourth theory of national education, which is simply a combination of the second and third, is, that the state should educate with and through the church. In countries where the established church represents the uniform faith of the people, this principle might work in many respects advantageously. The church being here co-extensive with the state, and possessing already a complete territorial system of arrangements, adapted to and sympathized in by the whole population, it seems at first sight to be a matter at once easy, convenient, and economical to employ the church agency through the length and breadth of the land to conduct and superintend the *educational* agency; though of course under state control. The same objection, however, lies here as we before urged in relation to a purely church education; namely, that the church is not constituted upon a scientific basis, and from its naturally conservative tendencies is apt, in some cases, to come into collision with the advancing educational tendencies of the age. The more the fact becomes realized that the church has a spiritual function of its own, the less will society be disposed to encumber it with social duties which will hinder its own legitimate activity, and only be imperfectly performed after all. This theory, however, can only be entertained at all in countries where the religious faith is uniform: in countries like our own, where this is not the case, the only application of it would be one in which the government co-operated with all the religious bodies, and assisted them equally to carry on the work of popular education. This system, however, has the double disadvantage,—1*st*, Of investing spiritual bodies with a civil and political function; and 2*dly*, Of putting into their hands additional means of maintaining their own denominational peculiarities through the popular school. It is a matter not at all denied or concealed, that religious bodies who take up the cause of popular education do so not simply and solely for the benefit of the community, but equally for the benefit of their own denomination, and to spread its influence more largely throughout the country. Hence the school becomes a kind of appendage to the church; education is viewed with respect to church purposes, and a system of antagonisms which has grown up in the religious life of the people becomes *doubled*, by having an educational as well as an ecclesiastical arena on which the combat may be carried on. All this is of course much modified and softened by state control, but by no means obviated, as we shall have occasion to observe in the case of our own country.

We are now reduced to a last and fifth theory of education, viz., that the state should undertake it *through the people*. According to this plan, the government provides that the country shall be divided into certain districts, that in each district a competent board shall be elected to manage the educational affairs; that a sufficient rate shall be raised to support the necessary schools, and that the local authorities shall thus co-operate with the central government in giving vigour and efficiency to all the institutions which may be originated for the instruction of the country. Of course the details of such a system will be very different in different countries. In some, the central government will have a greater preponderance; in others the local board will exercise the principal functions; in others, again, the principle of voluntary effort may come in as a portion of the whole plan; but in each case the fundamental idea is the same—that of the union of the people, in their capacity as free citizens, with government, in the institution and superintendence of popular education. Whatever difficulties this plan may in special cases have to encounter in its course to a practical realization, yet, *as a theory*, it stands pre-eminently above all the rest. It has none of the partial character about it which is inseparable from the idea of leaving education to fight its own way, but goes directly to the root of the question, and aims at complete measures for meeting the wants of the case. It equally avoids the opposite evil of centralization, and, by creating a local authority, places the educational institutions of a country in a position where they cannot be made part and parcel of the machinery of government. Again, it contemplates the wants of the people, not through the peculiarities of any particular religious system, but by the light of reason and common-sense, as expressed by the spirit of the times; and as it stands apart from religious dissension, it can adapt itself to all the circumstances which the future history of a country may bring into existence. As a theory, moreover, this has already received the stamp of practicability both in America and in some of the British colonies; and in no new country probably, where free institutions exist, would any other system now be ever maintained or even attempted. In old countries like our own, the pathway to such a system is not so clear or so

National Education. feasible; but all the changes which are introduced naturally tend to this as the final result.

Looking to the relation which the parent holds to the teacher in the above-mentioned system, this, of course, will be different in each. *1st*, In the case of education being a question of supply and demand, the parent stands simply in the position of a *purchaser*, who gives a certain price in the market for value received on the part of his child. The whole is simply an ordinary commercial transaction. *2dly*, When the government provides education and takes any means to enforce it, then the parent stands to the teacher in the relation of a subject of the realm to one who administers and carries on a national institution, and has no power of complaint or appeal so long as he administers it according to principles laid down by superior authority. *3dly*, Where the *church* provides education, the relation of the parent to the teacher is that of a member of a religious community to the government of the church to which he belongs, and his appeal, in case of dissatisfaction, must be simply to the church authorities. *Lastly*, When the people provide education in their capacity as citizens, the parent stands to the teacher in the relation of a unit in the local community to any municipal officer who carries out the will of the whole. The first relation is a *commercial* one, the second a *civil*, the third an *ecclesiastical*, the fourth a *municipal*. In the last case the teacher is a citizen who is entrusted by his fellow-citizens with a certain duty, which he is able to perform more satisfactorily than themselves. In other words, a portion of parental duty is given up to one who devotes his whole time to do *well* what the parents individually would do very imperfectly, or not at all.

Educational agencies actually existing.

(2.) Having gone through the various *theories* which have been propounded as to the proper agencies to be employed in carrying on the work of national education, let us now view the question as a *matter of fact*; and inquire who actually *do* educate the people in the most civilized countries of the world, and what are the agencies which really *are* employed for this purpose. A clear statement of the actual facts of the case may tend to throw considerable light on the working of the different theories already explained.

Prussian education.

The country which has usually been held up as having the most complete and thorough-going system of national education is Prussia. It may be as well, therefore, to begin by giving a brief statement of the principles and some of the details of the Prussian educational system. And, first of all, I should premise that the question of national education has been viewed in Prussia not in relation to one portion, but in relation to the whole extent, of the community; not in relation either to elementary education alone, but in relation to superior and university education as well,—the whole forming one graduated system adapted to all classes of the people. The basis of this system is purely governmental; the centre from which it all emanates being a minister of instruction immediately dependent on the crown.

The entire instruction of the country is divided into three main departments:—*1st*, The universities; *2d*, The high schools or gymnasia; and, *3d*, The primary schools, including those adapted to the village, and the somewhat superior ones which are intended for the towns. For conducting and superintending these different classes of educational establishments a considerable machinery is put into operation, of which we must next give some general idea.

The kingdom of Prussia is divided into ten provinces, viz.,—Eastern Prussia, Western Prussia, Posen, Pomerania, Brandenburg, Silesia, Prussian Saxony, Westphalia, Cleves, and Lower Rhine. Each of these provinces again is divided into districts (*Regierungs-Bezirke*); each district is divided into circles (*Kreise*); and each circle into communes (*Gemeinde*). These divisions, which subserve the general purposes of government, are also taken as educational divisions, and form the geographical basis of the whole superintendence.

First, with regard to the provinces. Most of these possess a university. The superior direction of the university is in the hands of a commissioner who belongs strictly and solely to the government, so that the entire administration of the universities is governmental, not being interfered with in any way by local authorities, either civil or ecclesiastic. All the laws and regulations affecting them, as well as all the appointments of professors, emanate directly from the crown.

Next, in regard to the high schools or gymnasia. The direction of these is placed in the hands of the *provincial* authorities. Each province possesses a consistorium, which is charged with the affairs of the church, the school, and the public health. That portion of the consistorium to which the affairs of public instruction are committed is termed the *Schul-collegium*, each member of it being appointed and salaried from the crown. The members of the consistory who administer ecclesiastical affairs are all clergymen; those who administer the educational affairs of the province are all *laymen*, so that the educational and the ecclesiastical elements are kept *quite distinct* in high quarters, and can there never come into collision. The basis of the Prussian system of education, it will be seen from the above explanations, is wholly civil; its connection with the church being only seen in those minor details to which we shall have soon to refer. Just as the administration of the universities emanates from the central government of the country, so does that of the high schools or gymnasia emanate from the *provincial* government, which makes all the appointments, and keeps a board of examiners sitting in perpetuity, at once to test the capacity of the teachers, and the proficiency of the students previous to their being drafted off to the universities.

Thirdly, with regard to the primary schools. The direction of these is made over to the smaller divisions of the country; that is, to the departments, the circles, and the communes.

Every commune is bound to have at least one primary in or near it; and every child of that commune within a certain age, whose parents cannot show that he is otherwise efficiently instructed, is bound under certain pains and penalties to attend it. Accordingly, both the means of education and the obligation to use them are carried out strictly throughout the entire length and breadth of the land. In order to maintain these schools, care is taken first of all to manage and properly appropriate all the old school funds and charities, of whatever kind, and put them to their proper use. Next, all the land proprietors and fathers of families in the village form a school constituency (*Landschulverein*), upon whom it is incumbent to raise sufficient funds, by means of an equitable tax, for keeping the school in an efficient state after all the school endowments and school fees have been taken into account. If in any case the poverty of the commune renders this impossible, then the additional funds required must be made chargeable upon the whole department. In larger parishes and in towns schools of a higher order (*Bürgerschulen*) must be maintained, according to the wants of the population, which are supported virtually in the same way as the small country schools.

The *management* of these institutions is organized in the following manner:—In every village a committee is formed, consisting of the patron of the church (if any), the clergyman, the local magistrate, and some two or three of the principal inhabitants. These are called the school-presidency (*Schul-vorstand*). In towns or places where there are churches of different communions, the clergyman of

National Education.

each communion is to be on the committee; and in larger places still, where several schools exist, there is a school commission appointed to manage the whole.

A complete system of inspection also exists. The clergyman of the commune (or clergymen of each communion, where more than one exists) is nominated *ex officio* the local visitor. In every circle, however, there is an official inspector appointed by the provincial government, who is generally an ecclesiastic, either Catholic or Protestant, according to the preponderance of the population. Thus, the two authorities which come nearest into contact with the children are the ministers of religion; and this is considered to be the best guarantee for keeping up the strictly religious character of primary education. After this, however, all clerical influence ceases, and is never admitted in any way into the higher administration.

The next higher authority, after the district inspectors above alluded to, is the *Schulrath*, who is, in fact, the minister of instruction for each department (*Bezirke*), and forms the link between the local school committees and the provincial government. Very little of the direction of the schools, and none of the legislation, is left in the hands of the local managers. All they have to do is to carry out the orders of the superior authorities, and find the necessary funds. They retain, however, a voice in the appointment of teachers, but must not interfere with them as to the manner in which they discharge their duties, or the methods of instruction they follow. The government takes care that *all* the teachers shall have a sufficient normal school training, and obliges them to pass an examination, and hold a certificate of competence, before they can be chosen as teachers at all. When, therefore, their appointment is once made, it is presumed that they *understand* the details of school organization and method better than those who have not been trained for the purpose. Accordingly, although the Prussian primary teacher is but poorly paid, yet his position is independent, and his superior education always entitles him to hold a respectable rank in the society amongst which he is placed. Every appointment of a teacher, moreover, as well as every dismission, must be known and ratified by the provincial government.

In the year 1846 the number of educational institutions in Prussia, according to the official tables, was as follows:—

Elementary schools	23,030
Bürger schools	1,202
Higher town schools	100

making a total of 24,332 *primary* schools, with 2,540,775 pupils between the ages of 6 and 14. To these must be added 117 gymnasia, with 29,474 pupils, all enjoying a sound classical training; and 382 infant schools, with 25,000 pupils. The population of Prussia in 1848 was about 16,000,000, comprehending about 3,000,000 children between the ages of 7 and 14. Of these, about 2,600,000 were actually in the governmental schools, leaving only 400,000 to be accounted for by private education, sickness, and other unavoidable causes. There can be no doubt, therefore, that the Prussian people are really educated throughout the whole community, and educated, too, according to their relative stations in life, with decided efficiency.

From the above sketch we can easily see that the department of public education in Prussia forms a most complete and all-embracing system, emanating entirely from the government, and responsible to the government for all its acts. All the questions which form stumbling-blocks and difficulties in our own country are summarily disposed of, because the idea of *the state* dominates over every other, and all private interests or opinions are made to bend to this as the governing principle of society. Much of the burden is borne directly by the government, such as the cost of the universities, and partly also that of the gymnasia and normal schools; but no difficulty is felt in making all property rateable, and imposing it as a duty upon every parish to see that sufficient education is provided for the children of the commune. The advantage, indeed, of sound education being brought within the reach of all for so trifling a fee, makes any disposition, which there might otherwise be, to complain of the burden wholly unreasonable.

Again, education being provided *for* all, the law compels that it should be embraced *by* all; and thus all the apparatus of motives for inducing attendance is obviated, and the whole question of early removal from school settled by an authority from which there is no appeal.

The religious question is settled with the same ease. Respect is had for differences of faith. The master is usually appointed in accordance with the religion of the majority of the people; and if there be any considerable number of inhabitants of different communions, separate schools for each are rather encouraged than not. Where this cannot be the case, it is usual to appoint the second master from the communion of the minority. No religious instruction is ever given to any of the scholars except by a teacher belonging to their own denomination; and parents have absolute permission to withdraw any of them from religious teaching which is opposed to their professed convictions.

Whether this formal and governmental religious teaching has had much real effect in cherishing the religious faith of the people is much to be doubted, if we may judge by the results: but no one can doubt the vast effect of the system *as a whole* in encouraging learning, and raising up an immense body of highly-educated men.'

We ought, however, here to make a distinction between learned men and men who have the power of applying their learning to practical objects. With all its vast amount of *learning*, Prussia does not take the lead in enterprise and civilization generally. "It is sometimes asked," says Horace Mann, "why the Prussians, with such a vast and powerful machinery for popular instruction, do not as a nation advance more rapidly in the path of civilization; why the useful and mechanical arts among them are still in a half-barbarous condition; why the people are so little enterprising; and finally, why certain national vices have not yet been eradicated. . . . The chief cause," he concludes, "of the helplessness and incapacity of the Prussians is this. When the children once leave school they have very few opportunities of *applying* the knowledge, or *exercising* the capacities, which have been acquired and developed there. Their mental resources are not drawn upon, their capacities are not quickened or strengthened by practice. Phrases such as "the active duties of life," "the responsibility of citizens," "the stage or career of action," "obligations to posterity," which are in common use amongst us, would have a foreign sound in the ears of a Prussian. In Prussia the government takes about the same care of the citizen as the citizen takes of his cattle. The citizen does not elect functionaries, is not called upon to inquire into the character or eligibility of candidates for office, has no vote to give. He neither makes nor repeals laws. He is not called upon to discuss or decide questions of peace or war, of finance, customs, taxes, or postal and internal arrangements. He is not asked where a road is to be opened or a bridge to be built, although in the one case he has to furnish the labour, and in the other the materials. His sovereign is born to him. The laws are made for him. If there be question of war, he is not called upon to account for it or to end it; he has merely to fight, to be shot, and to be paid. The tax-gatherer tells him how much he has to pay in taxes; the ecclesiastical authorities draw the plan of a church which he is made to build; and his spiritual guides, who have been appointed by others, prepare a creed to which he has only to subscribe. He is told in the same way how to

obey his king, and how to worship God. But although an ocean slumbers in the mind of every child that is born, what will prevent its eternally remaining in a state of gloomy stagnation, if no refreshing, quickening breeze be allowed to stir over its surface."

This is probably a correct account of the fundamental weakness of the whole Prussian system. Education does everything for the people that could be expected, but education *alone* is insufficient to produce practical energy. This can only be done through the influence exerted by political liberty and popular institutions, which open an independent course of action for every citizen of the country.

In giving the above sketch of the state of national education in Prussia, we have in fact before us, with minor modifications, a general idea of what exists throughout all the different states of Germany. German education, therefore, as a whole, may be pronounced purely governmental, complete in its organization, and productive of a vast amount of intellectual culture. It is open, however, to grave doubts whether it produces fruits equally good in relation to the practical energy of the people, to their moral habits, and to their religious faith. These last results appear to depend upon causes operating in the national mind, in the social habits, and in the religious life of the people, quite distinct from anything which can be secured by a governmental system of education, however complete both in theory and practice.

Dutch education.

Holland is in many respects different from Germany. It has been more under the influence of popular institutions, and had some apprenticeship to the art of self-government. The general features of the national education of Holland bear the stamp of this. They are less minutely defined and regulated by the central authority than those of Germany,—less under the direct influence of the state,—and are thrown more into the hands of local managers. The only officer of the state who has anything directly to do with public education is the minister of the interior, together with a *referendaire* and one head inspector. This forms, in fact, the whole amount of centralization which exists in the system. All the other functionaries are quite distinct from either the civil or municipal authorities. They consist chiefly of district inspectors, appointed by the government, who have almost the absolute direction of the educational affairs in their hands, each being a kind of educational plenipotentiary in his own district. These inspectors, moreover, hold a convention from time to time, and thus form a kind of educational parliament, in which all the affairs of the country relating to public instruction are duly discussed. In addition to the inspectors, there is a committee of management in each town or school district, who act in concert with them, but are quite distinct from the municipal officers of the country.

All the details of primary education, in fact, are left in the hands of the inspectors; neither is any precise *mode* of rating imposed upon the townships in support of the schools, except that they must confer with the inspectors, and raise sufficient funds in any way that appears most suitable, in order to keep up the institutions in an efficient state.

Another peculiarity of the Dutch system is the mode in which the religious question is solved. As Holland contains a considerable number of religious sects, it was considered undesirable to provide religious instruction in each school, according to the denomination of the children. Instead of this, it was determined not to introduce any catechism, or distinct dogmatical teaching at all. They reasoned very judiciously, that children are unable to distinguish between different dogmatic systems; that the inculcation of them during their daily lessons is not only unnecessary, but unadvisable; that it is much more suitable, in fact, for children in the day-school to have a good knowledge of holy Scripture given them, together with an earnest inculcation of Christian duty, accompanied with simple devotional exercises, than any more direct dogmatic teaching. As other agencies exist in the country for the direct teaching of theology, it was thought that the children might be safely relieved of this during the ordinary hours of daily instruction; so that the difficulties connected with variations of doctrine in connection with the primary school might be avoided *ab initio*. Hitherto no inconvenience is believed to have resulted from this principle, nor are the children any less inclined to Christian doctrine in after life from its not having formed any part of the *daily routine* of the primary school. Taking it altogether, the public education of Holland may be regarded as fully equal in efficiency to that of Germany,—in some respects, indeed, superior,—and the number of children actually found in the schools shows that although the attendance is not compulsory, yet almost the entire population is really educated.

French education.

We come next to France. Here, as in Germany and Holland, the plan of public education is threefold, comprehending, 1*st*, The universities; 2*d*, The colleges; and 3*d*, The primary schools. The universities are divided into five faculties,—namely, theology, law, medicine, science, and literature. Each of these faculties can exist apart from any of the rest. Thus there are altogether in the whole of France, 7 faculties of theology, 9 of law, 3 of medicine, 9 of science, and 7 of literature. All these are under the direct control of the government, as represented by the minister of instruction. The colleges of France, which answer to the gymnasia of Germany, are twofold,—1*st*, The royal colleges, which are wholly dependent on the government; and 2*d*, The communal colleges, which are supported partly by the government and partly by the municipal corporations and departments; but still are under the entire *control* of the state.

With regard, thirdly, to primary instruction. This has always been, until recent times, in a lamentably defective state. Freedom of instruction existed; the principle of supply and demand had ample scope for operation; the church, too, as well in the Catholic as in the Protestant portions of the country, had the crying deficiency constantly before its eyes, but comparatively little was done to remedy the evil until the subject was taken up warmly by the government. In the year 1831, under the enlightened *régime* of M. Guizot, M. Cousin was sent on a mission into Holland and Germany, to report on the system of popular education as there organized and carried out. The well-known and elaborate reports which he compiled as the result of this tour of examination, formed the basis for a new law, which was first carried into effect in the year 1833.

This law provides, first of all, for the complete liberty of education; that is, it allows any one, under certain defined conditions, to assume the office of a teacher, and to open a private school. Moreover, it admits of denominational schools being enrolled on the government list of educational institutions, and awards them stipends on the same principle as the rest. The chief object of the law, however, is to provide for the establishment and proper regulation of communal schools throughout the whole country. To give any idea of the principles on which the law is founded, the sources of the pecuniary supplies, and the general mode of superintendence, I subjoin the following excerpts from the text of the law as then brought into operation. After explaining the difference between primary and secondary education, and defining the conditions under which persons are authorized to become public teachers, the law proceeds as follows:—

"*Art.* 8.—The public primary schools are those which are maintained in part or entirely by the communes, the departments, or the state.

"*Art.* 9.—Every commune is bound, either by itself or united to one or more neighbouring communes, to maintain at least one elementary primary school.

National Education.

"In cases where local circumstances permit it, the minister of public instruction may authorize, after having heard the municipal council, under the title of communal school, schools more particularly belonging to one or other of the religious denominations recognised by the state.

"*Art.* 10.—The communes, chief towns of departments, and those whose population exceeds 6000 souls, must have, in addition, one *superior* primary school.

"*Art.* 11.—Every department is bound to maintain a normal school, either alone or in union with one or several neighbouring departments.

"The general councils will deliberate upon the means of securing the support of the normal schools. They will deliberate also upon the union of several departments for the support of a single normal school. This union must be authorized by royal ordinance.

"*Art.* 12.—There will be provided for every communal teacher—

"1. A conveniently situated residence, equally to serve him as a habitation as to receive pupils.

"2. A fixed salary, which must not be less than 200 francs for a primary elementary school, and 400 francs for a primary superior school.

"*Art.* 13.—In default of endowments, donations, or legacies, which assure a residence and a salary conformable to the preceding article, the municipal council will deliberate on the means of providing for it. In case of any deficiency of the ordinary revenues for the establishment of the primary communal, elementary, and superior schools, they will be provided by means of a special tax, voted by the municipal council; or, in default of the vote of this council, established by royal ordinance. This tax, which must be authorized each year by the financial law, must not exceed three centimes, in addition to the other taxes upon persons or property.

"When communes are not able, either alone or in union with several, to procure a locality and to secure a salary by means of this contribution of three centimes, the recognised necessary expenses of primary instruction shall be provided for, if the funds of the department are insufficient, by an especial tax voted by the council-general of the department; or, in default of the vote of this council, it shall be established by royal order. This tax, which must be authorized each year by the financial law, shall not exceed two centimes.

"If the centimes thus imposed on the communes and departments are not sufficient for the wants of primary instruction, the minister of public instruction must provide for them by means of a supply, which shall be carried over annually for primary instruction to the budget of the state. Each year there shall be annexed to the proposition of the budget a detailed account of the manner in which the funds were employed which were granted for the preceding year.

"*Art.* 14.—In addition to the fixed salary, the communal teacher shall receive a monthly fee, the rate of which shall be regulated by the municipal council, and which shall be collected in the same form, and according to the same rules, as the direct public contributions. This sum shall be drawn month by month, in accordance with a register of the pupils, certified by the teacher, examined by the mayor, and rendered valid by the under-prefect.

"Those pupils of the commune or of the united communes whom the municipal councils have designated as unable to pay any recompense, shall be admitted into the communal elementary school gratuitously.

"*Art.* 17.—There shall be in connection with each communal school a local committee of superintendence, composed of the mayor or his assistant, the president, the rector or minister, and of one or more of the chief inhabitants, nominated by the committee of the district.

"Several schools of the same commune can be united under the management of the same committee. When, in consequence of the article 9, several communes are united to maintain a school, the committee of the district must nominate, in each commune, one or more of the chief inhabitants to form a part of the committee.

National Education.

"*Art.* 18.—In every district of the under-prefecture a committee shall be formed, especially charged with the superintendence and encouragement of primary instruction.

"*Art.* 19.—The following are members of the district committees:—

"The mayor of the chief town, or the oldest of the mayors of the chief town of the district. The justice of the peace, or the oldest of the justices of the peace of the district. The priest, or the eldest of the priests of the district. A minister of each of the other creeds recognised by the law, who officiate in the district, and who have been nominated according to the second paragraph of article 17. A head-master, principal of a college, professor, rector, head of an institution, or master of a school, nominated by the minister of public instruction, when there are schools, institutions, or colleges in the district of the committee. A primary instructor, residing in the district of the committee, and nominated by the minister of public instruction. Three members of the council of the district, or of the chief inhabitants, nominated by the said council. The members of the general council of the department, whose real place of residence is in the district of the committee. The prefect by right presides over all the committees of the department, and the under-prefect by right presides over all those of the district; the king's procureur by right is a member of all the committees of the district. The committee chooses its vice-president and secretary every year; the latter may be taken from amongst their own number. When a secretary is appointed who is not a member of the committee, he becomes one by his nomination.

"*Art.* 21.—The communal committee inspects the public and private schools of the commune.

"It watches over the salubrity of the schools and the maintenance of discipline, without any detriment to the prerogative of the mayor in matters of municipal police.

"It finds out if everything has been provided for the gratuitous education of poor children.

"It prepares a list of children who do not receive primary instruction, neither at home nor in any private or public schools.

"It causes the committees of the district to be made acquainted with the different wants of the corporation, with regard to primary instruction.

"*Art.* 22.—The committee of the district inspects, or causes to be inspected by delegates taken from amongst its members or from its own body, all the primary schools in the district. When the delegates have been chosen out of the committee, they have a right to be present at the meetings, and to have a deliberative voice.

"When the committee judges it necessary, it unites several schools of the same commune under the inspection of the same board, as it has been prescribed in article 17.

"Every year it sends to the prefect, and to the minister of public instruction, an account of the condition of all the primary schools of the district.

"It gives its opinion on the assistance and the encouragements to be granted to primary instruction. It urges necessary reforms and improvements.

"It nominates the communal teachers upon the presentation of the municipal council, proceeds to their installation, and receives their oath.

"The communal teachers are to be *appointed* by the minister of public instruction.

"*Art.* 23.—There shall be in each department one or more commissioners of primary instruction, charged to examine all those who are candidates for certificates of capa-

National Education.

city, whether for elementary primary instruction, or for superior primary instruction; and they shall deliver the said certificates under the authority of the minister. These commissioners shall also be charged to examine pupils of the normal school at their entrance and on their departure from the institution.

"The members of these commissions shall be nominated by the minister of public instruction.

"The examinations shall take place in public at times appointed by the minister of public instruction."

The law, of which the above are some of the principal provisions, was carried into effect in the year 1833. That it did not remain a dead letter, but was applied with vigour and success, may be seen from the fact, that in ten years from its first establishment, *i.e.*, in the year 1843, the following items appear amongst the statistics published by the Board of Education:—

Number of communes in France	37,038
Number provided with schools	34,578
Number not yet provided	2,460
Total number of primary schools	59,828
Number of inspectors	87
Number of sub-inspectors	113
Evening classes for labourers	6,434
Total number of children attending primary schools	3,164,297
Number admitted gratuitously	763,820
Number of normal schools	78
Number of professors in the same	495
Number of colleges	358
Number of scholars in them	31,316

It could hardly be expected that this vast mass of educational machinery could in ten years be brought into a high state of efficiency; still, there can be no doubt but that a noble effort was made, which, if steadily carried out, in process of time will elevate the peasantry and people of France to the highest rank amongst the educated nations of Europe.

American education.

Having now gone through the system of national education followed in some of the principal countries of Europe, we pass over to America, where a totally different kind of political life prevails, and where the school system is based upon more popular principles. In most of the United States (in which a very complete institution for popular education exists) we find a system characterized by the extreme minimum of centralization. The last of the theories we before noticed is here almost perfectly realized,—that, namely, in which the government indeed *provides* for education, but does so entirely through the people. The question of education is not even mooted in the central Congress of the States; it is left wholly for the authorities of each state to determine whether they will have any system of education or not, and if so, how it shall be carried on. Some of the states, accordingly, have no public education at all; the greater part, however, have established a system of education by law, though the details of the act appear very different as we pass from one state to another.

United States.

We turn first to the state of Massachusetts, the original core and centre of the American people. The practice of having schools legally maintained according to the wants of the population is one which, in New England, came down from the time of the first Puritan settlers. As the population advanced, however, as immigration increased from year to year, and the country became involved in various political struggles, popular education fell into the background, so that it became totally insufficient in quantity for the wants of the people. It is only within the last twenty or thirty years, indeed, that any large and well-directed efforts have been made for its improvement; but these efforts have certainly been upon a scale which cannot but excite admiration and approval.

Every township in the state, comprising 150 families, is bound to maintain two schools during nine months of the year, or three schools during six months. If it contain 500 families it must maintain two schools throughout the year, or three schools during eight months. In these schools reading, spelling, writing, arithmetic, English grammar, and geography, must be taught.

National Education.

Every township containing 500 families must also maintain a superior kind of school, called an English high-school, in which geometry, algebra, surveying, and history are taught, besides the other usual branches. Townships containing 4000 souls must maintain, in addition, a classical high school; and the whole of these schools must be open to the entire population, within the given age, without any distinction whatever. Each township can divide itself into districts for the better carrying out of the government of the schools. Should any township neglect to provide school accommodation at this rate, it is liable to pay a fine of double the average cost of the schools themselves, out of which the proper schools are provided by the state. Any child unlawfully excluded from such schools may, through the parent or guardian, prefer a claim before the legal tribunals for compensation.

So far the provision of the government extends, but no farther. All the other details are entirely in the hands of the township itself, which holds a yearly meeting for voting in supplies and appointing officers, to whom the management of the school affairs are to be entrusted. Every male inhabitant, twenty-one years of age, is empowered to vote at this meeting. There are two committees usually appointed,—one to manage the business affairs, the other to overlook and inspect the schools. These committees are bound to perform their duties punctually and efficiently, and receive a pecuniary compensation from the township for every day they are employed in the school business.

Of late years some important additions have been made to this system. It was agreed that the monies procured by the sale of the state lands should be consolidated into a permanent fund for the benefit of the education of the people. A board of education was instituted also in 1837, which was not intended, indeed, to exercise any *authority* over the townships, but to recommend improvements, and to distribute the money from the fund equally through all the townships. A normal school was also founded at the public expense. This small attempt at centralization has been productive of much benefit. To it we owe the labours of Horace Mann and others in the cause of public education, as well as many of the more important improvements which have gradually sprung up.

To give some idea of the kind of differences which exist in the school laws of the several states, I quote the following passage from a little work entitled *A Digest of the Common-School System of the State of New York*, by Mr Randall, the general deputy-superintendent, in which the principal points of the school laws *in that state* are succinctly laid down:—

"The affairs of each district are managed, under the general direction of the inhabitants entitled to vote therein, by three trustees (one of whom is annually elected, and who hold their offices for three years), a district clerk, collector, and librarian. These trustees are required annually, between the 1st and 15th of January, to report to the town-superintendent the length of time a school has been taught in their district during the preceding year by qualified teachers, the amount of public money received and expended, the number of children taught, the number between five and sixteen residing in the district, together with such other information as may from time to time be required of them by the superintendent of common schools. They have power also, and are required, to call annual and special meetings of the inhabitants to make out tax-lists of all taxes voted for district purposes, and annex their war-

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National Education.

pel no farther in matters of religious instruction than it is itself the expression of the mind of the country, and than it is authorized by law to do. Therefore, in the *General Regulations on the Constitution and Government of Schools respecting Religious Instruction*, it is made the duty of every teacher to inculcate those principles and duties of piety and virtue which form the basis of morality and order in a state; while parents and school teachers, or school managers, are left to provide for and give such further religious instruction as they shall desire and deem expedient."

By this it will be seen that in Canada the state does not ignore religious instruction, nay, rather sanctions it; but it says,—"Religion in the denominational sense is not our province. So far as we are concerned with the schools, we can only recognise what is common to all; and whatever religious instruction is demanded over and above this must be left either to the supplementary education of the family and the church, or must be a personal arrangement between the school managers and the parents of the scholars."

The system of secondary education in Canada is not as yet so far developed as in some of the United States, but the question is in progress, and will no doubt end in the establishment of grammar schools for a higher and classical culture in all the larger towns or parishes. With regard to *university education*, this, both in Canada and the States, rests at present mainly upon private foundations.

Education in the British Isles.

It is time, now, that we come to our own country, which, so far as England at least is concerned, has proved the most backward of any of the more progressive nations in adopting any system of national education. Those who can look back upon the state of education in England some twenty or thirty years ago, can well remember what a blank this whole department of our national life presented. The educational zeal, indeed, which the Reformation called into play provided an extraordinary number of charities and bequests to be appropriated to this purpose. Some of these were devoted to those usually very useless institutions called grammar schools, and some others more directly to clothe and teach a limited number of poor children in the parish. It is believed, indeed, that if the whole of the property accruing from such charities were consolidated and properly applied, it would prove a most important element in carrying forward the entire education of the country. In spite of all this, however, the mass of the people remained in gross ignorance down to the early part of the present century.

Lancasterian schools.

About the year 1808 Joseph Lancaster, a member of the Society of Friends, began his labours in London on the site now occupied by the British and Foreign School Society, and not only gathered a vast number of children around him, but imbued a number of young men and women with his principles and methods, who were sent out into various parts of the country to carry on the same work there. This was the germ of the present normal school in the Borough Road, Southwark.

Bell's schools.

Lancaster, as a teacher, admitted no catechism or form of denominational doctrine into the schools, but gave daily religious instruction from the Bible, avoiding all points of difference or dispute. Nearly at the same time Andrew Bell, who had been previously engaged in the instruction of the Orphan School at Madras, returned to England, and was employed to use his experience in organizing schools very similar to those of Joseph Lancaster, in connection with the National Society of the Church of England. The starting-point of popular education in England, therefore, was the institution of the British and Foreign, and the National School societies, under whose patronage a number of so-called British and National schools were gradually spread throughout the country. It need not be added, that the quantity of education thus provided could bear no sort of relation to the actual wants of the country. Neither was the quality of the instruction for a time much better. The funds of the schools were usually small,—the teachers ill educated. No normal schools, in the proper sense of the word, existed, and the monitorial or mutual system of instruction alone prevailed.

Privy Council grants.

This state of things went on till about the year 1833, when the lords of the Privy Council, seeing the great destitution of the country, began to give small grants from the Treasury in aid of school buildings, through the British and Foreign and the National School Societies respectively. In 1839, when the demands for such grants began to increase, a Committee of Council on Education was formed in order the better to regulate and extend them. Aid was also afforded to normal schools; and the resolution was passed, that every government grant should henceforth carry with it the right of government inspection. With reference to the inspectors, however, the archbishops were to have the right of veto upon their appointment on behalf of the National schools, and the British and Foreign School Committee to have the same right on behalf of the British schools. This state of things continued till the year 1846, when Sir James Shuttleworth, who had been acting from the first as the secretary of the Education Committee, brought forward a series of minutes for apprenticing pupil teachers in schools; for granting augmentation to teachers' stipends, on their submitting to an examination and receiving a certificate of competency; and for making grants of books, maps, and apparatus.

These minutes of 1846 were only the commencement of a series of developments which have been going on to the present time. The grants have since then been thrown open virtually to *all religious denominations*, and indeed to all private individuals or commercial companies who choose to take the initiative in providing education for the people; the only stipulation in regard to religious teaching being, that some portion of the authorized version of the Scriptures be daily read in all the Protestant schools receiving grants.

To give some idea of the *extent* to which popular education, as aided by the state, has now been developed, the following statistical facts, taken from the minutes of the Committee of Council on Education for 1856–57, will be sufficient, without going into minor details. It should be observed, however, that the grants to schools in Scotland are here included:—

1. *Money expended by Government in England and Scotland for Educational purposes between December* 31, 1855, *and December* 31, 1856.

In building and enlarging elementary schools	L.74,470	11	1
Do. normal schools	9,586	18	11
In providing books and maps	3,199	5	7
Do. scientific apparatus	757	10	11
In aiding the salaries of certificated teachers	52,088	6	10
In stipends to assistant teachers	5,050	3	5
In stipends to pupil teachers	158,228	16	2
In capitation grants	20,079	15	0
In grants to training schools	45,785	6	8
Reformatory and industrial schools	8,158	15	10
Pensions to teachers	393	13	0
Inspection	30,829	15	10
Expenses of administration in London	15,004	3	1
Total	L.423,633	2	4

2. *The above amount has been divided amongst the different classes of schools as follows:—*

Church of England schools	L.268,230	2	1
British and foreign schools	39,474	4	7
Wesleyan schools	22,789	16	1
Roman Catholic schools	19,185	1	0
Parochial Union schools	5,509	11	8
Church of Scotland schools	28,534	14	8
Free Church schools	23,520	3	11
Episcopal Church schools	3,308	9	4
Administration	13,080	19	0
Total	L.423,633	2	4

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reformation and improvement. If individuals or religious congregations *choose* to busy themselves about these matters they can,—and fortunately for the country many do; but the few are really undertaking the work of the many; that which ought to be a matter of national importance, in the burden of which every one ought to take his share—I mean the education of the whole community—is left to the comparatively feeble efforts of a small philanthropic minority, little able to cope with the magnitude of the question, though aided liberally from the public purse. *3d*, The plan is by far too sectarian in its whole character. Had the government taken a perfectly uniform attitude towards all classes of schools; had it simply agreed to aid the secular and moral education in which the whole country is equally interested, appointed inspectors to report on *all schools alike*, and left the religious element to each party to supply for themselves, as in Canada, there would have been at least *one central point of unity* around which the whole education of the country might eventually have gathered, so as to form some approach to nationality; but in place of this, sectarian trust-deeds, *even more stringent than they were before*, have been sanctioned; the system of sectarian inspectors has been admitted; the religious element has been included in the government reports in the case of the national schools, thus severing them in their relation to government from the rest; and the denominational system has accordingly been rendered *complete*. In this way, the government aid and inspection, which might have gradually softened down the sectarian spirit and formed a rallying-point of national unity, has really legalized it and made it permanent; and schools are now seen rising up in rivalry one over against the other, both of which are equally paid for from the national funds. *4th*, The present plan is not to be recommended on the score of economy. Were the country divided into districts, and the educational wants of each district taken into account and properly supplied, the school question would assume an *economic* form. At present the partial distribution of school accommodation, assuming as it does a *denominational* form, goes directly contrary to all principles of economy. Large sums are spent in districts where schools are not all required. One denomination planting a school in a given locality excites the envy and jealousy of another; and straightway a rival establishment must appear, both of which languish for want of scholars, and perhaps of funds also, just because the neighbourhood is only sufficient to support one good school. Double the school accommodation that is requisite will have to be supplied on the present principles before the wants of the whole country are met.

The same want of economy exists in all the details of the government administration. Instead of the inspectors being purely governmental officers, which they were first intended to be; instead of each having a limited district within which he reports upon all classes of schools; there are no less than seven different classes of inspectors roaming the country, and crossing each other's orbits in every direction, in order to suit some particular denominational type of schools. Thus there are National school inspectors, British school inspectors, poor-law inspectors, Church of Scotland inspectors, Free Church inspectors, and an Episcopal Church of Scotland inspector. All the official documents and books at the office of administration, moreover, have to be kept separately, for each of these different classes of schools, so that the whole work is complicated in every possible way.

The consequence of possessing a system of education so partial in its extent, and incomplete in its scheme of operation, is that a great number of spontaneous institutions have sprung up to supply the deficiency. The number of dame schools, and schools of private adventure held by wholly incompetent persons, is still *incredibly great* in all the more populous towns of the country.

Again, with regard to middle education, this is thrown almost entirely upon the principle of supply and demand. The grammar-school charities which exist throughout the country are so inconsiderable, as compared to the whole of the middle classes, and those which do exist are for the most part so imperfectly administered, that they can hardly be taken into account as any valid element in the higher education of the country. Nearly the whole of the middle classes in England are virtually shut up to the principle of *boarding-schools*, in which we find of course every possible variety both of matter and of method. A few well-endowed grammar schools, and a few other proprietary day schools, form the only exceptions to this general statement. This may certainly add somewhat to the individuality of the English people; but as a system of national education for the middle classes it is, as a whole, the least efficient and the most expensive of any that could possibly be devised. A good rating system like that of America, which should supply higher as well as primary schools in every district throughout the country, would be an enormous saving to the whole of the middle classes of the community, and give them as well a guarantee of efficiency such as they cannot now possibly possess.

Another and very important mode in which private effort has sought spontaneously to supply the deficiency of popular education, is by putting the means of improvement into the hands of the *adult population*. I refer now to the rise of mechanics' institutes, mutual improvement societies, and other institutions of a similar nature.

Adult education in Great Britain.

The rise of these institutes and societies may be traced to the efforts of Dr Birkbeck in Glasgow, in the year 1800, to form a class of mechanics in connection with the Andersonian Institution, to whom he proposed giving instruction in the rudiments of natural and mechanical philosophy. Their further development, however, amongst the larger towns of the country generally dates no earlier than about the year 1823. Their primary intention was to impart instruction to working men in the rules and principles of the various arts with which they were already practically acquainted. Hence, for a considerable time after their first rise the prevailing tone and tendency of their operation was *scientific*. Lectures were given on the elements of natural philosophy, on chemistry, on mechanics, on geometric drawing, and on a variety of other topics bearing more directly upon the occupations of the artisans. In addition to this, libraries were collected, and the books lent out to the members at a very low rate; evening classes were also formed in some places for regular *courses* of instruction in the various arts and sciences.

In the course of some years, however, the general features of these institutions began to change. Scientific lectures lost their novelty; the expenses attendant upon the regular engagement of scientific men were found to be too great a drain upon the institutions; a large number of the subscribers preferred to hear something more light and amusing; and thus the scientific element began to make way for music, poetry, and light literature.

The following table gives a fair idea of the process of this change, as seen in the Mechanics' Institution at Manchester:—

Number of Lectures on	1835 to 1839.	1840 to 1844.	1845 to 1849.
Science	235	127	88
Mental Philosophy	8	16	2
Literature and Education	53	80	84
Fine Arts and Drama	99	55	55
Total	395	278	229

If a similar list were continued down to the present time, the same two results would be still visible,—namely, first

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to exist either in England or Scotland. It is true there is no educational division of the country, no legal obligation to erect a school in every parish, no public tax for school purposes; but a plan of operation has been laid down which compels the schools aided by government to be open to all, without distinction of religious creed, and which confines the religious instruction to specific periods, in which the children can receive it from their own pastors or teachers.

Under the liberal patronage of government primary schools have been now largely extended, model and normal schools erected, evening schools, industrial schools, agricultural schools, set on foot, and a general stimulus given to social improvement. A vigorous system of inspection is also kept up by the government commissioners. In addition to three head inspectors there are no less than thirty-four district inspectors, who visit each school at least three times every year, and report its progress or deficiencies to the central office in Dublin.

The following statistical details are taken from the reports of the commissioners for the year 1855:—

Number of schools under inspection	5124
Number of children in attendance	538,246
Number of teachers in training	288
Number of workhouse schools	139
Number of model-farm schools	37

Total expenditure by government during the year, L.212,017, 4s. 9d.

Hints for the improvement of British education.

We have now shown, in regard to our own country, who are the educators, what are the principal agencies employed, and to what extent those agencies are operative. The whole subject presents certainly a very heterogeneous aspect. While on the continent of Europe and in America we have systems of primary education, which carry instruction by force of law into every village and every district; while we see this system of primary instruction still further supplemented by high schools adapted to the commercial and middle classes generally, and these, again, crowned by universities, accessible to all at a very moderate rate of expenditure, England presents nothing whatever of the same kind. We have denominational schools, adventure schools, schools supported by individuals and by commercial companies, schools aided by government and schools not aided, endowed schools, subscription schools, with duplicate variations of every class, in Scotland and Ireland. Similar diversities are also to be seen in the *character* as well as the constitution of the schools. Some are excellent, some miserably bad; some teach religion and theology to the utmost extent, some limit it to a verse or two from the Bible, and some are wholly secular. In relation to *method*, some are monitorial, some collective, some sectional, and some have no system whatever; while, in relation to *locality*, some places are overdone with school accommodation, and others have no accommodation at all. The question therefore comes, Whether it is possible to adjust these facts so as to bring out of them a theory and a practice of education that shall be sound in itself, and suited to the wants of the country at large?

This question no doubt presents many difficulties; neither is it possible to say how many unforeseen obstacles may arise before any plan, however simple and apparently unobjectionable, could be realized. First of all, it is not possible in a country like this to begin virtually *de novo*, as in France and Prussia. The ground is already to a large extent occupied. Charities exist all over the country which have been left expressly for educational purposes. The state church has begun to work the parochial division of the country into an educational as well as an ecclesiastical system, and claims the schools thus originated as an appendage to the church, with which the nation, as such, has no right to interfere. Denominational schools have been planted all over the country in common with almost every sect, who are equally jealous of any foreign interposition. The Committee of Council on Education have recognised all these classes of schools, have aided all alike, and have pledged themselves to a certain extent to the denominational system. The stimulus given by the government system of aid and inspection has been, it is true, almost incalculable; and the improvement in elementary schools within the last ten years *unprecedented*. And yet, with all this, the step which the government has taken, when viewed in relation to a future complete system of national education, has been obviously *a step in the wrong direction*. No truly national system can by any possibility grow out of the present minutes of council, unless they are greatly modified in their whole structure and tendency. This is virtually acknowledged by all practical men; and the very attempts which have been made in the House of Commons within the two or three last sessions of Parliament to introduce an education bill, show that some totally new principle must be introduced before any broad or satisfactory system for the country can be realized. In what way, then, can these improvements be introduced so as to co-operate with the agencies already in existence? This is the great practical question of the present moment in regard to national education. To build up any complete theory would be visionary. We shall merely give a few hints to show the direction which we conceive the development of education must take in order to have any chance of present success.

1. First of all, the country should be divided into educational districts. The present parochial divisions of the country are on many grounds objectionable. Not only are they extremely unequal in population and extent, but it is extremely difficult to dispossess the present functionaries, both ecclesiastical and municipal, of the idea that they have some especial claim to precedence in any matters which assume a parochial character. Such claims applied to education would at once prove fatal to any really national system, as it would set the different parties now engaged in it in direct opposition to each other.

2. Having divided the country into districts, the next thing would be to find out, not by *local* but by *governmental* authorities, what is the educational supply, and what are the educational wants of each. To determine this, note must be taken of all the existing schools, of whatever denomination, distinguishing those which are already under the inspection of the Committee of Council from those which are not. Care should be especially taken to look into the amount and the application of all charitable trusts for education, and to report definitely upon them.

3. A third step of great importance would be, to pass an act of Parliament empowering a board of charitable trust commissioners to take these trusts for a time into their own hands, to find out what they will realize by proper management, and to appropriate the amount (according to the spirit, if not to the letter, of the founder's will) to the general education of the district in which the property is situated.

4. The next point would be for a school-rate to be levied on actual property in each district, according to its requirements. This school-rate might take the place of the grants now made to teachers, pupil-teachers, and managers, from the Committee of Council on Education, as well as the voluntary contributions of managers, and would also be employed to plant new schools in the district, wherever the present provisions arising from existing schools and charitable endowments were found to be insufficient.

5. The rate-payers in each district would elect a committee of management totally distinct from any existing parochial authorities, into whose hands the rate funds would be paid, and who would be responsible for its partition to every school, fulfilling certain conditions, according to the number of children in average attendance. They would also carry out the provisions of this act in regard to new schools to be erected in destitute localities.

National Education.

6. All schools applying for the rate should be examined and reported on by inspectors appointed by government, who should have power to determine whether a school was deserving of support from public funds or not.

7. The *local management* of *existing* schools should not be interfered with; only provision should be made that the religious instruction should be given at a specified time (as in the Irish schools), that parents should have the power to withdraw the child from any kind of religious teaching to which they object, and that the day-school should involve no conditions in regard to attendance at any particular place of worship on the Sunday.

8. The government should not interfere with the religious element of the schools beyond the above stipulations, and demand no reports on it, but should leave it in each case to the local managers to provide for as they think best.

This is of course only a rough sketch of the direction in which education might move forward. All the existing machinery on this plan would remain untouched; all the provisions of the Committee of Council on Education respecting normal schools, examinations for certificates of merit, pupil-teachers, inspection, &c., could be still carried out as before; the only new elements would be the education districts, the principle of a rate, and a school committee in each district,—not to manage the institutions, but to apportion the funds according to the details of the measure. All schools, of course, as far as the government is concerned, would lose their denominational character, and be inspected and reported on by one general class of inspectors, simply *as elementary schools.* In this way, without doing any great violence to the present organized state of things in the country, a system of national education might be gradually consolidated which would combine the advantages of local management and local support with the numerous benefits derived from governmental inspection. Already strong indications have been given that we may look for a union of all political parties in some measure of this kind. For the system of government aid has now gone *so far*, that it can neither recede nor fully develop itself without certain organic changes.

To make the plan above sketched out *complete*, of course it must comprehend the establishment of middle or high schools, as well as schools for the working-classes. This might at first sight *seem* to involve an outlay which would press too heavily to be endured upon the rate-payers of each district. But, in point of fact, the mere circumstance of comprehending a plan of *middle-class* schools in the general system of national education would be an actual relief to the great majority of the persons upon whom the rate must fall. The middle classes in this country are *now* educating their children in boarding-schools at a very great expense, and are usually getting a very inferior article for their money. By paying a moderate rate, they might have excellent grammar schools brought to their very doors, and thus secure a superior education for their own families, *as well as* adequate instruction for the labouring classes, for a sum far less than what they are now usually paying for the very desultory training which they are obliged to put up with in the boarding-schools of the country. There certainly is no valid reason why a series of higher institutions should not flourish under government patronage and inspection in England, as well as the "gymnasia" do in Germany, the "colleges" in France, and the higher English and classical schools in America.

III. HOW A SYSTEM OF NATIONAL EDUCATION SHOULD BE PRACTICALLY ARRANGED AND CARRIED FORWARD.

Normal schools.

The first, and perhaps most important point, in a practical system of national education, is to have efficient normal schools for the proper training of teachers. Without these, no effective instruction is likely to be realized throughout the country at large. It is not enough that a teacher be a man of sufficient learning; his learning must be ready for use. He must understand the character of childhood, and know how to interest it; he must be able to exercise strict discipline without severity; he must comprehend the best methods of school organization, and adapt his plans to the precise wants of his scholars; he must be able to anticipate their difficulties, smooth their path, encourage their efforts, chide their indolence, excite their emulation, and lead them on from one step of mental development to another. All this can only be accomplished by a *special training* for the purpose, and such a training it is the office of the normal school to afford. Study and practice must there go together, so that when the student goes forth to his labour, he may *at once* know what to teach and understand how to teach it. All the countries where education is successfully carried on have laid the foundation for that success in the normal schools; and the best earnest we now have for continued progress in the department of public instruction in our own country lies in those thirty or more normal schools which are forming the minds of more than 2000 pupils for future efficiency as public teachers throughout the country.

Organization and method.

The next thing that claims attention is the *organization* of the primary school, and the *method* of instruction. School methods may, by a broad classification, be reduced to three principal types,—these are, *1st,* The monitorial or mutual system; *2d,* The collective or simultaneous system; and *3d,* The sectional system. The monitorial system consists in the employment for a certain period every day of some of the elder boys to assist in the instruction of the younger. The method of Lancaster, who chiefly introduced this system, was to form a monitors' class from the more advanced scholars, to give them special instruction, and then to employ them in giving *back* the lessons they had received to the other children in small groups or drafts. The extravagant expectations which were at first entertained of the efficiency of this method have not been by any means realized. A certain amount of *mechanical* work can be performed by monitors with good effect, and a large amount of drudgery thus taken out of the hands of the teacher; but here their utility ceases. That which the child most needs (and which is the principal educating element in every good school) is, to come into close contact with some superior mind, who knows how to foster and stimulate the germs of thought, to instil sound principles, to correct false or vicious habits, and to insinuate knowledge into the young mind through every avenue by which he can reach it. The idea of committing the education of children, either wholly or principally, to monitors, could only be entertained where the standard aimed at is extremely low and imperfect, neither can the mutual system itself be ever regarded in any other light than a mere substitute for better teaching, where that better teaching cannot be procured.

The collective or simultaneous method errs on the opposite extreme. It collects the whole school together upon a *stage* or *gallery* adapted for the purpose, and attempts to construct a system of lessons such that the whole of the scholars may be taught *at once* by a single master. That this method may serve well for a certain amount of moral training is not to be denied; but as an intellectual instrument it proves extremely defective. Children of different degrees of mental development cannot possibly profit by the same lessons. If those lessons are adapted to the elder scholars, the younger ones are wholly unable to follow them; if they are adapted to the younger scholars, then they are useless to the rest. The simultaneous school is good for making a display, and often surprises those who do not look beneath the surface; but it almost inevitably fosters superficial knowledge, and leaves the child helpless when thrown *alone* upon his own individual resources.

National Education.

The sectional method is a *via media* between the two extremes I have just described. It goes on the principle that children ought to be classified according to their age and attainments, and a suitable teacher employed for every section. In Prussia the almost universal plan is to make each school-house consist of a number of class-rooms, each class-room being adapted to a single section under one teacher. The same method is followed in the schools of the Christian Brothers in France. When *sufficient*, and at the same time *efficient* teachers can be procured, there can be little doubt that this is the best possible organization for a school, whether primary or secondary. It combines in it every requisite for complete training, whether moral or intellectual. The difficulty of carrying out this system properly, however, becomes great, just in proportion as the number of scholars becomes large. Both in the Prussian schools and those of the Christian Brothers in France, the sections are apt to swell amidst dense populations, to such proportions, that the task becomes too great for a single teacher, and imperfection naturally results.

Various plans have been formed to obviate this difficulty. Amongst others, it was arranged in some of the larger primary schools of Holland that a few of the elder and more advanced scholars should be taken as apprentices in the schools, and employed to teach the lower classes. It was a development of this idea which led to the organization of the pupil-teacher system in England under the Committee of Council on Education.

According to this plan, candidates are examined by the inspectors and reported on to the council-office. If their qualifications are found satisfactory, an indenture is made out, and they are apprenticed to the school for five years; the master being made responsible for their proper training, and their progress being tested by yearly examinations on the ordinary visit of the inspector. The advantages of this plan have proved great. It has enabled every school to adopt a sectional classification; it secures the services continuously, from year to year, of under-teachers, who ordinarily increase every year in intelligence and efficiency; and what is more, it fills the normal schools, not, as was previously the case, with crude, unformed material, but with young men and women who have been well disciplined in the art of teaching, and have had already five years' training in those branches which are most necessary for a teacher thoroughly to understand. Thus, by one and the same arrangement, the schools have been re-organized on sounder principles, and provision has been made for a constant succession of well-trained and well-qualified teachers.

Gradation of public schools.

A third important point is the proper *gradation* of public schools. In Prussia there are three principal grades,—viz., 1*st*, The country school, in which only elementary instruction is given; 2*d*, The town school, in which some amount of mathematical and scientific teaching, as well as modern languages, are introduced; and 3*d*, The high school or gymnasium, which is throughout constructed on a classical and professional basis.

In Holland there are five grades,—1*st*, The poor schools, which are wholly gratuitous; 2*d*, The intermediate schools, in which a very small fee is paid; 3*d*, Town schools, in which there is a higher fee and a higher range of instruction; 4*th*, The French schools, which prepare for active and commercial life; and 5*th*, The grammar schools, which prepare for the learned professions antecedently to the universities. The subject of the gradation of schools is now becoming one of the prominent questions in the educational system of America, and will have to become so ere long in our own country.

Schools necessary in England.

The simplest classification that can be made for a country like England, where the gradations in society are so marked, will probably be found to be a classification into four distinct grades,—First, we want in all the large towns a series of *free schools* for the *lowest strata* of society, to occupy thoroughly the whole ground that is now very inadequately taken by the *ragged school*. Next to this come those schools which are at present being so largely established through the country, in which both the nature of the instruction and the entrance-fee are adapted to the wants and resources of the working-classes. Thirdly, we should require a series of town schools, adapted more peculiarly for the mercantile classes, including, in addition to all that is taught in the primary school, the departments of mathematics, science, and modern languages. Fourthly, we should need a proper number of grammar schools, answering to the gymnasia of Germany and the royal or municipal colleges in France, and united to those who intend to embrace a professional life. If such a plan were carried out, every father of a family upon whom a portion of the rates fell would, whatever his sphere in life, get a return far more than equivalent to what he is required to pay. Lastly, with regard to the teachers themselves, if we expect to keep up an efficient staff, two conditions are necessary:—1*st*, That they be adequately remunerated; and 2*d*, That their position be made sufficiently *independent*. The remuneration of teachers must of course depend upon the average rate of payment for men in a similar position of life throughout the country. It must, at any rate, be such that the teacher can live and bring up his family *according to his station*, without seeking extraneous help from other sources. Anything less than this will be sure to deteriorate the profession, by presenting too little inducement for the more energetic minds to continue within its ranks.

The teacher, however, must not only have sufficient remuneration, but his position must be secure and independent so long as he labours with zeal and efficiency. For this purpose, his salary should not depend upon voluntary contributions, which are always fluctuating, and likewise place the teacher too much in the power of the donor; neither should it depend mainly on school-fees, which leads him to pander to the prejudices of parents in order to increase the number of the scholars. The teacher is undoubtedly in the best position when his salary depends on public funds, whether local or governmental, and is responsible, not to any individual, but to a regularly-constituted authority. Where this is the case, he can labour alone for the good of his pupils, and be sure of approbation and support so long as he labours earnestly and intelligently in his sphere.

Conclusion.

In conclusion, let us not forget that the whole subject we have been discussing is one of supreme importance to every country. There is no part of the surface of our globe but bears traces of nations who were once flourishing and progressive, but who have now disappeared, or nearly so, from the rank of civilized communities. The fortunes of every country lie in the spirit of the citizens. Where this is vigorous, enlightened, and moral, the country must *stand*,—nay, must even *advance* on the road towards a still higher and more developed state of society. But where the public mind becomes a prey to ignorance, superstition, and vice, a retrograde movement sets in which leads gradually to disorganization, and finally to absolute dissolution. The history of Germany and of Spain since the time of Charles V. may be taken as an illustration of these two tendencies, presented to us, moreover, in modern times, and in connection with two of the principal nations of Europe. There can be no doubt but that the future of every nation now existing is equally bound up with the cause of popular enlightenment. Whether we regard ourselves, therefore, as philanthropists or as patriots, it is *equally* incumbent upon us to take a *personal* interest in the national education of our country; for it is the sum of *personal interest* which in every free country forms and moulds the character of public opinion; and then it is public opinion which ordains the statutes and shapes the institutions of the realm. (J. D. M.)

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France sur la Vérité de l'Histoire des Frères de la Rose-Croix, 8vo, Paris, 1623; and *Jugement de tout ce qui a été imprimé contre le Cardinal Mazarin*, 4to, 1650. A book entitled *Naudæana* was published at Paris in 1701.

NAUEN, a town of Prussia, province of Brandenburg, and government of Potsdam, on the Havelbach, 23 miles W.N.W. of Berlin. It contains a church, town-house, and hospital; and has manufactures of linen, beer, and brandy. The greater part of the town was burnt down in 1830. Pop. 4220.

NAUMACHIA, an ancient Roman spectacle representing a sea-fight. It was sometimes exhibited in a circus or amphitheatre filled with water for the occasion; but more generally naval theatres, surrounded with seats and porticoes, and named after the spectacle itself *naumachiæ*, were constructed. The most celebrated of these were that of Julius Cæsar in the Campus Martius, that of Augustus near the Tiber, and that of Domitian surrounded with an erection of stone. Claudius preferred to exhibit his naval shows on the Lake Fucinus. The *naumachiarii*, as the combatants were called, were usually captives or condemned malefactors. They were drawn up in two great opposing squadrons, distinguished by the names of any two maritime nations, and were doomed to fight until the one party had exterminated the other, unless the emperor, or the private person who had given the entertainment, put a stop to the engagement. The naumachiæ, like other Roman games, were often celebrated with the most extravagant pomp and magnificence. Artificial nereids and sea-monsters were sometimes seen swimming among the ships; and the sight of two large fleets grappling with each other in deadly combat, to amuse a crowd of idle spectators, was no uncommon occurrence.

NAUMBURG, a town of Prussia, province of Saxony, pleasantly situated in the midst of vine-covered hills in the valley of the Saale, 18 miles S.S.W. of Merseburg. The town consists of a walled portion and three suburbs. It is well built, and contains some fine streets and public buildings. The cathedral, which is partly in the Gothic and partly in the Romanesque style, was completed in 1249; but several additions have since been made. It has a choir at each end, and of these the western is the more ancient. The interior contains many curious monuments, sculptures, and specimens of painted glass. There are several other churches in the town, one of which, that of St Wenzel, contains a fine painting by L. Cranach. Naumburg has also a citadel, town-hall, arsenal, a high school, an industrial school, and several hospitals. Manufactures of carriages, woollen cloth, hosiery, shoes, chemicals, &c., are carried on. This is one of the most northerly places in Europe where the vine is cultivated, but the wine produced is little better than vinegar. Some trade is carried on in the articles of manufacture, as well as in oil, wine, wool, &c.; and two fairs are annually held. Naumburg was besieged in 1482 by the Hussites under Procopius; but they were induced to raise the siege by the entreaties of the children of the town. This event has been dramatized by Kotzebue, and is still celebrated by an annual children's festival on the 28th of July. Naumburg was a place of importance in the Thirty Years' War, as well as in the campaigns of 1806 and 1813. Pop. 13,802.

NAUNTON, Sir Robert, secretary of state to James I., was born in 1563 in Suffolk, and was educated at Trinity College, Cambridge. His public life was begun by an embassy to Scotland in 1589. The Earl of Essex afterwards employed him to reside in France under the guise of tutor to a young gentleman named Vernon, but in reality as a spy on the French government. On the fall of his patron, he seems to have returned home; and in 1601 was elected public orator in the university of Cambridge. It was there that his learning introduced him to the notice and patronage of James I. After passing through several political offices, he was appointed secretary of state in 1618. Sir Robert Naunton died in 1635. His chief work, *Fragmenta Regalia, or Observations on the late Queen Elizabeth, her Times and Favourites*, was published in 4to, 1641. He is also the author of *Arcana Aulica*, 8vo, 1694; and *Memoirs of Robert Cary, Earl of Monmouth*.

NAUPACTUS. See Lepanto.

NAUPLIA, or Napoli-di-Romania, a town of Greece, in the Morea, at the head of the gulf formerly called the Argolic, but which now bears the name of the town; in N. Lat. 37. 34., E. Long. 22. 48. It stands on the N.E. side of a flat-topped hill, on the summit of which is a castle called Palamidhi, one of the strongest places in Europe. This hill stands on a peninsula, to the N. of which is the harbour of the town, large and well sheltered, but not deep enough to admit large vessels. The most of the streets of Nauplia are narrow, though straight; but several wide and handsome streets have been recently built; while the whole town, instead of the wretched and dirty appearance which it formerly presented, has now a neat and clean appearance, like that of a second-rate Italian seaport. There are two squares, which are connected by the main street running through the middle of the town; and the principal public buildings, besides the churches, are the royal palace, the court-house, and the barracks. Nauplia has a military academy, a school for the middle classes, a circulating library, and other literary establishments. The town is surrounded by Venetian fortifications, and is defended by a battery and by another fortress besides the one which stands on the top of the hill. A considerable trade was formerly carried on here by Greek vessels in corn, wine, oil, silk, fruits, &c.; but this has considerably declined, and the only articles in which there is now any commerce are the necessaries of life. The climate is unhealthy, and the town has been frequently exposed to the ravages of pestilence. In ancient times the site was occupied by a town of the same name. It was of great antiquity, and is said by Pausanias to have been founded by the colony of Egyptians whom Danaus brought with him. That it was a town of foreign origin may be inferred with probability from the contrast between its situation, on a promontory of the coast, and those of the other ancient Greek towns among the mountains and glens of the interior. It was at first an independent town, but in the seventh century B.C. was conquered by the Argives, and Nauplia then became merely the seaport of Argos. In the second century it is described by Pausanias as deserted, and as having some remains of a temple of Neptune. About the time of the Crusades, it rose to be a town of some importance, under the name of *Anaplion* or *Anaplia*, which has since been changed by the restoration of the ancient appellation. It was occupied in the thirteenth century by the Venetians, and made by them the chief of their settlements in the Morea. Taken by the Sultan Solyman in 1537, but soon afterwards retaken, it was not finally added to the dominions of the Porte till 1718. The Turks again lost it on the outbreak of the Greek insurrection, and it was the seat of the new government from 1829 till 1834, when that honour was transferred to Athens. It is peopled to a large extent by foreigners from France, Germany, and Italy. Pop. estimated at 15,000.

NAUVOO, a town of the United States, North America, state of Illinois, on the left bank of the Mississippi, 52 miles above Quincy, and 220 above St Louis. It was founded by the Mormons in 1840, and laid out with great regularity on a tract of ground gradually sloping upwards from the river's edge. The principal building was the Mormon temple, a large limestone edifice, containing a stone baptistry

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